Development and Validation of a Rapid Epidemiological Assessment Tool for Lymphatic Filariasis

John Owusu Gyapong B.Sc., MB ChB, M.Sc.

Thesis submitted to the University of London for the degree of Doctor of Philosophy (Ph.D.) in the Faculty of Medicine

Tropical Health Epidemiology Unit
Department of Epidemiology and Population Sciences
London School of Hygiene and Tropical Medicine
University of London

June 1997

Abstract.

The real burden of lymphatic filariasis in most endemic areas remain unknown even though it is a major public health problems in many tropical countries. This is particularly so in sub-Saharan Africa, primarily because the standard procedures for assessing communities at risk of the disease are cumbersome, time-consuming, expensive and very intrusive. The nocturnal periodicity of the parasite requires parasitological examinations to be done at night and thus it becomes logistically cumbersome to organize. As a result of the lack of data on the burden and distribution of the disease, health care managers do not put much priority on its control. The need to develop instruments which are easy to use in the field to identify communities at risk is therefore paramount for the initiation of any control programme. The aim of this study was to develop and validate rapid epidemiological assessment tools for the community diagnosis of lymphatic filariasis, and in the future, use the tools to determine the distribution of the disease, identify high risk communities, and obtain sufficient information for planning a control programme in Ghana. The data collection methods used were:

- Key informant interviews and other qualitative data collection methods,
- Physical examination of a sampled population by trained health workers, and
- Filarial surface antigen assays of those who were physically examined.

These methods were validated using standard epidemiological techniques such as:

- Physician examination of the same individuals who were examined by the health worker, and,
- Night blood parasitological examination of the same individuals who had the antigen assays done on them.

The key informant interviews were qualitatively very useful in identifying communities at risk, and tracing people with overt chronic disease. The system of sending questionnaires through routine administrative systems worked very well. The return rate of the questionnaires was about 95%. The District Assemblies provided reliable information on the communities, but teachers provide more accurate figures

when compared with existing data from those communities. Routine reports from health institutions, even though useful, grossly under estimated the burden of the disease in the community. This is because these reports were influenced by:

- physical accessibility and ability to pay for the services,
- socio-cultural beliefs associated with the disease,
- technical expertise and laboratory facilities available at the institution, and
- the quality of record keeping.

The prevalence of hydroceles was high in the communities (range = 4.5 - 40.75%, mean = 17.78%). The community microfilaria prevalence correlated very well with the community prevalence of hydroceles (r = 0.84). There was a generally high agreement between the health worker's clinical findings and that of the physician (Kappa>0.85 in most instances). The prevalence of infection detected by the Og4C3 surface antigen was consistently lower than the standard night blood smears in all the 20 communities. Thus, even though the antigen test had been shown in the laboratory to have a sensitivity of about 99% and specificity of a similar value, it was not possible to replicate such a high sensitivity under field conditions using blood collected on filter paper.

The findings of the study suggested that it is possible to obtain reliable and valid estimates of the burden of lymphatic filariasis at community level using a combination of cheap and non-invasive methods such as:

- Key person interviews,
- Examination of a random sample of the population by peripheral level health staff.

The antigen assays will however require further development for field use.

Table of Contents.

List of Tables.

List of Figures.

Acknowledgments.

WHO/TDR.

This investigation received financial support from the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Disease (WHO/TDR). I am also very grateful to WHO/TDR for awarding me a fellowship to enable me pursue my studies in London. Drs Eric Ottesen and J. H. F. Remme of gave me very useful comments during the course of the study.

London School of Hygiene and Tropical Medicine.

I wish to thank my supervisor Dr Roger Webber, for his immense support and encouragement throughout the Ph.D. programme. He actively supported me in the development of the study protocol, data collection in Ghana, and analysis and write up. Dr Brian Southgate was also very helpful and always placed his wide experience in filariasis research at my disposal. Ms Jo Morris and Dr Steve Bennett provided me with statistical support during the design, implementation and analysis stages of the study.

I wish to acknowledge the support of the Tropical Health Epidemiology Unit, especially the head of the Unit, Prof. Richard Hayes for allowing the Unit to support me financially to attend the XIVth International Congress for Tropical Medicine and Malaria in Nagasaki, Japan; and a short course on Quantitative Methods for the Evaluation of Tropical Disease Control, at the Erasmus University Medical School, Rotterdam, The Netherlands; all as part of the training. Ms Simin Bahrainipur and Mrs Helen Priestly, secretaries in the unit were very helpful to me during my stay in the unit. Andrzej Radalowicz provided me with excellent computing advice in the processing of the data and production of this document.

Ministry of Health, Ghana.

The Ministry of Health, my home institution granted me paid study leave to undertake my studies abroad. I wish to thank the Director of Medical Services for his support throughout the period of my studies. Dr Sam Adjei, the Director of the Health Research Unit (and my immediate boss) has been very instrumental in my career in the last four years. He stimulated me to study lymphatic filariasis, and later supported my TDR Fellowship application. He provided an excellent working environment during the data collection and was very supportive throughout the period of my studies.

The District Directors of Health Services in the three study districts (Ahanta West, Bawku East and Winneba) and their District Health Management Teams also provided immense support during the data collection phase of the study. I would like to mention in particular Mr Samuel Odoom and Mr Joseph Newton, epidemiology field technicians of Winneba and Ahanta West districts respectively for their role in community mobilization and data collection.

Laboratory Support.

All blood specimens were collected by Mr Kwabena Omane-Badu, a technician at the Department of Community Health, School of Medical Sciences, Kumasi, Ghana. He also processed and read all the blood slides. The James Cook University Tropical Biotechnology Pty Ltd., Townsville, Australia, provided the kit for the antigen assays and also carried out the ELISAs.

The Communities.

I wish to thank the Chiefs, Elders, and People of all the communities in which these studies were carried out for their support, co-operation and participation. I wish to acknowledge the role of the District Assemblies for their role in community mobilization.

Navrongo.

My career in public health started when I joined the Ghana Vitamin A Supplementation Trials in Navrongo. Some of the people who were very helpful in steering the course of my work include the late Prof. Hutton Addy, Dr Paul Arthur, Dr Fred Binka, and Dr David Ross. It was Dr David Ross who actually encouraged me to start detailed studies in lymphatic filariasis. To all my colleagues in Navrongo, I say a very big thank you.

