KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
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COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES,
DEPARTMENT OF CLINICAL MICROBIOLOGY

WUCHERERIA BANCROFTI ANTIGENAEMIA AMONG SCHOOL CHILDREN:

A CASE STUDY OF FOUR COMMUNITIES IN THE KASSENA-NANKANA EAST DISTRICT OF THE UPPER EAST REGION OF GHANA

BY

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JUNE, 2014

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES THROUGH THE DEPARTMENT OF CLINICAL MICROBIOLOGY, SCHOOL OF MEDICAL SCIENCES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF PHILOSOPHY

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DECLARATION

I hereby declare that this submission is my own work towards the MPhil and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

I dedicate this work to my dear mother, Mrs Rakiatu Abdulai, my brother Mohammed Awel Rahamani as well as Munifatu Rahamani, Lamie Rahamani and Azimi Rahamani.

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I first give thanks and praises to God Almighty.

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LIST OF ABBREVIATIONS OR ACRONYMS

ADL	Adenolymphangitis
°C	Degree Celcius
CFA	Circulating filarial antigen
LF	Lymphatic filariasis
CDC	Centre for Disease Control and Prevention
cm	Centimetres
DEC	Diethylcarbamazine-citrate
ELISA	Enzyme link immunosorbent assay
GAELF	Global Alliance to Eliminate Lymphatic Filariasis
GFELP	Ghana Filariasis Elimination Programme
KNED	Kassena-Nankana East District
MDA	Mass Drug Administration
RBC	Red blood cell

ABSTRACT

INTRODUCTION: Lymphatic filariasis (LF) is a parasitic disease of public health concern in Northern Ghana. Since mass drug administration of ivermectin and albendazole began in 2000 with Kassena-Nankana district as one of the implementing units, no studies has been conducted among pre-school and school-age children on the prevalence of *W. bancrofti* antigenaemia in spite of 3.5% prevalence reported among adults in 2008. This study was therefore carried out in four communities in the Kassena-Nankana district between December 2010 and May 2012 where mass drug administration has been administrated and continued to be administrated to investigate the prevalence of *W. bancrofti* antigenaemia among school children to aid advocacy for more comprehensive treatment coverage for children. The study was a cross sectional analytical survey, restricted to school children between the ages of 2-10 years. Four hundred (400) school children aged 2-10 years were randomly selected from a list of compounds in the communities. About 3-5 mls of blood was collected into heparinised test tube and tested using immunochromatographic test to detect *W. bancrofti* antigen (ICT-Filariasis card test). Of the 200 children tested before MDA, 25(12.5%) children tested positive for filarial antigen and of the 200 school children tested after MDA, 13(6.5%) children tested positive for circulating filarial *W. bancrofti* antigen. The microfilaria antigen prevalence among the communities after MDA ranged from 0% in Bui to 4.0% in Manyoro and 22% in Gumongo.

This study has demonstrated that community variations in the prevalence of filarial antigen exists in Kassen-Nankana district. There is the need for regular surveillance that will inform treatment coverage and effectiveness.

CHAPTER ONE

INTRODUCTION

1.1: BACKGROUND OF THE STUDY

Lymphatic filariasis (LF) is a parasitic disease caused by nematodes (*Wuchereria bancrofti, Brugia malayi* and *Brugia timori).* The preferred habitats of these parasites are the lymphatic vessels and lymph nodes where they induce the development of disfiguring and debilitating clinical symptoms (Rocha *et al*., 2009). LF is transmitted by a wide range of mosquitoes, depending on the geographic area (CDC, 2010). In Africa, the most common vector is *Anopheles* and in the Americans it is *Culex quinquefasciatus* (CDC, 2010). *Aedes* and *Mansonia* can transmit the infection in the Pacific and in Asia (CDC, 2010), which if left untreated can develop into a chronic disease called elephantiasis.

The numbers of infected persons are on the increase worldwide due to rural-urban migrations resulting in mushrooming of shanty towns often encouraging formation of favourable mosquito breeding sites (Wamae, 1994). Some 120 million people are affected worldwide of whom about 40 million are incapacitated and disfigured by the disease (Wamae, 1994, WHO, 1998). Although LF is not fatal, it has been ranked one of the world's leading causes of permanent and long-term disability and poverty (WHO,1998) and can be devastating and crippling at both the individual and community levels (Wamae, 1994).

Wuchereria bancrofti is the main species responsible for human lymphatic filariasis and the only known aetiologic agent in Africa (Wamae, 1994). LF is a major public health problem in the Tropics (Harnett et al., 1998, WHO, 2002). Lymphatic filariasis is endemic over wide geographic areas of Africa, Central and South America, Asia, and

Oceania (WHO, 2002, WHO, 1992). In these zones, an estimated 751 million people are at risk of filariasis infection (WHO, 1992). Of the more than 78 million persons already afflicted, more than 90% are believed to harbour *Wuchereria bancrofti* (WHO, 1992, Melrose, 2002).

Studies conducted along the coast of Ghana reported the prevalence of microfilaraemia with W. *bancrofti* to be 9-25% (*Dunyo et al.*, 1996, Gbakima et al., 2005). The presence of microfilaraemia in rural communities has been reported to be 26-32% (Gyapong et al., 1994, Dzodzomenyo et al., 1999) in endemic regions such as Upper East, Northern, Upper West, Ashanti and Western regions with a reported minimum prevalence of 0% in the Brong Ahafo region to a high prevalence of 36% in the Northern regions (Gyapong et al., 1994).

In 1998, the World Health Organization announced the Global Programme to Eliminate Lymphatic Filariasis (GPELF) with a goal of eliminating lymphatic filariasis as a public health problem (Menezes et al., 2007).Lymphatic filariasis is currently subjected to renewed control and elimination programmes (Alexander et al., 2003). This involves using annual mass drug administrations (MDA) of albendazole and ivermectin to all populations at risk (Alexander et al., 2003).

According to the WHO technical advisory committee on LF report 2005, the impact of MDA is variable, ranging from complete interruption of transmission, as in one site in Papua New Guinea where four rounds of MDA had been applied, leading to a significant reduction in transmission as pertains to Ghana and Mali where there have been three rounds of MDA (WHO, 2005).

The programme in Ghana has covered entire endemic population and has completed ≥ 6 rounds in many regions (WHO 2009) including the Kassena-Nankana (K-N) district of

the Upper East region, Ghana. The number of districts covered increased from 5 in 2001 to 82 in 2008(GFELP, 2008).

However after several rounds of MDA's there is the need to provide information about the antigen prevalence among school children in some of the endemic communities especially in the Kassena –Nankana district which was one of the few districts to have started the MDA in 2001(WHO, 2004). This information would be vital for management decision making on the LF elimination programme in the K-N district.

1.2: PROBLEM STATEMENT

LF is known to have widespread distribution in northern Ghana (Gyapong et al., 1996). The Kassena-Nankana East district was one of the few endemic districts in Ghana to start the MDA programme (WHO, 2004). Even though there have been several rounds of MDA which aims at interrupting transmission thereby reducing the prevalence levels and ultimately eliminating lymphatic filariasis, there is the need for monitoring, a vital element in programme management that enables the success of the strategy to be assessed (GPELF, 2000).

However current data on filarial antigen prevalence and the impact of MDA is not available. The goals of the neglected tropical diseases control programme (NTDCP) of Ghana requires that lymphatic filariasis should be reduced to less than 1% among endemic population and antigen prevalence of 0% among children by 2015.

The Global Programme to Eliminate Lymphatic Filariasis (GPELF) envisages the elimination of lymphatic filariasis globally as a public health problem by 2020.

1.3: AIM OF THE RESEARCH

To estimate the prevalence of filariasis antigenaemia among pre-school and school-age children in four communities in the Kassena-Nankana East district of the Upper East region of Ghana.

1:4 SPECIFIC OBJECTIVES

1. To identify the presence of circulating filarial antigen (CFA) in blood samples.
2. To estimate the prevalence of filariasis in the K-N East District.
3. To establish the prevalence level in the 4 communities.
4. To compare the prevalence level before and after MDA.

1.5: JUSTIFICATION

Lymphatic filariasis caused by *Wuchereria bancrofti* is a major public health problem and has adverse socioeconomic impact on the population. Current control programmes deploy MDA's using albendazole and ivermectin in Ghana. To confirm effectiveness of the MDA's, there is the need for regular monitoring of prevalence of LF antigenaemia to enhance management decision making. By establishing a regular surveillance on antigen levels, we would be monitoring our match towards attaining elimination of LF.

CHAPTER TWO

LITERATURE REVIEW

2.1 Lymphatic filariasis

Lymphatic Filariasis is caused by tissue nematodes (roundworms) that inhabit the lymphatic vessels and lymph nodes of a human host (Rocha *et al.*, 2009). There are three types of these thread-like filarial worms: *Wuchereria bancrofti*, which is responsible for 90% of the cases , *Brugia malayi* and *B. timori*,are among other species responsible for LF (Rocha *et al.*, 2009, Michael *et al.*, 1997,). Adult worms lodge in the lymphatic system and disrupt the immune system (WHO, 2011). They live for 6-8 years and, during their life time, produce millions of microfilariae (small larvae) that circulate in the blood in the night (WHO, 2011).

Lymphatic filariasis is transmitted by different types of mosquitoes; for example by the *Culex* mosquito, widespread across urban and semi-urban areas; *Anopheles* mainly in rural areas, and *Aedes*, mainly in endemic islands in the Pacific (Sasa, 1976, ICMR 2002).

2.2 Life Cycle & Risk Factors

There are three different filarial species that can cause lymphatic filariasis in humans (WHO, 2011). Most of the infections worldwide are caused by *Wuchereria bancrofti* (Wamae, 1994). In Asia, the disease can also be caused by *Brugia malayi* and *B. timori* (Rocha *et al.*, 2009, CDC, 2010).The infection spreads from person to person by mosquito bites (CDC, 2010).

The adult worm lives in the human lymph vessels, mates, and produces millions of microscopic worms, also known as microfilariae (CDC, 2010). Microfilariae circulate in

the person's blood and infect the mosquito when it bites a person who is infected. Microfilariae grow and develop in the mosquito (Rocha et al., 2009).

When the mosquito bites another person, the larval worms pass from the mosquito into the human skin, and travel to the lymph vessels (CDC, 2010). They grow into adult male and female worms, a process that takes 6 months or more (CDC 2010). An adult worm lives for about 5 - 7 years (CDC, 2010). The adult worms after mating release millions of microfilariae into the blood (CDC, 2010). People with microfilariae in their blood can serve as a source of infection to others (Almeida *et al.*, 1999, WHO, 2012).

A wide range of mosquitoes can transmit the parasite, depending on the geographic area (WHO 2012, Michael et al., 1997). In Africa, the most common vector is *Anopheles* and in the Americas, it is *Culex quinquefasciatus*, *Aedes* and *Mansonia* can transmit the infection in the Pacific and in Asia (Michael et al., 1997).

Many mosquito bites over several months to years are needed to get lymphatic filariasis(Parasites in humans, 2010). People living for a long time in tropical or sub-tropical areas where the disease is common are at the greatest risk for infection (Parasites in humans, 2010). Short-term tourists have a very low risk (Parasites in humans, 2010).