Family Support.

My wife Margaret, was very supportive at every stage of my studies, helped in the field organization and data collection. As a Medical Anthropologist, she provided me with the expertise of collecting and processing qualitative data at no cost. My two daughters, Akos and Nana Afia had to endure my persistent absence from home but they certainly knew that Daddy cared!

Chapter One

Introduction: Organization of the Thesis, Rationale, and Objectives of the Study.

1. Introduction.

1.1 Organization of the Thesis.

This thesis is organized into eight chapters. Chapter one describes how the thesis is set-up, and introduces the reader to the burden of lymphatic filariasis in most endemic countries. It then discusses the rationale and need to develop rapid assessment methods for community diagnosis of the disease as well as the objectives of the study. Chapter two reviews the current literature of the subject looking particularly at the epidemiology and control of the disease world-wide and Ghana in particular, with some current thoughts on the concept of community diagnosis and rapid assessment procedures (RAP). Chapter three describes the design, data collection methods, and findings of the pilot study. Chapter four describes the design and field operations of the main study and the main statistical methods used in analyzing the data.

Chapters five, six and seven describes and discusses various aspects of the results. These includes the baseline findings on the sample and the total population, the relationship between infection and disease at the individual and community level, and the role of community key informants in identifying and prioritizing diseases for control. The main conclusions, implications for control, and recommendations for further studies are presented in the last chapter.

1.2 Rationale for the Study.

Lymphatic filariasis is one of the major public health problems in many tropical countries. It causes a lot of overt and hidden debilitating diseases in the affected populations. The World Health Organization estimated that some 78 million people were infected with the filarial parasites world-wide (WHO, 1992). Although this gives an indication of the numeric scale of the problem, it does not provided enough information relevant to the public health importance of the infection since separate

estimates of disease were not available. More recent estimates suggest that some 120 million persons are infected with lymphatic filariasis world-wide; 107 million with *Wuchereria bancrofti* and 13 million with brugian filariasis. The number of physical disabilities due either to lymphoedema or elephantiasis, hydrocele and recurrent infections or the newly recognised sub-clinical abnormalities of lymphatic and renal function are currently estimated at 43 million, with bancroftian filariasis accounting for almost 40 million of these cases (WHO, 1994).

Data on the distribution of the disease are not widely available especially in sub-Saharan Africa primarily because the standard procedures for assessing communities at risk of the disease are cumbersome, time-consuming, expensive and very intrusive. In most parts of Africa, where the parasite exhibits a nocturnal periodicity, parasitological examinations needs to be done at night. This becomes logistically cumbersome to organize, and communities often refuse to co-operate. The alternative diagnostic procedure which has been used in the past is the diethylcarbamazine (DEC) provocation test. Since the DEC provocation test can cause unpleasant side effects (Mazzoti reaction), especially in areas endemic for onchocerciasis and other parasites such as *Loa loa*, few studies actually use this method. Immunological diagnosis at the community level are still at the developmental stages. Furthermore, community clinical examinations have been expensive to organize since they are usually done by physicians.

The result has been that, relatively few population based surveys of the prevalence and intensity of infection of lymphatic filariasis have been carried out, and the public health importance of this disease has therefore been underestimated. Actually, the World Health Organization pointed out in its last expert committee report on lymphatic filariasis in 1992 that:

> ***"no information was available from countries in the African region although both urban and rural bancroftian filariasis are known to be highly endemic in Zanzibar and along the coastal areas of Kenya, Madagascar and United Republic of Tanzania. Scattered foci are***

> ***also known from past studies in many areas of Central and West Africa in the broad transmission Zone"*** (WHO, 1992).

The expert committee therefore suggested that, as an urgent research priority, efforts should be made to collect more information on the distribution of the disease and vectors, especially from the African region. The current prevalence estimates shows that India has about 45.5 million cases and sub-Saharan Africa has 40 million cases. The public health significance of this for Africa is therefore clear, and there is an urgent need for more precise information on infection prevalence, including information to quantify the size of the population at risk or at least to identify endemic countries.

The cost of national epidemiological surveys to document the prevalence and intensity of lymphatic filariasis (and diseases with low mortality in general) is usually very high and therefore not usually considered a high priority in most Departments of Health in Africa where the health budget is usually between 5-8% of the total government expenditure. In Ghana where there has been considerable improvement on health spending in the recent past, this works out to approximately US $6.20 per capita (Hiscock, 1995). This is still very low and diseases like lymphatic filariasis will continue to receive low priority unless the public health importance, and the socio-economic burden of the disease is properly documented. Again, it is worth noting that most of the affected countries do not put much priority on the control of lymphatic filariasis at the national level because the infection is insidious and difficult to treat completely. Mortality attributable to it is rather insignificant and there are usually many more important public health issues such as high infant mortality, high maternal mortality, and the high morbidity and mortality associated with diseases such as malaria and measles to deal with. The woefully inadequate health resources are therefore channelled into these more important public health issues.

The 1993 World Bank Development Report uses Disability Adjusted Life Years (DALYs) as a standard measure for comparing the public health impact of different diseases. In this report, the global burden for lymphatic filariasis was estimated at

850,000 DALYs lost, which represents only 0.23% of the global burden of parasitic and infectious diseases (World Bank, 1993). These estimates were largely based on extrapolations from the gross chronic manifestations due to lack of data on the acute phase and other stages of the disease. Based on more recent knowledge of the epidemiology of the disease, this figure is seen as a gross underestimate, especially in the light of new findings relating to incidence, duration, and severity of acute adenolymphangitis. Such a narrow definition significantly reduces the estimated incidence of the disease, not only because the acute disease is likely to occur more frequently, but also because it occurs in the younger age group which is positively weighted in the calculation of DALYs, and this age group also constitutes the majority of the population in endemic areas.

In Ghana, even though the disease is now known to be a problem in many parts of the country, the prevalence and distribution has not been fully documented. This is because it has not been logistically feasible to survey all areas of the country in order to have a sound epidemiological basis for a control programme, and as a result the disease has had low priority on the national health agenda. The national survey (Gyapong JO *et al.*, 1996b) provides reasonable estimates of the burden of the disease but the design of the study did not consider the relatively focal nature of the disease and other bio-geographical factors. There is now therefore the need to develop research methods to provide information on prevalence and distribution of the disease so that appropriate interventions can be formulated, taking into consideration the social, economic and cultural setting of the people. This requires the development of instruments which are easy to use in the field to identify communities at risk so that the standard epidemiological survey techniques could be used only for validation purposes. It is hoped that based on such findings, it should be possible to extrapolate the results to other communities with similar characteristics and in the long run help map out the distribution of the disease in Ghana and possibly other parts of Africa. The only way to attract funding for such a programme is therefore to develop a tool which is:

- easy, convenient and quick to use,
- non-invasive,

- relatively inexpensive (cost-effective),
- repeatable,
- and above all valid.