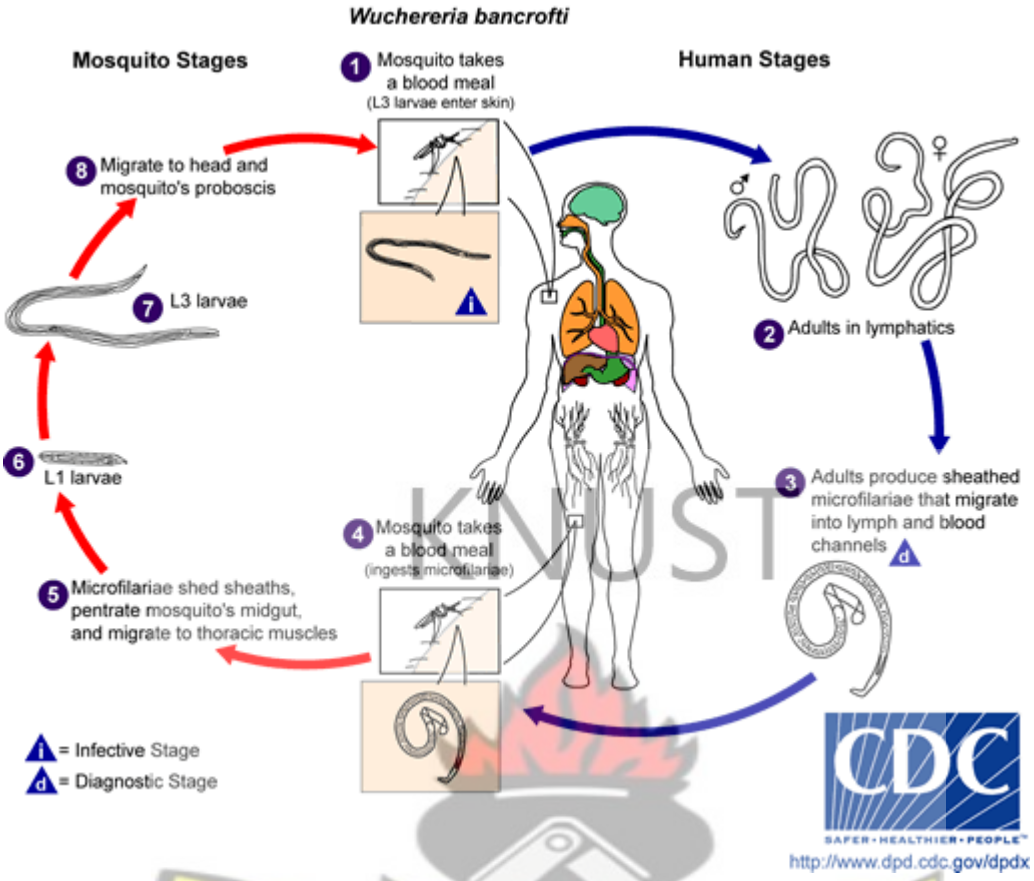


Figure 2. 1: Life cycle of *Wuchereria bancrofti*

2.3 Epidemiology

Lymphatic filariasis affects over 120 million people in 80 countries throughout the tropics and sub-tropics of Asia, Africa, the Western Pacific, and parts of the Caribbean and South America. (Wynd *et al.*, 2007).

In the Americas, only four countries are currently known to be endemic: Haiti, the Dominican Republic, Guyana and Brazil. In the United States, Charleston, South Carolina, was the last known place with lymphatic filariasis (CDC, 2010). The infection was eradicated early in the 20th century and currently there is no trace of LF in the U.S. (CDC, 2010).

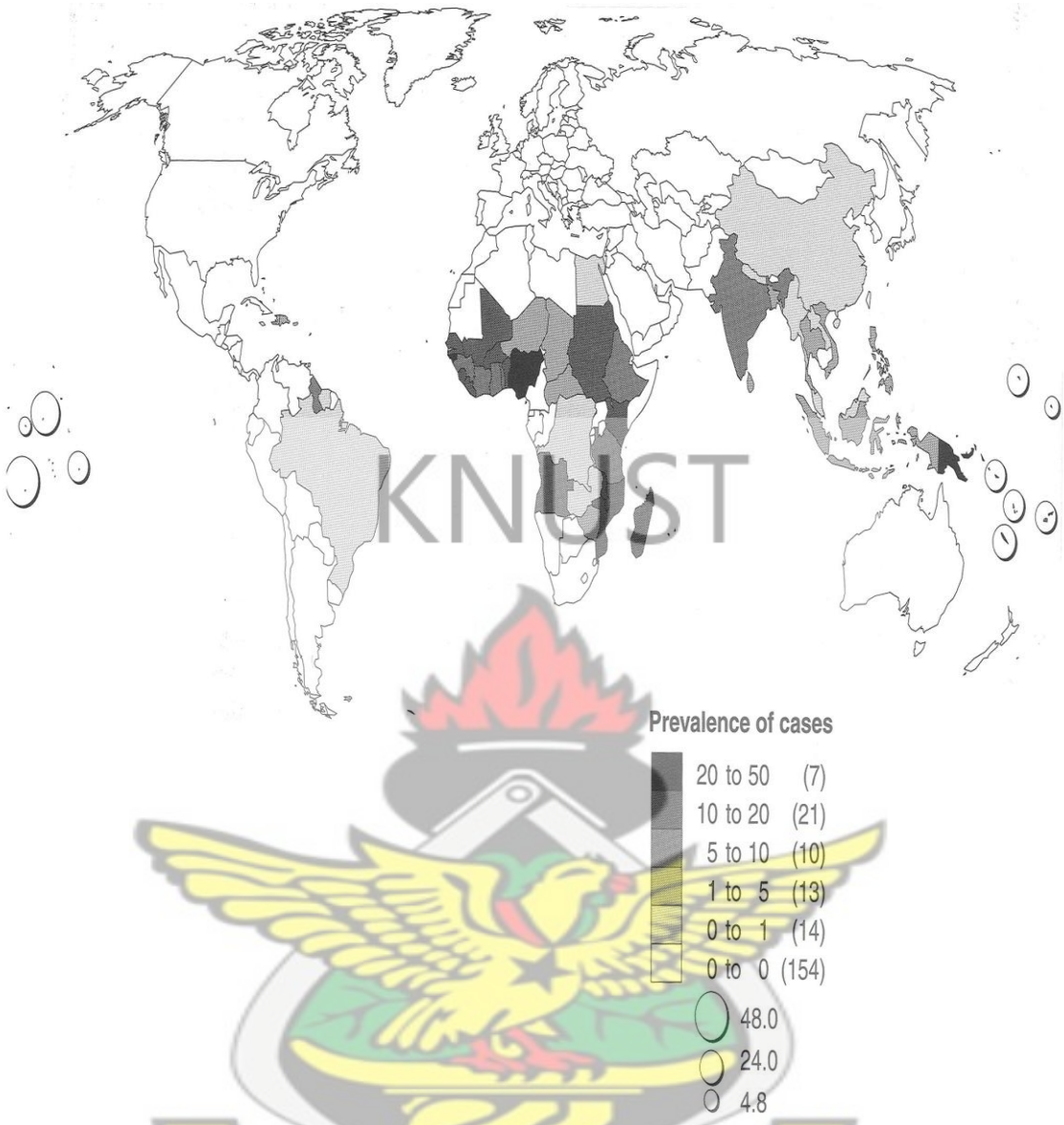
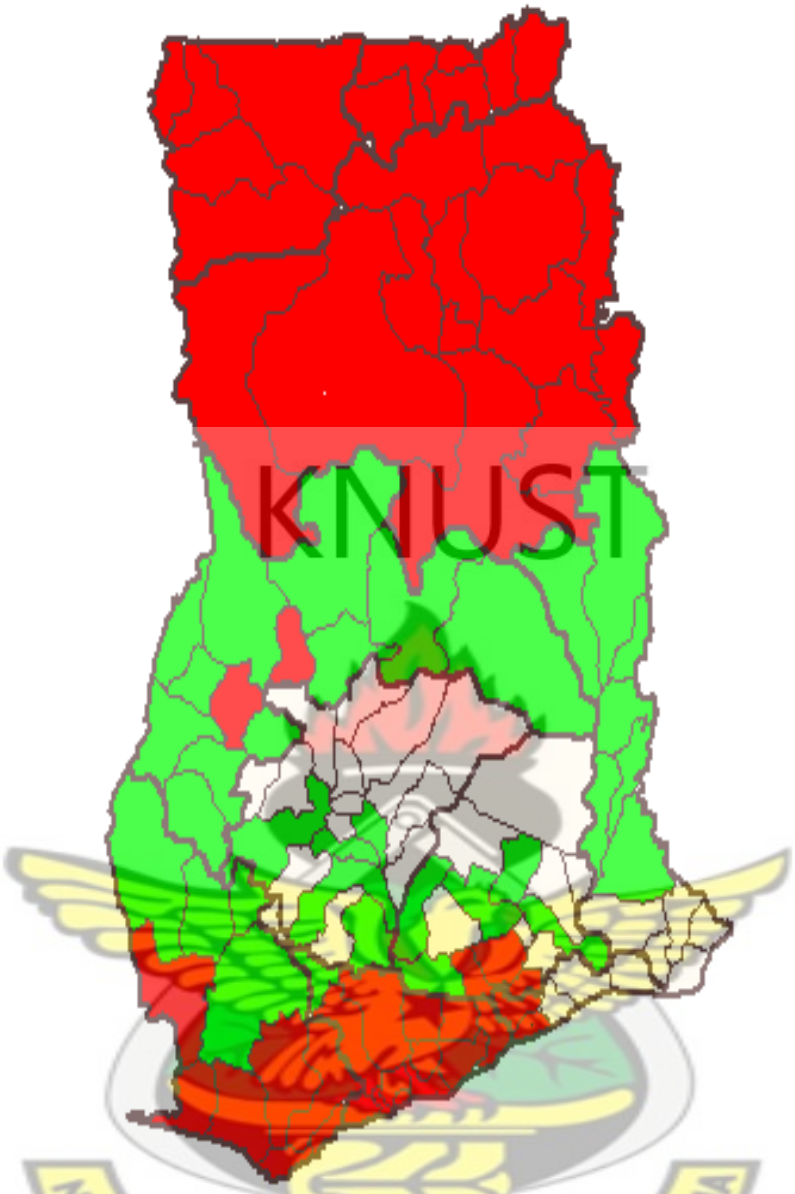


Figure 2.2: Geographical distribution of bancroftian filariasis

Figure 2.2. Geographical distribution of bancroftian filariasis case prevalences (%) based on the crude global burden of disease estimates. Different sized circles denote the corresponding prevalences estimated for various Pacific islands. The numbers in brackets indicate the number of countries. Reprinted from Parasitology Today, 13, Michael E., Bundy D.A.P., Global mapping of lymphatic filariasis, 472-476 1997, with permission from Elsevier Science.



RED = FILARIA ENDEMIC AREAS

GREEN= NON ENDEMIC

Figure 2.3: Distribution of Lymphatic Filariasis in Ghana.