This thesis reviews the epidemiology and control of lymphatic filariasis, and present the findings of a study to develop and validate a rapid epidemiological assessment technique for the community diagnosis of lymphatic filariasis.

1.3 Objectives of the Study.

1.3.1 General Objective.

To develop and validate rapid epidemiological tools for the community diagnosis of lymphatic filariasis, and in the future, use the tools to determine the distribution of the disease, identify high risk communities, and obtain sufficient information for planning a control programme in Ghana.

1.3.2 Specific Objectives.

1. To develop tools for rapid assessment of filariasis prevalence and intensity of infection at community level.
2. To validate the rapid assessment tools in different transmission zones in the country.
3. To field-test newly developed antigen assays for diagnosis of lymphatic filariasis.

Chapter Two

Review of Literature: Epidemiology and Control of Lymphatic Filariasis, Filariasis in Ghana, and Rapid Assessment Methods in Disease Control.

2. Review of Literature.

2.1 The Epidemiology of Lymphatic Filariasis.

2.1.1 Global Burden and Distribution of the Disease.

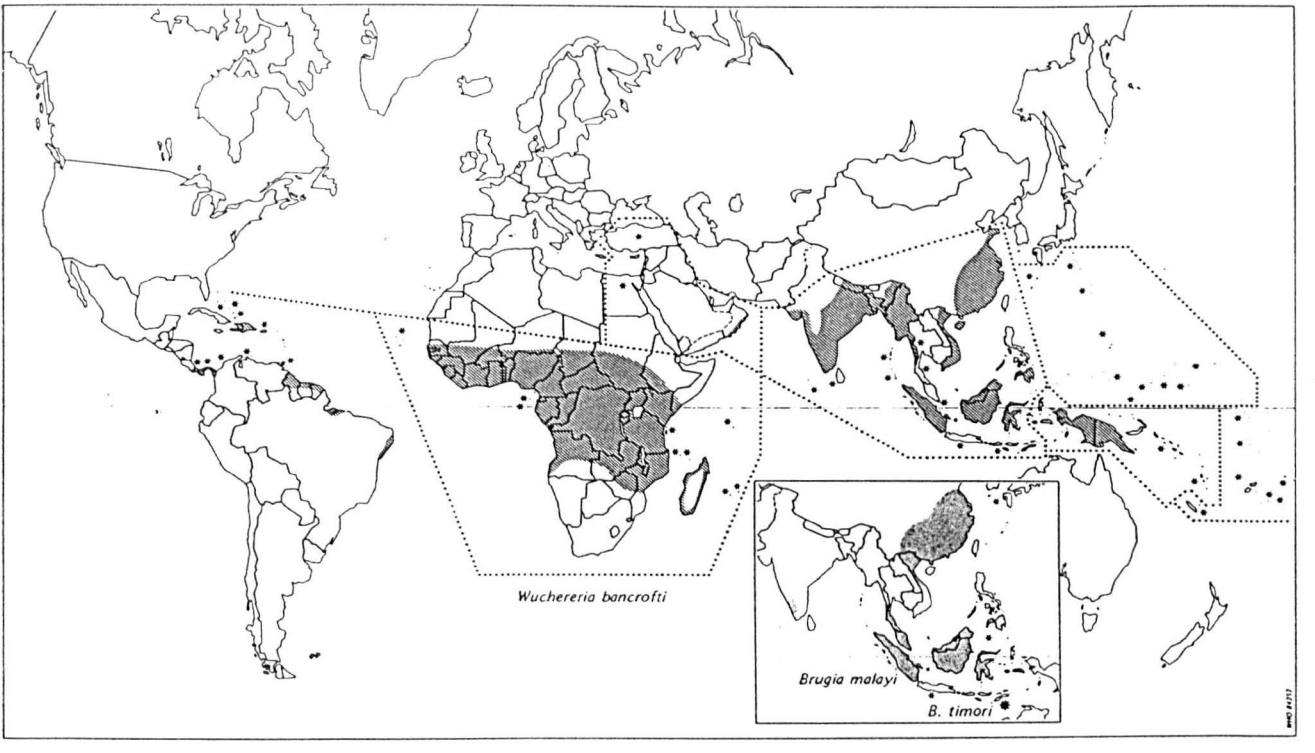
A minimum of 120 million people in 73 endemic countries worldwide are estimated to be infected with filarial parasites (Michael *et al.*, 1996; WHO, 1994). Figure 2.1.1 shows the global distribution of the infection. The most widespread parasite is *Wuchereria bancrofti* which affects about 107 million people in the tropical areas of Africa, India, South-East Asia, the Pacific islands, and South and Central America. Of these, India has by far the largest number of cases. Current estimates shows that India has 45.5 million cases and sub-Saharan Africa 40 million cases. India has a very similar burden of bancroftian infection to that in Africa, but with a slightly lower disease prevalence (Tables 2.1.1 & 2.1.2). The closely related *Brugia malayi* and *B. timori* parasites, which are found only in South-East Asia, affect some 13 million people. In much of Asia, Africa and the Western Pacific, as well as in certain regions of the Americas, lymphatic filariasis persists as a major cause of clinical morbidity and as an impediment to socioeconomic development. It is the world's second leading cause of permanent long-term disability and its prevalence is growing, largely due to the rapid unplanned urbanization in many endemic areas. In spite of the fact that safe and cost-effective methods to control and eliminate the disease are available, not much has been done globally to control the disease (Michael *et al.*, 1996; WHO, 1996b).