COURTESY: The Ghana Filariasis Elimination Programme.

2.4 Pathogenesis and Pathology

Human lymphatic filariasis is clinically a spectral disease (Almeida *et al.*, 1999).

The pathogenesis of the characteristic lymphatic damage is thought to involve three components: mechanical damage by motile parasites (Amaral F *et al.*, 1994, Case *et al.*, 1992); bacterial superinfection in previously damaged vessels (Ottesen ,1994); and local immunological responses to parasite antigen (Freedman *et al.*,1995) making the pathology associated with lymphatic filariasis results from a complex interplay of the pathogenic potential of the parasite, the immune response of the host, and external ('complicating') bacterial and fungal infections (WHO, 2000, GAELF, 2010).

The following factors affect the pathogenesis of filariasis:The quantity of accumulating adult worm antigen in the lymphatics (Baird *et al.*, 2002), The duration and level of exposure to infective insect bites (King, 2001),The number of secondary bacterial and fungal infections (Baird *et al.*, 2002),The degree of host immune response (Lamb *et al.*, 2004).

While genital damage (particularly hydroceles) and lymphoedema / elephantiasis are the most recognizable clinical entities associated with lymphatic filarial infections. However there are much earlier stages of lymphatic pathology and dysfunction where recognition has only recently been made possible through ultrasonographic and lymphoscintigraphic techniques (Almeida *et al.*, 1999, Freedman *et al.*, 1994). Results from ultrasonography study has identified massive lymphatic dilatation around and for several centimetres beyond adult filarial worms which, though they are in continuous vigorous motion, remain 'fixed' at characteristic sites within lymphatic vessels (Noroes *et al.*, 1996).

Histologically, dilatation and proliferation of lymphatic endothelium can be identified, and the abnormal lymphatic function associated with these changes can be readily

documented by lymphoscintigraphy (WHO, 2000). Furthermore, despite the earlier paradigm that pathology associated with lymphatic filarial diseases was primarily the result of immune-mediated inflammatory responses, all of these changes can occur in the absence of such overt inflammatory responses and, even by themselves, can lead to both lymphoedema and hydrocele formation (WHO, 2000).

The immune system during the development of the 'non-inflammatory pathology' is 'down-regulated' through the production of contra-inflammatory immune molecules; specifically, the characteristic mediators of Th2-type T-cell responses (IL-4, IL-5, IL-10) and antibodies of the IgG4 (non-complement-fixing) subclass that serve as "blocking antibodies" (Wayangankar, 2010, WHO, 2000, GAELF, 2010). Such adaptations do, of course, serve to promote the biological principle of parasitism in which a satisfactory balance between parasite 'aggressiveness' and host responsiveness must evolve to maintain this special relationship (WHO, 2000, GAELF, 2010)

Recent studies have shown that lymphatic filarial parasites contain rickettsia-like *Wolbachia* endosymbiotic bacteria (Wayangankar, 2010). This association has been recognized as contributing to the inflammatory reaction seen in filariasis (Taylor and Hoerauf, 1999).

2.5 Clinical Features

Clinical features and pathology depend on the sites occupied by developing and mature worms (GAELF, 2009), the number of worms present, length of infection, and the immune responses of the host especially to damaged and dead worms (GAELF, 2009). Symptoms of infection differ from one endemic area to another (Cheesbrough, 2009). There are chronic, acute and 'asymptomatic' presentations of lymphatic filarial disease

(Sabesan et al., 2010, Cheesbrough , 2009), as well as a number of syndromes associated with these infections that may or may not be caused by the parasites (Cheesbrough, 2009).

2.5.1 Chronic manifestations

Hydrocoele, even though found only with *W. bancrofti* infections (i.e., not *Brugia* infections) is the most common clinical manifestation of lymphatic filariasis (Pani *et al.*, 1991). It is uncommon in childhood but is seen more frequently post-puberty and with a progressive increase in prevalence with age (Shenoy, 2003, GAELF, 2009). In some endemic communities 40-60% of all adult males have hydrocoele (Gyapong *et al.*, 1998, GAELF, 2009). It often develops in the absence of overt inflammatory reactions, and, indeed, many patients with hydrocoele also have microfilariae circulating in the blood (GAELF, 2009).

Though the mechanism of the fluid accumulation in the tunica vaginalis is still unknown, direct ultrasonographic evidence indicates that in bancroftian filariasis the scrotal lymphatics are the preferred site for localization of the adult worms, and their presence may stimulate not only the proliferation of lymphatic endothelium but also a transudation of 'hydrocoele fluid' (Cheesbrough, 2009). The chemical constituents are similar to those of serum (GAELF, 2009). The localization of adult worms in the lymphatics of the spermatic cord leads to a thickening of the cord that is palpable on physical examination of most patients (Chessbrough, 2009, Amaral *et al.*, 1994).

The hydrocoeles can become massive but still occur without lymphoedema or elephantiasis developing in the penis and scrotum, since the lymphatic drainage of these tissues is separate and more superficial (Wayangankar, 2010, GAELF, 2009). Lymphoedema, can develop in the absence of overt inflammatory reactions. In the early

stages it is associated with microfilaraemia. The development of elephantiasis (either of the limbs or the genitals) is most frequently associated with a history of recurrent inflammatory episodes (GAELF, 2009).

In such individuals the early pitting oedema gives rise to a later brawny oedema with hardening of the tissues (GAELF, 2009). Later, hyper-pigmentation and hyper-keratosis develop, often with wart-like protuberances which, on histological section, reveal dilated loops of lymphatic vessels within the nodular lesions (GAELF, 2009). Patients with chronic lymphoedema or elephantiasis rarely are microfilaraemic (GAELF, 2009).

Very important in the progression of these lesions is the fact that the redundant skin folds, cracks and fissures of the skin provide havens for bacteria and fungi to thrive and intermittently penetrate the epidermis to lead to either local or systemic infections (Wayangankar , 2010, GAELF, 2009). Sometimes the skin over the nodular protuberances breaks down, causing the dilated lymphatic within to rupture and discharge its lymph fluid directly into the environment, at the same time serving as a causeway for penetration of bacterial or fungal organisms directly into the lymphatic system (Rull, 2010).

Chyluria, other chronic filarial syndromes, is caused by the intermittent discharge of intestinal lymph fluid (chyle) into the renal pelvis and subsequently into the urine (Cheesbrough, 2009, GAELF, 2009). The mechanisms underlying this discharge have been well defined, though the clinical course is known to be intermittent, sometimes remitting after treatment with DEC and sometimes after lymphangiography (owing to the scelerosing effects of the injected contrast material) or sometimes spontaneously (GAELF, 2009). Nutritional compromise can however be severe in patients with chronic

chyluria; specialy low-fat, high-protein diets supplemented with fluids that minimize the intake and subsequent loss of medium-chain triglycerides when possible can be helpful (Tolan and Steel, 2011, Rull, 2010).

2.5.2 Acute manifestations

There are 4 distinct acute manifestations of lymphatic filariasis, each with a different set of causal mechanisms and pathogenic implications (GAELF, 2009). Most important are the acute inflammatory episodes of the limbs or scrotum that are related to bacterial or fungal superinfection of tissues with already-compromised lymphatic function (Sabesan *et al.*, 2010). In the past these were termed 'filarial fevers' and more recently 'adenolymphangitis' (ADL). It has been suggested however that a better description would be 'DLA' (dermatolymphangioadenitis) to indicate that they start peripherally. They have features of cellulitis and drain centrally towards lymph nodes. (Tolan and Steel, 2011, Gyapong *et al.* ,1996)

Confused with this picture in the past was another (second) type of 'filarial fever' in which the inflammation was initiated in the lymph node (commonly the inquinal node) with 'retrograde' extension down the lymphatic tract and an accompanying 'cold' oedema(GAELF, 2009). In this case inflammation appears to be immune-mediated in response to an adult worm dying or being killed in the lymphatic tract (GAELF, 2009). Such immune-mediated reactions are now recognized to be much less frequent (10-20%) than the episodes of inflammation initiated by dermal infection (GAELF, 2009).

A third acute filarial syndrome is tropical pulmonary eosinophilia, caused by an immunologic hyper-responsiveness to filarial infection (GAELF, 2009). It is characterized by extremely high levels of peripheral blood eosinophilia, asthma-like

symptoms, restrictive (and often obstructive) lung disease, including very high levels of specific anti-filarial antibodies and an excellent therapeutic response to appropriate anti-filarial treatment (DEC) (Monica Cheesbrough, 2009, Gyapong *et al.*, 1996). It occurs with a frequency of less than 1% of all filariasis cases (Cheesbrough, 2009, Gyapong *et al.*, 1996). It is a severe condition that can lead to chronic interstitial fibrosis and pulmonary failure (Cheesbrough, 2009).

The fourth and least commonly recognized form of acute inflammatory reaction caused by filarial infection is that seen early after infection particularly in expatriates exposed to, and acquiring, the infection for the first time, as seen in military operations in filariasis-endemic areas (GAELF, 2009).

Lymphangitis occurs around early adult stages in these individuals, and an extensive set of biopsies of such lesions has indicated clearly their acute, eosinophilic inflammatory nature and their association with the presence of immature filarial worms (GAELF, 2009).

2.6 Diagnosis of lymphatic filariasis

2.6.1 Diagnosis

Until recently, diagnosis of filarial infection depended on the direct demonstration of the parasite (almost always microfilariae) in blood using relatively cumbersome techniques and having to take into account the periodicity (nocturnal or diurnal) of microfilariae (Rocha *et al.*, 2009). Alternative methods based on detection of antibodies by immunodiagnostic tests did not prove satisfactory since they both failed to distinguish between active and past infections and had problems with specificity owing to their

cross-reactivity with common gastrointestinal parasites and other organisms. (Knott 1939, Denham *et al.*, 1971, Dennis and Kaen 1971, Eberhard and Lammie, 1991).

Antigen detection: Circulating filarial antigen (CFA) detection should now be regarded as the 'gold standard' for diagnosing *Wuchereria bancrofti* infections (Weil *et al.*, 1997).The specificity of these assays is excellent, and the sensitivity is greater than that achievable by the earlier parasite-detection assays (Weil *et al.*,1997, CDC 2009). Essentially all individuals with microfilaraemia also have detectable circulating antigen, as well as do a proportion of those amicrofilaraemic individuals with clinical manifestations of filariasis (e.g., lymphoedema or elephantiasis) but no circulating microfilariae (GAELF, 2009). In addition, some individuals who appear normal also have detectable circulating antigen that disappears after effective treatment with DEC for these cryptic infections (GAELF, 2009).

Two commercial configurations of this assay are available. One based on ELISA methodology that yields semi-quantitative results (More and Copeman, 1990, Rocha *et al.*, 2009), and the other based on a simple card (More and Copeman, 1990) (immunochromato graphic) test, yielding only qualitative (positive/negative) answers (Rocha et al., 2009). Thus, this new diagnostic approach is equally applicable to clinical or field evaluation of bancroftian filariasis infections. (Amaral *et al.*, 1994).