2.1.2 The Burden in Africa.

Relatively fewer studies have been done on filariasis in Africa than other endemic areas of the world. Until recently, most of the detailed studies on the prevalence and distribution were reported from East African than the rest of the continent (Hawking, 1977; McMahon *et al.*, 1981a; Wijers and Kinyanjui, 1977), but lately a few other countries have began to report in some detail. It is currently estimated that some 512

million people are at risk of infection in sub-Saharan Africa with about 28 million people already infected. It is also estimated that some 4.6 million cases of lymphoedema and over 10 million cases of hydrocele occur in Africa. These figures represent approximately 40% of the global burden of lymphatic filariasis (Michael *et al.*, 1996; WHO, 1994).

Figure 2.1.1: Global Distribution of Lymphatic Filariasis



Source: WHO, 1984

Table 2.1.1: Global burden of bancroftian filariasis by sex and demographic region.

Condition and Sex	*World*	*Sub-Saharan Africa*	*India*	*China*	*Other Asia and islands*	*Latin America and the Caribbean*	*Middle Eastern Crescent*
Population	4,119.86*	512	850	1,134	793	441	391
Microfilaraemia- males	40.86 (1.95)	14.74 (5.82)	17.00 (3.87)	2.25 (0.39)	6.54 (1.63)	0.19 (0.08)	0.13 (0.06)
Microfilaraemia- females	32.41 (1.60)	13.13 (5.07)	12.46 (3.04)	1.80 (0.33)	4.79 (1.22)	0.13 (0.06)	0.11 (0.06)
Lymphoedema- males	5.36 (0.26)	1.78 (0.68)	2.60 (0.60)	0.06 (0.01)	0.92 (0.23)	0.014 (0.006)	0.027 (0.01)
Lymphoedema- females	7.81 (0.39)	2.86 (1.10)	3.98 (0.97)	0.05 (0.009)	0.87 (0.22)	0.017 (0.008)	0.029 (0.02)
Hydrocele- males	26.79 (1.28)	10.20 (4.03)	12.88 (2.93)	1.68 (0.29)	1.90 (0.48)	0.057 (0.03)	0.06 (0.03)
**Total cases- males	66.65 (1.28)	24.28 (9.60)	29.43 (6.70)	3.62 (0.62)	8.87 (2.21)	0.246 (0.11)	0.207 (0.10)
**Total cases- females	39.54 (1.95)	15.74 (6.08)	16.10 (3.92)	1.84 (0.34)	5.59 (1.42)	0.149 (0.07)	0.135 (0.07)

Upper numbers = cases in millions; Lower numbers (in brackets) = prevalence (%) in region.
*Total population in regions where significant infection exists.
**Number of patients with microfilaraemia alone plus those with overt disease (lymphodema or hydrocele), less those estimated to have both mf and disease.
Source WHO, 1994.

Table 2.1.2: Global burden of bancroftian filariasis by sex and age-group.

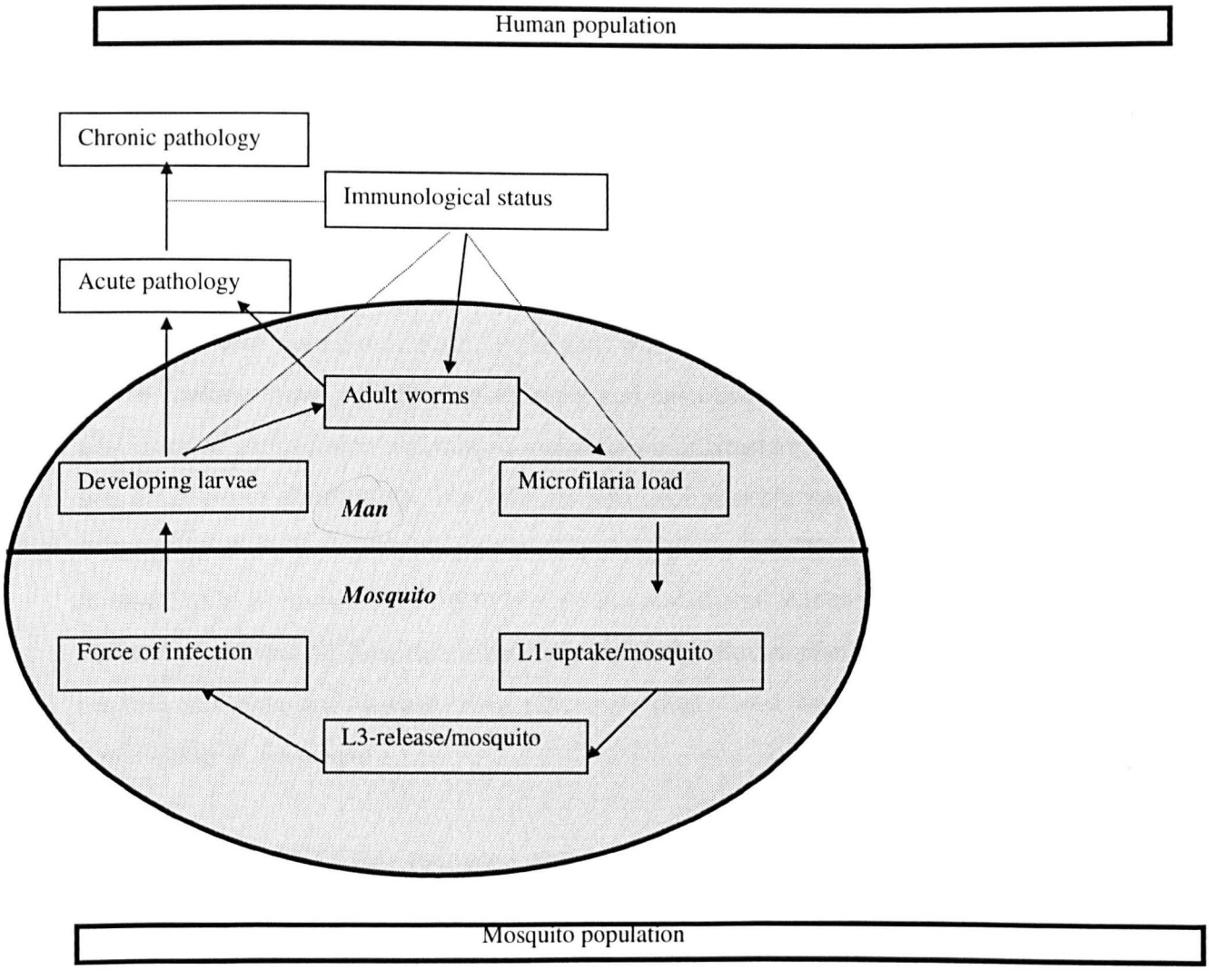
Condition and Sex	*Age group in years*					
	0-4	**5-14**	**15-44**	**45-59**	**60+**	**Total**
Population*	551.89	918.36	1,932.49	432.02	285.10	4,119.86
Microfilaraemia- males	1.44	5.75	24.54	6.15	2.99	40.86
	(0.51)	(1.22)	(2.48)	(2.81)	(2.18)	(1.95)
Microfilaraemia- females	1.21	5.69	18.22	4.55	2.75	32.41
	(0.45)	(1.27)	(1.93)	(2.13)	(1.86)	(1.60)
Lymphoedema- males	0.05	0.28	2.84	1.39	0.79	5.36
	(0.01)	(0.06)	(0.06)	(0.64)	(0.58)	(0.26)
Lymphoedema- females	0.08	0.66	3.61	1.18	1.65	7.81
	(0.03)	(0.15)	(0.38)	(0.85)	(1.11)	(0.39)
Hydrocele- males	0.06	1.82	15.62	5.65	3.64	26.79
	(0.02)	(0.39)	(1.58)	(2.58)	(2.66)	(1.28)