The CFA detection techniques are commercially available in the form of kits and have the advantage of allowing for diagnosis to be carried out using blood samples collected at any time of day (More and Copeman 1990, Amaral *et al.*, 1994, Weil *et al.*, 1997, Rocha 2002, 2004).

Figure 2.4: The simplicity of using ICT cards for LF detection is demonstrated in these pictures.

The left ICT card displays negative results for LF infection, while the right card displays positive results

2.6.2 Clinical Diagnosis

Many lymphatic filariasis patients are amicrofilaraemic, and because no serologic test other than that detecting CFA is specific, in the absence of antigen testing the diagnoses of these infections must be made 'clinically' (i.e., on circumstantial evidence) with support from antibody or other laboratory assays.

Most secure of these clinical diagnoses is that of the tropical eosinophilia syndrome (Dennis 1993, Moody and Chiodini, 2000); in addition to its distinctive clinical presentation such patients have extraordinarily high levels of total serum IgE (almost always in excess of 10 000 ng/ml), and their levels of specific antifilarial antibodies (both IgG and IgE) are extremely high, the absolute levels depending on the specific tests used (Rull, 2010).

For other amicrofilaraemic syndromes serologic findings based on detecting IgG4 antibodies have proven helpful (ELF, 2000). Since this subclass has greater diagnostic specificity and is stimulated by the presence of active infection (ELF, 2000). Such antibody analyses are also especially helpful in diagnosing the expatriate syndrome' where 'background (i.e., pre-exposure) levels' of IgG and especially IgG4 antibodies to filarial antigens will be very low, so that elevated levels have significant diagnostic implications in association with the clinical presentations(CDC,2010, ELF, 2000). Eosinophilia is a frequent concomitant of all filarial syndromes (ELF, 2000), but only when the levels are extremely high (as in tropical eosinophilia or the expatriate syndrome) (ELF, 2000). They are diagnostically helpful even though other parasite can increase eosinophilia (CDC, 2010).

2.6.3 X-rays Diagnosis

Conventional X-rays are rarely helpful in diagnosing lymphatic filarial infection (GAELF, 2004), except in the case of tropical eosinophilia where the picture can be variable (GAELF, 2004). Ultrasound examination of the lymphatics (especially scrotal lymphatics in men, and the breast and retro-peritoneal lymphatics in women) can reveal rapidly moving ("dancing") adult worms (Rosenblatt et al., 2009, Freedman et al.,1994) and lymphoscintigraphy, though not diagnostic of filarial infection, can identify lymphatic functional and gross anatomical abnormalities (Amaral *et al.*, 1994, Rocha *et al.*, 2009).

In situations of lymphadenopathy with or without accompanying inflammation of the nodes or lymphatic vessels, biopsy can often detect adult worms, but this approach is rarely used as a diagnostic procedure (GAELF, 2004).

2.6.4 Microfilaria Detection

Prior to the development of the CFA assay, detection of microfilariae in blood was the standard approach to diagnosing lymphatic filarial infection (Rocha *et al.*, 2009). It is the one still required today for both brugian filariasis and those situations where the antigen detection test is not available for bancroftian filariasis (Rocha *et al.*, 2009).

For such assessments one must take into account the parasites' possible nocturnal periodicity in selecting the optimal blood drawing time (10 p.m.-2 a.m. for most bancroftian infections) (Rosenblatt *et al.*, 2009). The simplest technique for examining blood or other fluids (including hydrocele fluid, articular effusions and urine) is to spread 20 microliters evenly over a clean slide that is dried and then stained with Giemsa or a similar stain (CLSI 2000, Garcia, 2007).

A wet smear may also be made by diluting 20-40 microliters of anti-coagulated blood with water or 2% saponin, which will lyse the red blood cells but allow the microfilariae to be readily identifiable (Cheesbrough, 2009). The larger the blood volumes examined, the greater will be the likelihood of detecting low parasitaemias (Cheesbrough, 2009).

Knott's concentration technique can be used to examine 1 ml volumes of anti-coagulated blood by mixing the blood with 10 ml of 2% formalin. This is then centrifuge and the sediment is examined either unstained or fixed and stained. The microfilariae are non-motal and generally straight, and they can be easily missed if the viscous sediment is not searched diligently (Knott 1939, Eberhard and Lammie, 1991).

More recently, membrane filtration has been advanced as the most sensitive technique for detecting and quantitating microfilariae in blood, companying urine or other body fluids (WHO, 2000). Polycarbonate (Nuclepore®) filters with a 3 µm pore size have proved most satisfactory (WHO, 2000). A known volume of anti-coagulated blood or

other fluid is passed through a Swinnex holder containing the filter, followed by a large volume (about 35 ml) of pre-filtered water that lyses the red blood cells (WHO, 2000). A volume of air then follows the water, and the filter is removed, placed on a slide and stained (Moody and Chiodini, 2000). Morphology of the parasite is much more difficult to assess than when specimens are prepared initially on slides, but detection and quantitation are very straightforward.

2.6.4.1 Specimen Processing

2.6.4.2 Preparing Blood Smears

Venous blood smears should be prepared as soon as possible after collection (CDC, 2010). (Delay can result in changes in parasite morphology and staining characteristics).

2.6.4.3 Thick smears

Thick smears consist of a thick layer of dehemoglobinized (lysed) red blood cells (RBCs) (CDC, 2010). The blood elements (including parasites, if any) are more concentrated (app. 30×) than in an equal area of a thin smear. Thus, thick smears allow a more efficient detection of parasites (increased sensitivity) (CDC, 2010). At least 2 smears per patient is prepared by placing a small drop of blood in the center of the pre-cleaned, labelled slide (CDC, 2010). Using the corner of another slide or an applicator stick, the drop of blood is spread in a circular pattern until it is the size of a dime (1.5 cm^2) (CDC, 2010).

A thick smear of proper density is one which, if placed (wet) over newsprint, allows you to barely read the words (CDC, 2010, Eberhand et al., 1991).The slides are laid flat and the smears allowed to dry thoroughly (protect from dust and insects!). Insufficiently

dried smears (and/or smears that are too thick) can detach from the slides during staining (CDC, 2010, Eberhand et al., 1991).

The risk is increased in smears made with anticoagulated blood (CDC, 2010, Eberhand et al., 1991). At room temperature, drying can take several hours, 30 minutes is the minimum, in the latter case, the smear is handled very delicately during staining. The smear drying can be accelerated by using a fan or hair dryer (use cool setting) (Eberhand et al., 1991). Thick smears must be protected from hot environments to prevent heat-fixing the smear. Thick smears are not fixed with methanol or heat. If there will be a delay in staining smears, dip the thick smear briefly in water to hemolyse the RBCs (CDC, 2010, Eberhand et al., 1991).

2.6.4.4 Thin smears

Thin smears consist of blood spread in a layer such that the thickness decreases progressively toward the feathered edge and in the feathered edge, the cells should be in a monolayer, not touching one another (CDC, 2010, Eberhard et al., 1991). At least 2 smears are prepared per patient (CDC, 2010, Eberhand et al., 1991). A small drop of blood is placed on a pre-cleaned, labeled slide, near its frosted end. Another slide is used at a 30-45° angle up to the drop, allowing the drop to spread along the contact line of the 2 slides. Quickly push the upper (spreader) slide toward the unfrosted end of the lower slide. The smear should have a good feathered edge by using the correct amount of blood and spreading technique. The thin smears are allowed to dry and are fixed by dipping them in absolute methanol.

2.6.4.5 Special Procedures for Detecting Microfilariae

Blood microfilariae: Capillary (fingerstick) blood.

Since microfilariae concentrate in the peripheral capillaries, thick and thin smears prepared from fingerstick blood are recommended. Anticoagulated (EDTA) venous blood (1 ml) should be concentrated by one of the following methods:

2.6.4.6 Centrifugation (Knott's technique)

This is done by preparing 2% formaldehyde (2 ml of 37% formaldehyde + 98 ml H_2O). 9 ml of this 2% formaldehyde is mixed with 1 ml of patient's venous blood. This is then centrifuge at 500 × *g* for 10 minutes and supernatant discard (CDC, 2010).The Sediment which is composed of WBCs and microfilariae (if present) is examined microscopically as temporary wet mounts. Thick and thin smears are prepared and then allowed to dry. The smear is dipped in absolute methanol before Giemsa staining to enhance staining of microfilariae (CDC, 2010, Eberhand *et al.*, 1991).

2.6.4.7 Filtration

Millipore® or Nucleopore® membrane filter (5 µm pore) is placed in a filter holder with syringe attachment.1 ml of venous blood (in EDTA) is then mixed with 10 ml of 10% Teepol® 610 (Shell Co.). This is then allowed to stand for several minutes to allow lysis. It is then transferred to a 10 ml Luer-Loc® syringe and then attached the filter apparatus.

The solution is forced through the 5 µm pore filter, followed by several syringes of water to wash out the remaining blood. 1 or 2 syringes full of air to clear excess fluid. A temporary wet mount is prepared by removing the filter and placing it on a glass slide and add a drop of stain or dye and a coverslip and examined microscopically

(cheesbrough, 2009).Permanent preparations are made by passing 2 to 3 ml of methanol through the filter while it is still in the holder. The filter is then removed and dried on a glass slide and it is then stained with Giemsa stain horizontally (so that the filter does not wash off the slide). The filter is covered with a coverslip before examining microscopically. (Eberhard and Lammie, 1991, Cheesbrough, 2009).

2.6.5 DNA PCR

DNA probe using polymerase chain reaction (PCR). The tests are of high specificity and sensitivity, which are available to detect parasite DNA in humans as well as vectors in bancroftian filariasis (McCarthy, 2000). Even though this method is quick and easy to perform, the disadvantage is that it requires sophisticated equipment and is available only in few countries (Anitha and Shenoy, 2001).

2.7 Treatment

2.7.1 Patients currently infected with the parasite

The most commonly used drug to treat the condition is diethyl-carbamazine (DEC). Diethylcarbamazine (DEC) is the drug of choice in the United States (CDC, 2010). The drug kills the microfilaria and some of the adult worms (Palumbo, 2008) . DEC lowers the blood microfilaria levels markedly even in single annual doses of 6 mg/kg, and this effect is sustained even at the end of one year (Palumbo, 2008).

Even though DEC kills the adult worms, this effect is seen in only 50% of patients (Anitha and Shenoy, 2001). By ultrasonography it is shown that even single doses of DEC kills the adult worms when they are sensitive to the drug (Palumbo, 2008). When they are not sensitive even repeated doses do not have any effect on the adult parasite (Noroes *et al.*, 1997). DEC has been used world-wide for more than 50 years (CDC,

2010). Since infection is rare in the U.S, the drug is no longer approved by the Food and Drug Administration (FDA) and cannot be sold in the U.S (CDC, 2010). Physicians can obtain the medication from CDC after confirmed positive laboratory results (CDC, 2010). CDC gives the physicians the choice between 1 or 12-day treatment of DEC (6 mg/kg/day) (CDC, 2010).