Upper numbers = cases in millions; Lower numbers (in brackets) = prevalence (%) in region.
*Total population in regions where significant infection exists.
Source WHO, 1994.

2.1.3 Cause and Transmission.

Human lymphatic filariasis is caused by *W. bancrofti*, *B. malayi* and *B. timori*, long thin filarial worms, 7-10 cm long that live in lymph channels. Figure 2.1.2 shows an annotated diagram of the life cycle of the parasite and the pathogenesis of the disease. Paired adult worms (macrofilaria) produce millions of larval forms called microfilariae (mf) that circulate in the bloodstream.

Figure 2.1.2: Life cycle of the parasite and the pathogenesis of the disease.



Female mosquitoes taking a blood meal, necessary for egg-laying, ingest the mf from infected individuals. Over a period of about 12 days, the mf progress through several

stages to an infective stage, called the L3, which breaks out of the mosquito mouth parts, escapes, and finds its way into the human bloodstream during another blood meal. The L3 matures into an adult worm within the human host between 3 to 15 months, migrating to the lymphatics, where it pairs with an adult of the opposite sex and initiates a fecund infection with the production of mf. The adult worms may live up to 8 years on the average but there are have been reports of some worms living beyond 20 years (WHO, 1984; 1992; 1996b).

In most places, transmission takes place only in the evening and night time, when the microfilaria are circulating in the peripheral blood and the particular vector mosquitoes are biting, however in other places such as in the Pacific, there is no such nocturnal periodicity (Dennis *et al.*, 1976; Dreyer *et al.*, 1996b; WHO, 1992).

Southgate (1992a), reported on the intensity and efficiency of transmission and the development of microfilaraemia and disease using incidence rates of microfilaraemia calculated from prevalence data, combined with entomological parameters such as vector landing rates, infective larval rates and infective larval densities to estimate efficiency of transmission and related transmission parameters to observed microfilarial and disease prevalence rates. The analysis was done on data published from different endemic areas in the world using reversible catalytic models. He found that much less intense levels of transmission were needed in sub-Saharan Africa than in Asia or the Pacific to establish *W. bancrofti* infections. Similarly, the *Anopheles* species appears to produce infection and disease more efficiently than *Culex* and *Aedes* species when transmitting *W. bancrofti.*

Ramaiah *et al.* (1994), also estimated permissible levels of transmission of bancroftian filariasis based on some entomological and parasitological results of a 5-year vector control programme in Pondicherry, South India. The programme reduced and maintained the transmission of *W. bancrofti* at appreciably low levels in many localities of Pondicherry town, but its impact on overall microfilaraemia prevalence was only limited. However, the prevalence of infection was reduced drastically in children born

after establishment of the programme, and only 18% of the number expected without vector control were found infected. No new infections were found in localities with less transmission intensity. They concluded that a Transmission Intensity Index (TII) of 0.50 and Annual Transmission Potential (ATP) of less than the 96-105 range were permissible levels of transmission, and below these levels no new infections may occur. Also the required duration of vector control to eliminate *Culex*-borne filariasis foci was estimated to be 11-12 years, slightly longer than that required to eradicate *anopheles*-borne filariasis.

Three epidemiologically important categories of relationship between filarial parasites and their mosquito vectors are recognised: proportionality, limitation, and facilitation (Webber, 1991). Proportionality implies that the proportion of microfilariae developing to infective larvae is constant and independent of the number of microfilariae ingested; limitation is the situation where this proportion is reduced as microfilarial intake increases; facilitation occurs when the proportion of ingested microfilariae developing to infective larvae is increased as microfilarial intake increases. The importance of these distinctly different vector-parasite relationships lies in the predicted importance of low-density microfilaraemia in sustaining transmission in various endemic areas with different genera of mosquito vectors. Low density microfilaraemia is the density of circulating microfilaraemia which is not usually detected by the standard survey techniques. It usually occurs after an intervention programme with chemotherapy. This leads to an underestimation of the true prevalence in populations since the presence of microfilaraemia is difficult to detect. Theoretically, low-level proportionality and limitation will increase the probability of transmission and of building up the parasite reservoir when most infected human hosts have low microfilaria densities. Entomological parameters become more reliable than blood survey techniques because the mosquito vector is able to ingest microfilaria at very low levels. *Aedes*, *Culex* and *Mansonia* species do this more efficiently since they exhibit limitation or proportionality, unlike the *Anopheles* species which exhibits facilitation (Bryan and Southgate, 1988a&b; Southgate, 1992b; Webber, 1991).

Zhang *et al.* (1991), also demonstrated in studies in China that long-term surveillance of microfilaria prevalence rates and intensities after control leads to the recognition of critical levels indicating that the interruption of transmission may have occurred, and hence the possibility of relaxing or ceasing active control operations. The critical levels vary with the epidemiological situation and the vector-parasite combination. These critical levels refer to anopheline transmitted filariasis both in China and the Solomon Islands where it was first shown (Webber, 1979, 1991; Webber and Southgate 1981). The use of such indicators could be of great potential importance to other endemic areas of the world, especially Africa where the main vector for transmission is the *Anopheles* mosquito.