One day treatment is generally as effective as the 12-day regimen (Andrade *et al.*, 1995). DEC is generally well tolerated and side effects are in general limited and depend on the number of microfilariae in the blood (CDC, 2010). However, the most common side effects are dizziness, nausea, fever, headache, or pain in muscles or joints (CDC, 2010).Caution is needed with patients who may also have onchocerciasis and loiasis since DEC can worsen onchocercal eye disease and can cause serious adverse reactions in patients with loiasis, including encephalopathy and death (CDC, 2010). The risk and severity of the adverse reactions are related to *Loa loa* microfilarial density (CDC, 2010).

However another treatment option is ivermectin, which kills only the microfilariae (Palumbo, 2008, CDC, 2010). Ivermectin may be used for *W. bancrofti* alone or in combination with DEC and it is highly effective but adverse reactions need supervision.(De Sole *et al.*, 1989). Mebendazole and its analogue flubendazole may be used. Albendazole is another possibility and a single-dose ivermectin with or without albendazole appears to be effective to treat *W. bancrofti* infection (Dunyo *et al.*, 2000, Reddy et al., 2007).

2.7.2 Patients with clinical symptoms

Lymphedema and elephantiasis are not indications for DEC treatment because most people with lymphedema are not actively infected with the filarial parasite (McCarthy,

2000, *Palumbo, 2008).*To prevent the lymphedema from getting worse, patients should ask their physician for a referral to a lymphedema therapist so they can be informed about some basic principles of care such as hygiene, exercise and treatment of wounds (Palumbo, 2008). Patients with hydrocele may have evidence of active infection, but typically do not improve clinically following treatment with DEC (Palumbo, 2008). The treatment for hydrocele is surgery (Palumbo, 2008).

2.8 Prevention & Control

The best way to prevent lymphatic filariasis is to avoid mosquito bites (CDC, 2010). The mosquitoes that carry the microscopic worms usually bite between the hours of dusk and dawn (CDC, 2010). If you live in an area with lymphatic filariasis, during the night it is important to sleep in an air-conditioned room or sleep under a treated mosquito net between dusk and dawn and also it is advised to wear long sleeves and trousers and use mosquito repellent on exposed skin (CDC, 2010).

Another approach to prevention includes giving entire communities medicine that kills the microscopic worms and controlling mosquitoes (CDC, 2010). Annual mass treatment reduces the level of microfilariae in the blood and thus, diminishes transmission of infection (Anitha, and Shenoy, 2001). This is the basis of the global campaign to eliminate lymphatic filariasis.

2.9 How to manage LF

Some recent studies have shown that with proper 'local care' of the affected limbs the acute adeno-lymphangitis (ADL) attacks can be prevented even in the case of severe lymphoedema (Palumbo 2008).

The ‘foot-care programme’ invovelves the following steps: Washing the affected parts with soap and water and drying with towels twice a day, raising the affected limb at night, regularly exercising the affected limb to promote lymph flow, keeping the nails and interdigital spaces clean, wearing shoes and use of antiseptic or antibiotic creams to treat small wounds or abrasions (Anitha and Shenoy, 2001, Palumbo, 2008).

Intensive personal hygiene and topical antibiotic ointments can also decrease the frequency of recurrent infection episodes in patients with elephantiasis of the scrotum, but, unfortunately, principles of management have not yet been developed for successfully reversing the anatomic distortions caused by the infection (Anitha and Shenoy, 2001).

Non-invasive management of chyluria relies on nutritional support, especially substitution of foods, rich in fat by high protein, high fluid diets where possible with medium- chain triglycerides (GAELF, 2004). 'Correction' of the lymphatic defect can be effected through surgery (GAELF, 2004), but even the sclerosing effects of lymphangiography or, often, time alone can lead to the cessation (GAELF, 2004).

2.10 LF and Children

In children, the infection from LF is usually symptomless and not clinically detectable (Shenoy, 2003). The damage caused by adult worms in the lymphatic system develops slowly, and it is generally not apparent until children are four or five years of age (Shenoy, 2003). However, swollen lymph glands may be observed as early as two years of age (GAELF, 2004). At about seven years, about 30% of infected children will start to

show ultrasound-detectable, irregular ballooning of the tiny walled lymphatic ducts and some will have noticeably swollen lymph glands (Shenoy, 2003).

2.10.1 Disease progression in girls

By about 13 years, girls may start to show clinically visible signs of infection of the lymph vessels in the leg (GAELF, 2004). Further cumulative damage to the lymphatic drainage system predisposes them to lymphoedema (an abnormal accumulation of lymph fluid in the tissues causing swelling of a limb) (GAELF, 2004). This may progress to elephantiasis (painful and disfiguring swelling of the leg, arm, breast or genitals, up to several times their normal size, with thickening of the skin) in adulthood (GAELF, 2004).

2.10.2 Disease progression in boys

By about 11 years, boys may start to show detectable ballooning of the lymphatic vessels in their scrotum (GAELF, 2004). By about 13 years, they may start to develop hydrocele - a fluid-filled, balloon-like enlargement of the sacs around the testes (GAELF, 2004). Scrotal nodules often develop in adulthood and further bacterial infection can lead to massive enlargement of the scrotum and gross deformation of the penis (GAELF, 2004). Less commonly, boys may also develop lymphoedema and elephantiasis of the extremities, similar to girls (Dreyer, 2000).

The parasites in infected males (patients) prefer the lymphatics of the scrotum over those of the extremities (GAELF, 2004). Thus, genital disease is more common in males, and is the most common of all clinical manifestations of LF. (GAEFL, 2004)

2.10.3 WHO's Response

World Health Assembly Resolution 50.29 encourages Member States to eliminate lymphatic filariasis as a public health problem (WHO, 2013). In response, WHO launched its Global Programme to Eliminate Lymphatic Filariasis (GPELF) in 2000 (Alexander *et al.*, 2003, Njenga *et a*l., 2011). The goal of the GPELF is to eliminate lymphatic filariasis as a public health problem by 2020 (Njenga *et al.*, 2011).

The strategy is based on two key components:

- Interrupting transmission through annual large scale treatment programmes, known as mass drug administration, implemented to cover the entire at-risk populations
- Alleviating the suffering caused by lymphatic filariasis through morbidity management and disability prevention.

2.10.4 Mass drug administration (MDA)

To achieve interruption of transmission, first the disease in endermic communities are mapped to know where to administer MDA.This is then followed by administration of single doses of albendazole plus either diethylcarbamazine or ivermectin in the endemic regions, thereby treating the population at risk entirely.

MDA should be continued for 4-6 years to fully interrupt transmission of infection (WHO, 2011). By 2010, 59 endemic countries had completed mapping, and 53 countries had started implementing MDA (WHO, 2011). Of the 53 countries that had implemented MDA, 37 had already completed five or more rounds of MDA in at least some of their endemic areas (WHO, 2011).

From 2000 to 2010, more than 3.4 billion treatments were delivered to a targeted population of about 900 million individuals in 53 countries (WHO, 2011). This has lead to considerable reduction of transmission in many places (WHO, 2011).

Recent research have shown that the transmission of lymphatic filariasis in populations at risk has dropped by 43% since the beginning of the GPELF (WHO, 2011). The overall economic benefit of the programme during 2000-2007 is conservatively estimated at US$ 24 billion (WHO, 2011).

2.10.5 Morbidity management

Morbidity management and disability prevention are vital for public health improvement and should be fully integrated into the health system (Addiss et al., 2007). The GPELF focuses on training health care workers and communities to provide proper care and treatment (Addiss et al., 2007). Clinical severity of lymphoedema and acute inflammatory episodes can be improved using simple measures of hygiene, skin care, exercise, and elevation of affected limbs (Addiss et al., 2007). Hydrocele (fluid accumulation) can be cured with surgery (WHO, 2012)

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site

The Kassena-Nankana District is one of the 12 district of the Upper East Region. The district covers an area of 1,675 square kilometers along the Ghana-Burkina Faso border. The area, which is mainly rural, is in the dry Guinea savanna woodland with a sub-Sahelian climate (www.kassenanakana.ghanadistricts.gov.gh).

There are two main climatic seasons, the wet and dry seasons. The wet season extends from April to October, with the heaviest rainfall mainly occurring between June and October while the mean annual rainfall is 1365 mm but the highest level is recorded in August. Similarly, the dry season is subdivided into the *Harmattan* (November to mid February) and the dry hot (mid February to April) seasons. Monthly temperatures range from 20°C to 40°C (www.kassenanakana.ghanadistricts.gov.gh)

The people live in dispersed settlements or compounds, protected by an outer wall and surrounded by land for subsistence farming (Gyapong *et al*., 1996). The district is largely rural, with only 9.5% living in urban quarters (Ngom *et al*., 1999). The population consists of two distinct ethno-linguistic groups: the *Kassena* form 49% of the district's population, while the *Nankani* constitute about 46% with the *Builsa* and migrants belonging to other ethnic groups making up the remaining 5% (Ngom *et al*., 1999).

The main languages spoken in the area are *Kassim* and *Nankam*, with *Buili* being spoken by most of the minority tribe (Ngom *et al*., 1999).Despite the linguistic distinction, the population is, in many respects, a homogenous group with a common culture. However the district has ten traditional paramount chiefdoms and is characterized by traditional forms of village organization, leadership and governance (Ngom *et al*., 1999).

The study took place in the Kassena-Nankana East district which is endemic with *W. bancrofti* (Gyapong et al., 1996). In 2001 mass drug administration started in the district as one of the sentinel sites. The prevalence of LF microfilaria in the district before MDA started was 32.4% (Gyapong et al., 1994). However after more than 5 rounds of MDA, microfilaria prevalence was reduced to 3.5% (GFEP 2008).

3.2 Study population

All Children between 2- 10 years old and permanently residing in the 4 communities of the Kassena-Nankana east were randomly selected for this study if they fulfilled the inclusion criteria. The Ghana Health Service (GHS) has over the years implemented a number of interventions among the study population, this includes the annual mass deworming exercises with albendazole and ivermectin.

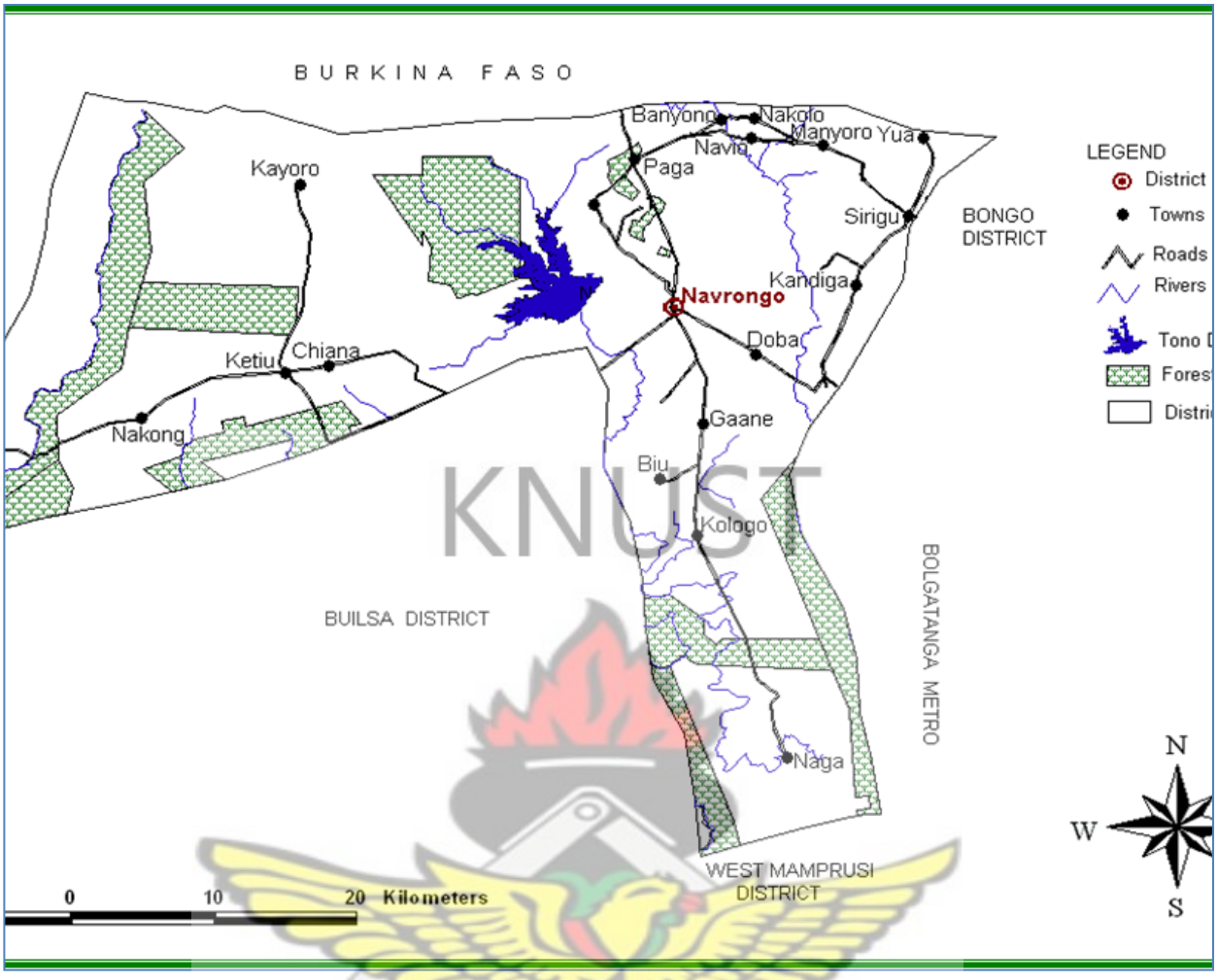


Figure 3.1: Kassena Nankana East and West combined map Courtesy Kassena-Nankana east District Assembly.

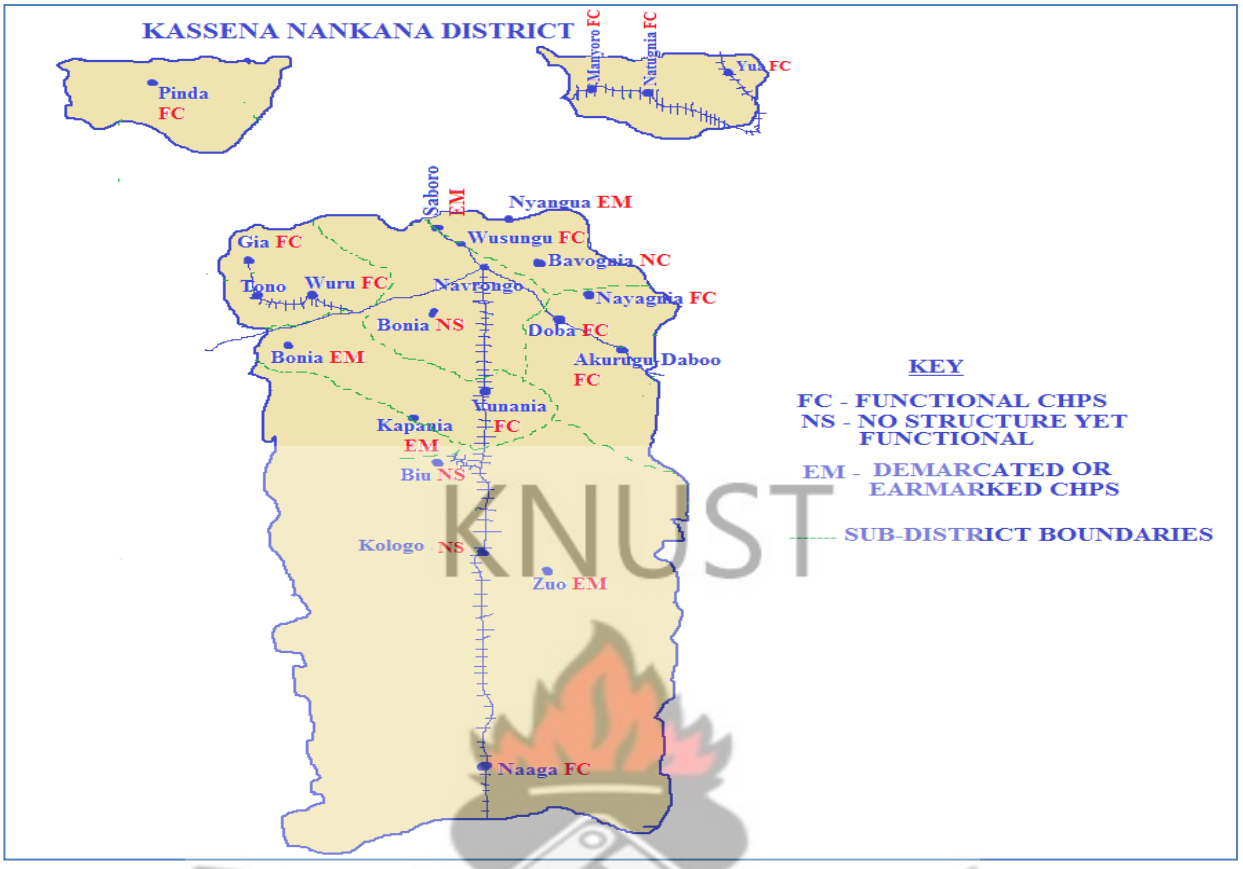


Figure 3.2: A map of the Kassena-Nankana East District: Courtesy Kassena-Nankana east District Assembly.

3.3 Study Type and Design

This is a cross-sectional analytical survey conducted in 4 communities in Kassena-Nankana East district in May 2012.

3.3.1 Inclusion criteria

All children born after start of MDA, residing in the selected communities and attending school were enrolled into the study.

3.3.2 Exclusion criteria

Children who were born before start of MDA, those not in school and those whose parents/guardians would not give their consent.

3.3.3 Study school and participant

Study school such as the Bui,Korania, Gumongo and Manyoro primary Schools and participants were randomly selected. These primary schools are located in endermic communities and over the years the GHS has been implementing the annual mass drug exercise in these communities.

3.3.4 Sample size determination

The total primary school population in the 4 communities was approximately 5500 pupil with Bui having four primary schools, Korania two, Gumongo two and Manyoro three (Headmaster). Eleven primary schools were randomly selected to give the sample of about 400 pupil required to estimate the filarial circulating antigen in the total primary school population before and after administration MDA.

3.4 Sample collection

A volume of about 2 ml venous blood samples was collected from each participant into a clean labelled heparin blood collection tubes using conventional venipuncture technique . A vain in the lower arm (cubital vein) was located and the area sterilized by cleaning with cotton wool moistened with 70% alcohol and allowed to dry. A sterile disposable syringe and needle was used to puncture the selected vein and blood was drawn and dispensed into the heparin tube from the syringe without the needle. The

collected blood sample were then stored at 2◦ to 8◦C until tested for *Wuchereria bancrofti* antigen.

3.4.1 Pre/Before MDA Sampling

Samples of 200 school children in the 4 communities age 2-10 years was collected between December 2010 to Jan 2011 before administration of drugs (MDA) and tested for filarial antigen using NOW ICT filarial antigen kit.

3.4.2 Post/After MDA Sampling

Samples of school children age 2-10 years in the four communities treated with MDA were collected. Two hundred blood samples were collected between November 2011 to January 2012 and tested for filarial antigen using the NOW ICT filarial test kit.

3.5 Laboratory investigations for both Pre and Post MDA

3.5.1 ICT Card test procedure

The NOW® Filariasis version of the card test (ICT filariasis for blood, serum or plasma, patent. no. 5,877, 028; 5,998 ,220 ;6, 017,767 sensitivity= 100%, specificity =96.37%, efficiency= 96.70%) was carried out according to the manufacturer's instructions. Briefly each card was removed from the pouch, labelled and laid flat on the work bench. To ensure good blood flow and performance the capillary tubes were filled with blood. 100µl of blood sample was slowly added to the pad from the capillary tube. The card was closed after 30 seconds to 1 minute when the sample has flowed into the pink area and it is completely wet. The result was read exactly 10 min later. The test was considered positive when both lines (test and control) could be read through the

visualisation window. Any line (light or dark) appearing in the test position indicates that the result of the test is positive; it is negative when the control line can be seen.

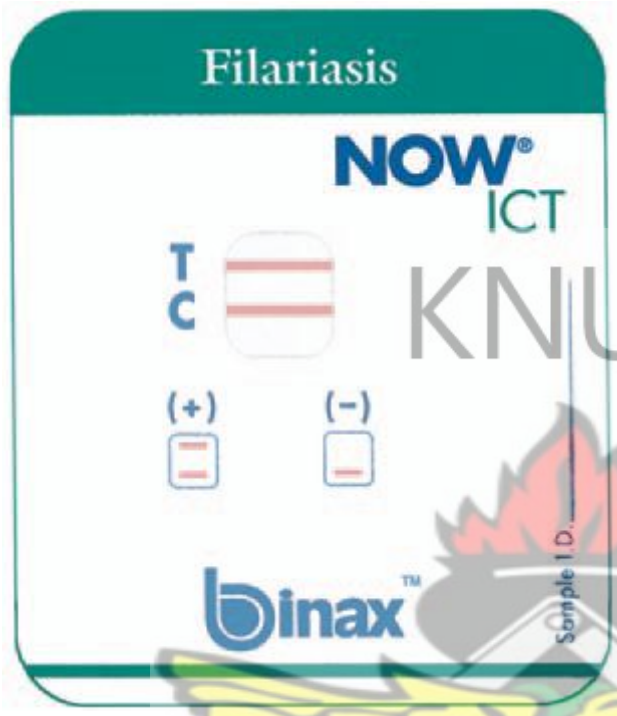


Figure 3.3: NOW ICT Filariasis test.

Positive test: Two pink lines T (Test) and C (Control) in viewing window. **Negative test:** Single pink line C (Control) in viewing window. *Courtesy of Binax Inc.*

3.5.2 Limitation of the filarial antigen test

This test is structured to indicate the presence or absence of *W. bancrofti* antigen in the sample. The absence of antigen does not exclude filariasis cause by other nematode species.

3.6 Ethical consideration

Signed informed consent was obtained if the potential child´s parent demonstrated understanding of the study after the study has been explained to him/her and was willing to enroll his/her child.