2.1.4 The Clinical Spectrum of the Disease.

Clinical disease associated with lymphatic filariasis presents in various ways, depending on the stage of the disease. The most dramatic and obvious manifestation, though afflicting a minority of people infected with the filarial worm is elephantiasis. Other disease states, both acute and chronic such as adenolymphangitis (ADL) and hydrocele affect a much larger percentage of people but lack the drama of elephantiasis. In most endemic communities, disease manifestation begins in late childhood or early adulthood, with acute attacks such as filarial fevers and adenolymphangitis. This usually affects the limbs, the female breasts and male genitalia in which case it may present as an acute epididymo-orchitis. These acute attacks recur at irregular intervals from once a month to less than once a year and may continue to do so often until the end of life. The frequent inflammatory attacks are known to leave some residual swelling over the years, and thus lead to the recognised chronic disease states associated with lymphatic filariasis which are elephantiasis and hydrocele. However, it is also known that within the same population, there are individuals who don't develop obvious chronic disease but may have had a history of long standing recurrent acute attacks (Gyapong JO *et al.*, 1996c; Pani *et al.*, 1995; WHO, 1992).

The exact aetiology of ADLs is still not very clear. There are at least two views of the cause. The first supposes that ADL results from the human immune response to parasite products released by the adult worm or by microfilariae (Addis *et al.,* 1994; Chan *et al.*, 1984; Kar *et al.*, 1993; Ottesen, 1984; Partono, 1987). The second school of thought suggest bacteria as an important factor in precipitating ADL attacks (Dreyer, Personal communication; Gyapong JO *et al.*, 1996c; Rajagopalan, 1990).

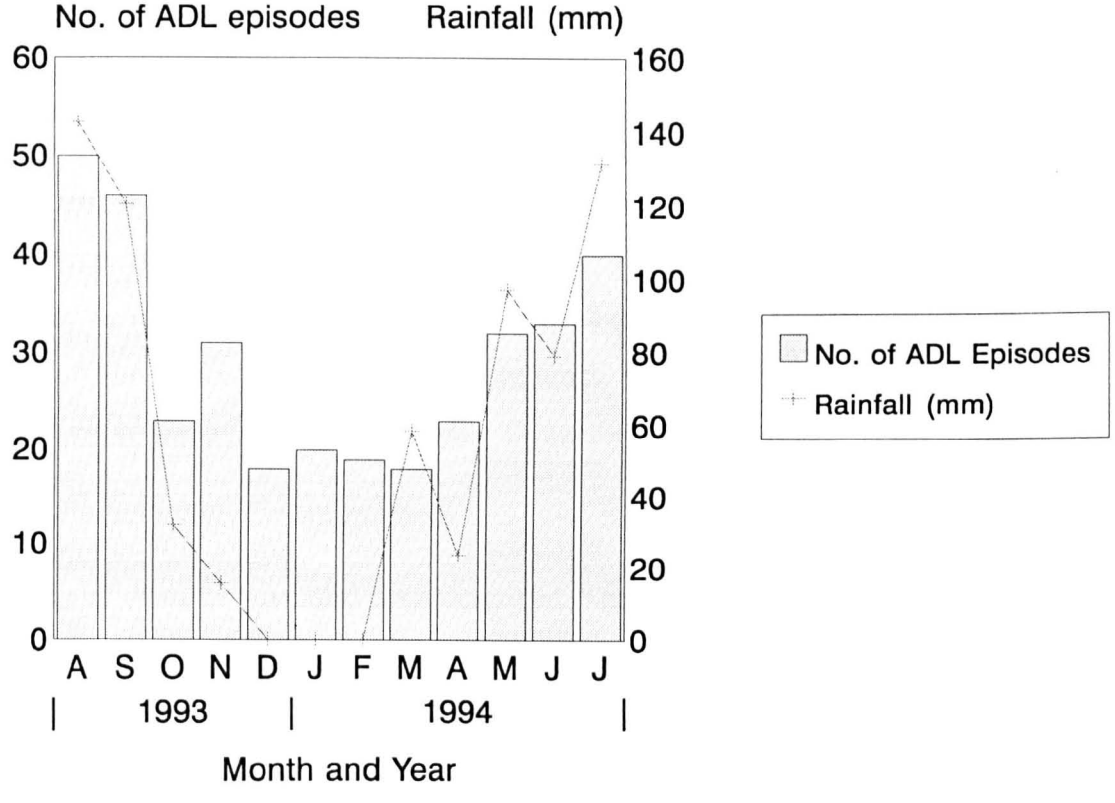
In a recent longitudinal study to investigate the socio-economic impact of lymphatic filariasis in northern Ghana, the incidence, severity and duration of acute adenolymphangitis (ADL) were measured. The incidence of ADL was found to be 95.9 episodes per 1000 per annum among adults 11 years and above, being much higher in females than in males. Among those with elephantiasis and other chronic filarial symptoms, there was no clear relationship between the stage of chronic lymphoedema and the incidence of ADL. The number of episodes per person per year ranged from 1 to 5. The mean duration of an ADL episode was 5.1 days (range 3-11 days) and the mean period of total incapacitation was 3.0 days (range 1-7 days). Over 75% of all ADL episodes occurred in the lower limbs, about half of which occurred in people with pre-existing chronic disease, most of whom had chronic lymphoedema of the leg. This association with chronic disease had earlier been reported in India (Pani *et al.*, 1995; Shenoy *et al.*, 1996).

The incidence of ADL was also found to be closely related to the rainfall pattern, being much higher in the rainy season (Figure 2.1.3). One important finding from this study is the sex differences observed in the occurrence of ADL. This is because there were fewer ADLs episodes associated with existing hydroceles than with elephantiasis, and in this community there are many more women with elephantiasis than men (Gyapong JO *et al.*, 1996c).

In a similar study in using similar methods in Pondicherry, South India, the incidence of ADL was found to be very similar (96.5 per 1000 per annum) except that it was much higher in males than in females and there was no seasonal pattern in the occurrence of

the episodes (Ramaiah *et al.*, 1996b). Similar findings have been found from other geographical areas (Pani *et al.*, 1997).

Figure 2.1.3: Seasonal variation of ADL in northern Ghana.