In the case of an illiterate parent, a left thumbprint was obtained on the consent forms and a separate Witness Consent form was signed by a literate witness who had observed the consent processes. The interview was done in Kassim and Nankam which are the local language in the district.

The study protocol was approved by the institutional review board of Navrongo Health Research Centre (IRB NHRC) and committee on human research, publications and ethics (CHRPE) of Kwame Nkrumah University of Science and Technology Kumasi.

3.7 Statistical analysis

Data analysis was done using statistical package for social science SPSS and MS Excel 2007 software. Data were analyzed for the frequencies of filarial antigen test. The prevalence of filarial antigen among the communities, sex and age, multiple Comparisons/Analysis of measurements by community were explored using T-tests and Least Square Difference (SLD); One-Way Analysis of Variance (ANOVA). The predictions of percentages of males and females and age groups testing positive for filarial antigen test were also explored using Binary logistic regression.

CHAPTER FOUR

RESULTS

4.1: SOCIO-DEMOGRAPHIC FEATURES OF THE STUDY PARTICIPANTS

About 32.5% of the study children were of pre-school level and 67.5% primary school or school-age level. Of these study children 52.5% were males and 47.5% were females. Majority of these children were of Kassim ethnicity. Prior to the survey the study children had been treated with the mass drug administration with albendazole and ivermectin by the Ghana Health Service.

4.2: PREVALENCE OF FILARIA ANTIGEN BEFORE MDA 2010

Of the 200 school children selected from the four communities before MDA, twenty-five tested positive for *W. bancrofti* filarial antigen. This represent 12.5% of those samples analysed.(Table 4.1)

Table 4.1 Prevalence of filarial antigen before MDA

	Frequency	Percent (%)
Negative	175	87.5
Positive	25	12.5
Total	200	100.0

4.3: PREVALENCE OF FILARIAL ANTIGEN TEST AFTER MDA

The overall prevalence of filarial antigen after MDA found in the study children was 6.5%.

The number of negative filarial antigen in the communities was 93.5% (n=187) while 6.5% (n=13) tested positive for filarial antigen.

The table below (Table 4.2) shows the frequencies of filarial antigen test obtained from the four communities.

Table 4.2: Prevalence of filarial antigen obtained from the four communities after MDA

	Frequency	Percent %
Negative	187	93.5
Positive	13	6.5
Total	200	100.0

4.4: PREVALENCE OF FILARIAL ANTIGEN AND SEX AFTER MDA

Out of the 200 pupils tested from the communities, 8.4% (n=8) of the positive individual were females (n=95) and 4.8% (n=5) were males (n=105). Even though the prevalence of filarial antigen was high among females than males, upon statistical analysis there was no statistically significant difference in the test results between the females and males (p=0.297).

However using the binary logistic regression analysis 8.4% of the female will test positive, while 34.0% of the males will test positive. The table below (figure 4.2) shows the prevalence of filarial antigen test and Sex after MDA.

Table 4.3: Prevalence of filarial antigen and Sex after MDA

GENDER	NUMBER OF CHILDREN	FILARIA ANTIGENAEMIA R E S U L T S	
		POSITIVE (%)	NEGATIVE (%)
MALE	105	5 (4.8%)	100 (95.2%)
FEMALE	95	8 (8.4%)	87 (91.6%)

4.5: PREVALENCE OF FILARIAL ANTIGEN AND AGE AFTER MDA

The individual who were tested were categorized into two age groups 1-5 and 6-10 years. Among the respondents tested, 65 were within the age range of 1 – 5 years, 135 respondents were within the age bracket of 6 – 10 years. This implies that respondents

within the 6 – 10 age brackets constituted the majority. One (1) out of the 65 respondents of ages 1 – 5 tested positive. Twelve (12) out of the 135 respondents between ages 6 – 10 tested positive. That means majority of the respondents who tested positive were between the ages of 6 – 10 years. Even though there were more positive results with ages 6-10 years than those of 1-5 years there was no statistically significant difference in the test results between the age groups (p=0.052).

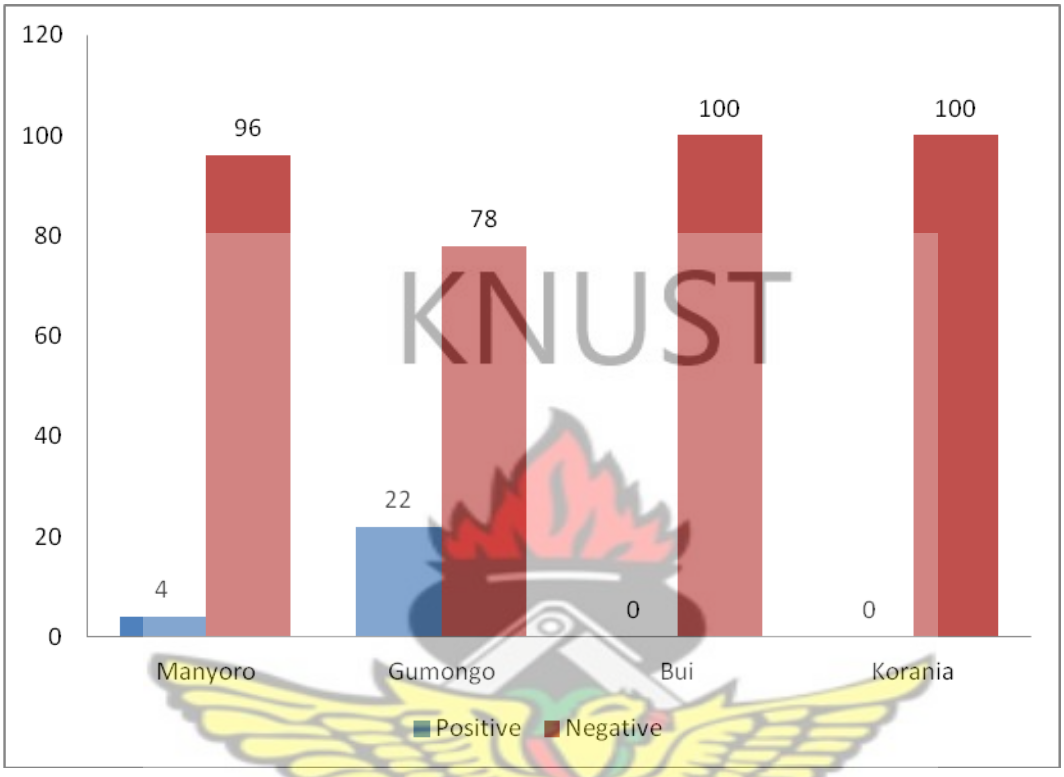
However binary logistic regression analysis predicts that 1.6% of the children in age groups 1-5 years will test positive, while 64.2% of the children in age group 6-10 years will test positive. Table 4.4 represents the above information. In all, 13 respondents tested positive, representing 6.5% while 187 respondents tested negative, representing 93.5% of respondents

Table 4. 4*:* Prevalence of filarial antigen and age after MDA

AGE RANGE (Years)	NUMBER OF CHILDREN	FILARIA ANTIGENAEMIA	
		NUMBER POSITIVE (%)	NUMBER NEGATIVE (%)
1 – 5	65	1 (1.5%)	64 (98.5%)
6 – 10	135	12 (8.9%)	123 (91.1%)

4.6 PREVALENCE OF FILARIAL ANTIGEN AMONG COMMUNITIES AFTER MDA

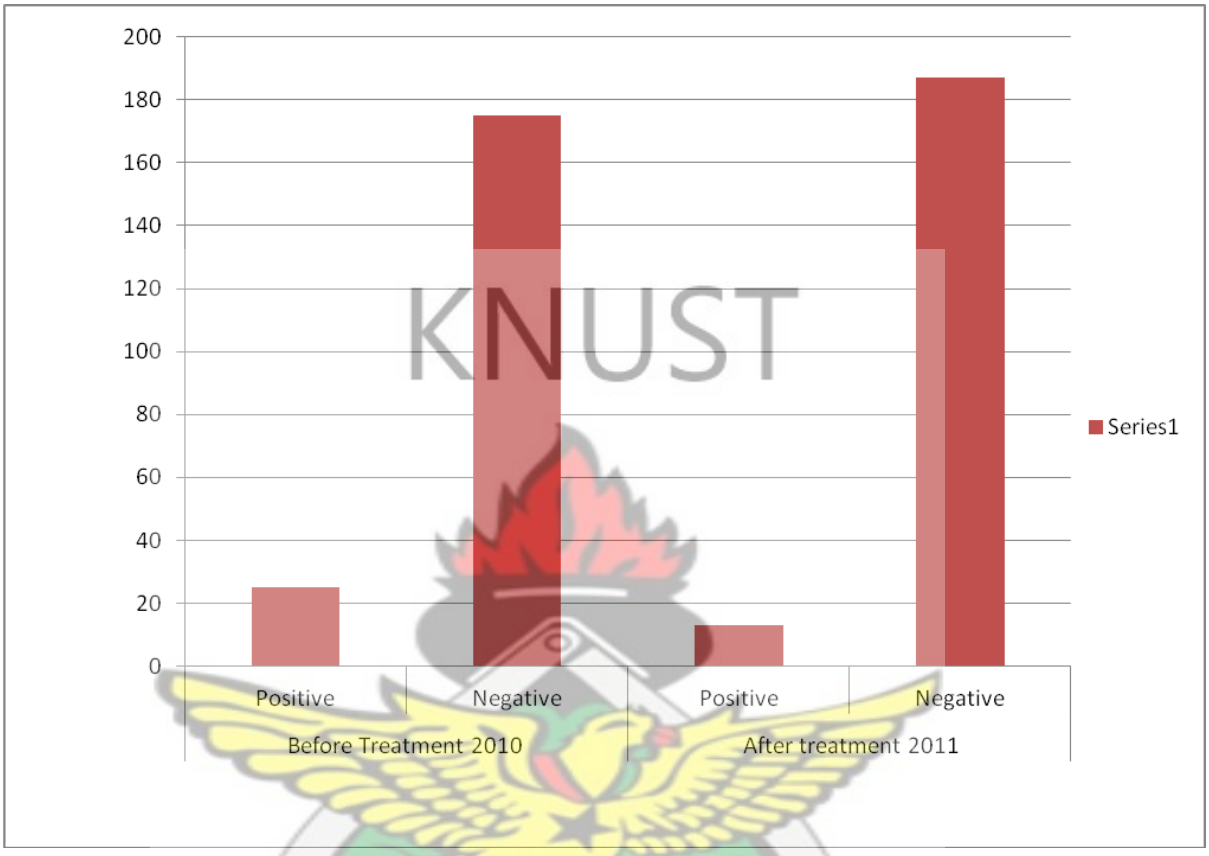
Figure 4.1: Prevalence of filarial antigen test among communities after MDA.



From the figure 4.1 above the prevalence of filariasis was high in Gumongo with 22.0%, followed by Manyoro 4.0% with Bui and Korania having a prevalence level of 0% each. There is significant difference between all the four communities Manyoro, Gumongo, Bui and Korania (p=0.000). Manyoro and Gumongo are located in the north of KNE but are far apart. Bui is located down south while Korania is located central of KNE district.

4.7 COMPARISON OF FILARIAL ANTIGEN PREVALENCE BEFORE AND AFTER MDA.

Figure 4.2: Comparason of Prevalence of filarial antigen before and after MDA



From the figure 4.2 above the prevalence of filarial antigen was 12.5% before MDA and 6.5% after MDA. There is therefore a reduction in the prevalence of filarial antigen after MDA.

CHAPTER FIVE

DISCUSSION

5.1 DISCUSSION

In spite of the many rounds of mass drug administration (MDA) in Ghana since 2000 with one implementation unit (IU) and an additional two (2) IUs in 2001 filarial infections with its crippling effect continue to affect the people of Kassena-Nankana East district.The success of MDA depends on the fact that children born after the start of the MDA should not be infected with filariasis and therefore should not habour filarial antigens.

The purpose of the study was to find out the prevalence of filarial antigen in school children in communities endermic with filariasis, some of which were sentinel sites, and after several rounds of MDA of single dose of albendazole and ivermectin. This is a current report on filarial antigen among school in an endermic community.

5.2 Frequency of filarial antigen

According to NTDCP 2007-2008 the antigen prevalence of lymphatic filariasis was between 20% to 40% in the north and 10% to 20% in the south. However an important finding of this study was the overall prevalence of filarial antigen after MDA being 6.5% which reveals lower antigen prevalence as compared to the 12.5% prevalence before MDA.

It can be said therefore that microfilaraemia prevalence has seen a drastic reduction especially when compared to the prevalence of filarial antigen of 12.5% before MDA in 2010 and Gyapong, 2000, Gyapong et al., 2002 where geographical distribution of human infection with *Wuchereria bancrofti* was investigateded in four West African

countries, Ghana, Benin, Togo and Burkina Faso and the results reveals that the prevalence of filarial antigen exceed 70%.

The reduction in antigen prevalence after several rounds of MDA is consistent with Swaminathan et al., 2012 where after eight rounds of MDA antigen prevalence fell to a range of 0.7% - 0.9% in children 2-10 years and can also be compared to Tisch et al., (2008) where *Wuchereria bancrofti* filarial antigen in individuals who participated in a five year mass drug administration trial in Papua New Guinea had proportion of microfilaria positive individual declined to the greatest degree after the MDA (Tisch et al., 2008).

5.3 Prevalence of filarial antigen among communities

Bui and Korania were the two sentinel sites in the K-N district to have started the MDA and therefore the zero filarial antigen prevalence among children born after the start of MDA in these communities is comparable with the observation in Kenya where after several rounds of MDA and although the annual MDA was not administered in some years the filarial antigenaemia declined from 34.6% to 10.8% and children born since the start of the programme were negative for filarial antigen (Njenga et al., 2011).

The results obtained from this study in Bui and Korania follows a similar result obtained by the Ghana Filariasis Elimination Programme where after an impact assessment carried out for the LF programme demonstrated marked reduction in m.f prevalence from 23% to 0.0% (GFEP, 2008). These results obtained from the current study could indicate Bui and Korania could have reached the end point in programme to eliminate lymphatic filariasis in their respective communities.

It can also be suggested from this current study that the zero prevalence could be attributed to several MDA rounds in these two communities and LF infection in children born after implementation of the MDA suggest transmission of *W. bancrofti* infection in this area may have been interrupted.

Manyoro and Gumongo had relatively high prevalence 4.0% and 22.0% respectively, these communities are further away with very bad terrain that is bad road network which sometimes get cut off during rainy seasons. This therefore leads to a situation where not all children in these two communities are able to assess the MDA drugs. Moreover these communities according to Gyapong et al 1996 have a lot of traditional believers and therefore believe the cause of filariasis is as a result of magic. Their perceived cause of the disease are different from the scientific interpretation and as such they do not patronize the MDA programmes. This is because they do not believe the drugs could help prevent them from getting filarasis.

Also the greatest problem envisage by Gyapong et al., 1996 again was that of vector control since these communities did not associate filariasis with the mosquito. In their opinion, the people get hydrocele from many fevers but not from mosquito.

The high level of filarial antigen in these two communities in children born after the start of MDA and after repeated rounds of MDA is consistent with Weil et al., 2008 where although infection rates decreased in children after MDA, many young children had positive circulating filarial antigen after three rounds of MDA.

Also the MDA did not start at the same time with Bui and Korania and therefore most children in Manyoro and Gumongo would have started accessing the MDA drug quite lately and as seen in the finding of Weil et al., 2008 where it was suggested that these

children might have been exposed to the parasite before the MDA started in these communities even though other communities might have started.

5.4 Prevalence of filarial antigen and gender

According to Wayangankar (2012) both male and female are equally susceptible to filariasis because of different local, culture and social work place as well as differences in exposure to insect vector. However an important finding of the study is the fact that males are more likely to test positive than females which is consistent with observations in Brazil by Medeiro et al., (1999) where men are said to be more susceptible to LF than women and also consistent with the findings of Gyapong (2000) in which prevalence of filarial infection was statistically much higher in males than females.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

This study has demonstrated the absence of filarial antigen among children born after the start of MDA in Bui and Korania but this is not same for Manyoro and Gumongo. This demonstrates that community variations in the prevalence of filarial antigens exist in the KNED.

This present study has also demonstrated that males are more likely to test positive than females for lymphatic filariasis.

6.2 LIMITATIONS

The study was limited by not too large sample size due to unwillingness of some parents to release their wards to participate in this study because some parents do not believe in the scientific basis of filariasis.

6.3 RECOMMENDATION

Since the Kassena-Nankani East district is an endemic district where several rounds of MDA have been implemented, It will be recommended that more communities in the district are monitored to estimate the prevalence of filarial antigen in the district and also long term follow-up studies will be needed to determine whether several rounds of MDA have interrupted LF transmission in the district.

The high prevalence of filarial antigen among children born after start of MDA in Gumongo and Manyoro despite the many rounds of MDA in the study area indicates the

need for developing good implementation strategies by stake holders and district health management.

Filariasis mapping is essential to help decision-makers plan and manage filariasis control as well as to identify the hot spots and allow for prioritisation

While implementing the recommended control strategy, research in certain areas is also essential to address issues related to monitoring and evaluation, morbidity management to enhance elimination process.

A more extensive research need to be carried out in Bui and Korania to determine if these two communities have actually gotten to the end point of the programme.

The continued provision of MDA by the national LF elimination programme should be encourage in order to help the NTDCP to achieve its goal of eliminating LF from Ghana by 2015.

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APPENDIX

6.4 Appendix 1- Consent Form

Wuchereria bancrofti antigenaemia among school children in Kassena-Nankana East District, Ghana.

CONSENT FORM

I have been adequately informed of or I have read and understood the purpose, procedures, potential risks and benefits of this study. I have had the opportunity to ask questions about it. Any questions that I have asked have been answered to my satisfaction. I know that I can refuse to participate or have my child participate in this study without any loss of benefit to which I or my child would have otherwise been entitled. I understand that if I agree to participate, I can withdraw my consent at any time without losing any benefit or services to which I or my child am or is entitled. I understand that any information collected will be treated confidentially. I freely agree to participate or have my child or ward participate in the study. After signing below, I will receive a copy of the information sheet and this consent form.

Name of participant.....

Signature or Right Thumb Print (participant or parent or guardian).....

Date.....

Name of parent or guardian.....

Name of witness.....

Signature or Right Thumb

Print.....

Date.....

I have adequately informed the participant of the purpose, procedures, potential risks and benefits of this study. I have answered all questions to the best of my ability.

Name of study personnel.....

Signature.....

SƐƐM TƆNƆ

Ba tage ba bire ne lanyirane naa a gaga ye a nii ko kuri kolo gwane zamsem dento laga de ke to, choe selo de na wo toge de ke to, chaana yalo na wae ya tui dedane de wola. Amo nei choŋa a bwe bwea zamsem dem gwane. Bal ere bwea yalo mama amo na b we to ye amo gyege wopolo. Amo yei wo a wo wane a'vii se'a toge a'ke naa a'bu ye toge o'ke zamsem dento ye ko ba pa se de ga wonttelo amo naa a bu on ya na manŋ se de nei to. A'nige ko kuri wo labaare delo mama ba na jonŋ ye wokolo ban a pa se nɔɔna ni to mo. Amo tete mo se a tɔge a ke naa a'bu on naa bu wolo amo na nii o'to tɔge o'ke zamsem dem.

Wolo na lag'o tɔge o'ke to tu yire: .....

Jenŋa titigem naa jazem nubeo kom zim(wolo na lag'o tɔge o' ke to naa o tu naa wolo na nii o to) dɛ dem: .....

Tu on naa wolo na nii o'to yire: .....

Dansɛra tu yir : .....

Jennŋa titigem naa jazem nubeo kom zim: .....

dɛ dem: .....

Amo taga a bere wolo na laga o'tɔge o'ke to ni ko kuri lanyirane kolo gwane zamsem dento laga de ke to, choe selo de na wo toge de ke to, chaana na wae ya tui dedane de wola. Amo lere bwea yam mama de'amo dam na wae tei to.

Zamsem dem tontonŋ on yire: .....

Jenŋa titige: .....

dɛ dem: .....

SAKERE GƆNIƆ

Ba yele pale ma sonŋa bii en kalem mɛ bɔke sem enŋa te zamsego wa yete de enŋɛ, sɔ sɛya te de wan dose enŋɛ la, danŋɔ sese en wan taa bɔna bi lae sunŋrɛ. Mam nyɛ sore soke sokere zamsego la enŋa. Ba lerege sokere woo tem am soke tem am tara pupeilum. Mam mii te en wan taa zagse te'n ka po enŋɛ bii 'n biya kan po enŋɛ zamsego wa dee la kan bote tem am konŋɛ bunsɛba tem am bii 'n biya la en nare te to nyɛ sere la. Mam bɔke te labaare sere wula te ba toe la dela sɛla te ba kan base te nɛɛriba wum ko. Mam menŋa en dike en putere sake te'n po enŋɛ bii en biya la bii bisɛks tem am bisera ka la po enŋɛ zamsego wa. Mam san tigiti en nuusi, en wan toe labaare gɔnŋɔ la lae sakere gɔnŋɔ wa.

Mina en wan po enŋɛ la yuurɛ: .....

Nuusi tigitigo bii zuo nudiire (mena en wan po enŋɛ la bii a'dogira bii mina en bisere biya la) dare la: .....

dogira la bii mina en bisere bya la yuurɛ: .....

Danseya dana yuurɛ: .....

Nuusi tigitigo bii zuo nubire la diire: .....

Daare la: .....

Mam yele pale mina en wan po ennɛ la te'wum sonŋa bɔke sem enŋa te zamsego wa yete de ennɛ, sɔ sɛya te de wan dose ennɛ la, danŋɔ sese en wan taa bɔna bi lae sunŋrɛ. Mam lerege sokere wula mam panŋa en paa sem.

Zamsego la tontona la yuurɛ: .....

Nu dire: .....

Dare:.....