[From Gyapong JO *et al.*, 1996c]

Elephantiasis usually affects the legs from the hip down and the arm in both males and females. The male genitals (mainly the scrotum but sometimes the penis as well) and the female breasts and genitals (mainly the vulva) are less frequently affected. The importance of hydrocele as a clinical sign was said to be of much more importance in the African region than other parts of the world, but recent available information suggest

that the observed difference was probably an artefact and could have arisen from the use of different measurement criteria (Gyapong *et al.*, 1997).

Tropical Pulmonary Eosinophilia (TPE) is now recognised as one of the clinical syndromes associated with lymphatic filariasis. It may be caused by human or non-human filarial parasites. It is characterised by immunological hyper-responsiveness of the human host to the parasite, especially microfilariae. There is marked increased production of IgE and IgG anti-parasite antibodies and pronounced hyper-eosinophilia. In some areas, it is associated with paroxysmal nocturnal cough, breathlessness and wheezing, occasionally accompanied by radiological evidence of diffuse consolidation. In other areas, it may be associated with lymphadenopathy and splenomegaly. Microfilaria are almost never present in the blood, but remnants of microfilariae surrounded by aggregates of eosinophils, are sometimes found in the reticulo-endothelial system, usually the spleen, liver, lymph nodes or lungs. This syndrome has been found to respond well to diethylcarbamazine citrate (Magnussen *et al.*, 1995; WHO, 1987; 1996).

Renal associated diseases have also been described. These may present as chyluria or haematuria. The pathophysiology is related to blockage of the retroperitoneal lymph nodes below the cisterna chyli with consequent reflux and flow of the intestinal lymph directly into the renal lymphatics, which may rapture and permit flow of chyle into the urinary tract. Chyluria has been commonly reported among East African males suffering from bancroftian filariasis (McMahon *et al.*, 1981a; Wegesa *et al.*, 1979; Wijers, 1977). Haematuria can also be caused by acute glomerulonephritis especially in bancroftian filariasis infection (WHO, 1992). The renal pathology is also known to respond to standard 12-day course DEC treatment (Dreyer *et al.*, 1992).

A review of available data suggests that the prevalence and intensity of infection, and clinical disease are higher in men than in women (Brabin, 1990) but in northern Ghana, the converse has been reported (Gyapong *et al.*, 1994).

2.1.5 Relationship Between Infection and Disease.

Communities within endemic areas differ in the proportion of people who are microfilaraemic, in the mean densities of microfilariae that are detected, and in the prevalence of clinical symptoms, which suggests a difference in the intensity of transmission. In every community where filariasis is endemic, each individual will fall into one of the following categories:

- No microfilaraemia and no evidence of disease,
- Microfilaraemia with no evidence of disease,
- Acute filarial disease with or without microfilaraemia, and
- Chronic filarial disease with or without microfilaraemia and acute attacks.

Bundy *et al.* (1991), showed by modelling the disease through time that there is a sequential progression from infection, microfilaraemia, amicrofilaraemia to chronic obstructive disease in all individuals who experience microfilaraemia and that only the probability of developing microfilaraemia is geographically variable. Another study using data sets from Pondicherry showed similar findings, but since little information is available about the natural history of lymphatic filariasis, there is no conclusive evidence for an inevitable progression from one clinical state to another (Srividya *et al.,* 1991).

A standard tenet in the epidemiology of lymphatic filariasis is that patent infection is negatively related to chronic disease (Bundy *et al.*, 1991; Grenfell and Michael, 1992; Ottesen 1989, 1992). Recently however, there has been increasing evidence to suggest that this negative relationship may not be so. Michael *et al.*, (1994) examined the empirical evidence for this negative relationship by using published data from field studies carried out in a variety of bancroftian filariasis endemic areas. Meta-analysis of the individual study results for each disease category of hydrocele in males only, lymphoedema only, and both conditions combined (total chronic disease) indicated, contrary to expectation, no evidence for a negative association between infection and disease. Indeed, the trend of the empirical evidence was found towards the opposite

direction, with the majority of studies showing equal propensity of disease in microfilaraemics (mf+ves) and amicrofilaraemics (mf-ves), and more studies indicating a positive rather than a negative relation. There was also a trend for more positive studies for hydrocele compared to lymphoedema. Theoretical analysis suggests that between-study differences in blood sample volumes are unlikely to confound this finding. Analysis of between-study heterogeneity suggests that variations in the local incidence or prevalence of infection rather than unique geographical, including vector, differences might underlie the observed between-study variability in the microfilaraemia-disease association. Recent studies in Tanzania also do not support the hypothesis of a general negative relationship between microfilaraemia and chronic disease (especially hydrocele) in bancroftian filariasis (Simonsen *et al.*, 1995).

2.1.6 Immunological Response to Infection.

The basis of the immunological perspective of filarial disease is that differential immune responsiveness among individuals exposed to the infection results in the different clinical manifestations that develop. The mechanisms involved in this differential responsiveness appear to reflect different T-cell cytokine response patterns. Asymptomatic patients with the clinically silent presentation of asymptomatic microfilaraemia, who have previously been described as immuno-suppressed with respect to their generating pro-inflammatory (Th1-type) immune response to parasite antigen, are now recognised to be fully responsive to parasite antigen but to produce cytokines and mediators that have primarily anti-inflammatory (Th2-type) effects.

Studies with immuno-deficient mice indicated the existence of two alternative pathways to the development of lymphatic pathology. The first one is dependent on the induction of inflammatory reactions by host immune response and the other entirely independent of the immune system and reflecting the direct action of the parasite or its products on the lymphatics (Ottesen, 1992). As histopathology of affected individuals is consistent with this hypothesis, it may be that lymphatic pathology seen in amicrofilaraemic, highly

immuno-responsive infected patients derives from inflammation induced by immune responses to parasite antigen, whereas the lymphatic pathology sometimes seen coexisting with immuno-suppressed states of asymptomatic microfilaraemia actually reflects lymphatic damage that is not immunologically mediated.

2.1.7 Diagnosis.

Accurate diagnosis of human filarial infections still remains a problem for clinicians and coordinators of filariasis control programs. It is based on parasitological, histopathological, clinical and immunological approaches. No significant advances have been made for the first three approaches although some refinements in their use and interpretation of results have occurred. For the immunological approach, intradermal tests and antibody detection assays using crude parasite extracts generally lack specificity and/or sensitivity to discriminate between past and present filarial infections in humans. Antigen detection assays would therefore provide a more accurate indication of active filarial infections. Several monoclonal antibodies to various stages of lymphatic filarial parasites have been developed and appear potentially useful for filarial antigen detection.

For an ideal diagnostic procedure, one requires a method which is sensitive enough to detect low density microfilaraemia, accurate in estimating parasite densities, economical, easy to use and above all acceptable to the community. None of the currently available methods satisfy all the criteria so the choice of method largely depends on the circumstances under which one is working, the amount of funding available, and the preference of the investigator.

2.1.7.1 Clinical and Epidemiological Diagnosis.

For clinical and epidemiological studies, the commonly used diagnostic criteria are the presence of microfilariae and clinical disease in the patient or at the community level. The traditional procedures for identifying microfilariae are:

- thick blood film,
- the counting chamber technique,
- membrane filter concentration method,
- Knott's concentration technique, and
- DEC provocation test.

In general capillary blood gives higher counts than venous blood. Dreyer *et al.* (1996b), demonstrated using paired samples taken at the same time from individuals that capillary blood contained about 1.25 times the number of mf present in venous blood, and that 20 µl or 60 µl blood films did not reliably detect carriers with fewer than 100 or 60 mf/ml of venous blood and are thus inadequate for the detection of low density microfilaraemia. If the parasite has been shown to have a nocturnal periodicity in the particular study area as in most place, then night blood samples will be the most ideal. The thick blood films tend to lose a lot of microfilariae during the dehaemoglobinization and washing stage of the staining process (Denham *et al.*, 1971; Abaru & Denham, 1976; McMahon *et al.*, 1979). This can however be overcome by omitting dehaemoglobinization but then identification of microfilariae becomes more difficult. With counting chambers, storage and spillage of samples are the major draw backs. The membrane filtration technique requires relatively larger volumes of blood and as such co-operation from the community is usually low.

Several authors have discussed the relative efficacy of the different method for detecting microfilariae in the blood (Lim *et al.*, 1993; Partono *et al.*, 1973; Wamae, 1994; WHO Expert Committee on Filariasis, 1993). The general conclusion they draw is that, the concentration methods give a higher yield of microfilaria and are therefore recommended especially in monitoring low density microfilaraemia during a control

programme. However, they admit that the blood smears will continue to be the mainstay of large scale field studies for a long time, since it requires a much smaller amount of blood, which is more acceptable to most communities.

Ultrasonographic examination for the identification of adult worms has recently been developed in Recife, Brazil. In this procedure lymphatic dilation and tortuosity are observed in the patients, and these lymphatic vessels, show peculiar aleatory movements (filaria dance sign). A segment of the lymphatic tract containing these mobile intraluminal structures that were resected surgically from the left spermatic cord of one individual confirmed that these structures were living *W. bancrofti* adult worms two females and one male (Amaral *et al.*, 1994; Dreyer *et al.*, 1994). In recent times, this diagnostic tool has been used to assess *in vivo* adulticidal efficacy of antifilarial drugs (Dreyer *et al.*, 1995; 1996a).

2.1.7.2 Immunodiagnosis.

Several immunodiagnostic procedures have been developed and tried in the field with various degrees of success. They have been based on detection of the body's serological response to infection or detection of parasite antigen. Monoclonal antibodies selected for stage and species specificity and molecularly defined filarial antigens have been available for some time now but the development of sero-diagnostic assays compatible with field use for lymphatic filariasis are yet to be fully achieved. Some of the factors that have hampered the development of new sero-diagnostic tests for lymphatic filariasis have been partially overcome. The scarcity of parasite materials from species that infect humans has been alleviated by the ability to maintain complete life cycles of several *Brugia* species in small rodents and more recently by the development of genomic and cDNA libraries from different stages of several filarial species that parasitize humans. As a result of this, there are now a number of recombinant filarial antigens available for testing. In a study conducted by Ganayni (1992), crude *W. bancrofti* microfilaria and *Litomosioides carinii* adult cuticular antigens were tried in Enzyme Linked

Immunosorbent Assay (ELISA) and Indirect Haemagglutination Test (IHAT) for immuno-diagnosis of bancroftian filariasis. Both tests gave a higher positive reaction with microfilaraemic, clinical filariasis and endemic normal sera respectively. ELISA using *W. bancrofti* was found to be the most sensitive.

The use of monoclonal antibody-based enzyme immunoassay for detection of filarial antigen in human serum has been shown to be sensitive and specific for active infection with *W. bancrofti* by several groups of scientist (More and Copeman 1990; Turner *et al.*, 1993, Weil *et al.*, 1986). Weil *et al.* (1987), evaluated a monoclonal antibody-based enzyme immunoassay for detecting soluble parasite antigen in sera collected in an area in South India endemic for Wuchereria bancrofti. They detected filarial antigen in sera from 56 of 57 microfilaraemic patients, 9 of 64 amicrofilaraemic patients with clinical filariasis, and 11 of 70 endemic controls. They did not find any antigens in sera from patients from non-endemic areas who had a variety of other filarial and non-filarial helminth infections. Parasite antigen titers were significantly correlated with microfilarial counts in night blood smears (r =0.64, $p<0.01$). They speculated that negative antigen tests in patients with clinical filariasis may be explained in part by antibody-mediated clearance of circulating antigen. Antibodies to circulating *W. bancrofti* antigen were detected in 41 of 55 antigen-negative sera from patients with clinical filariasis. Despite this limitation, detecting parasite antigen by enzyme immunoassay provides significant advantages over previously available methods for diagnosing active *W. bancrofti* infection.

In a follow-up study to assess the feasibility of testing whole blood collected by finger prick in this assay, a preliminary study was performed to compare antigen test results obtained with whole blood, blood dried on filter paper, and serum. Results obtained with anticoagulated whole blood specimens agreed with serum results in 94 of 97 cases. All whole blood and serum specimens from 28 people with positive microfilaria smears were positive in the test. Filter paper blood specimens were less satisfactory because of decreased sensitivity and specificity (Santhanam *et al.*, 1989).

Many more studies have since been reported showing the usefulness and superiority of immuno diagnosis (Faris *et al.*, 1993; Ramzy *et al.*, 1991; Turner *et al.*, 1993, Weil *et al.*, 1996), but all the authors conclude that, until this tool is further developed to become cheaper more and user-friendly under field conditions, it may not have a role in large scale epidemiological surveys in the near future. The Division of Control of Tropical Diseases (CTD) and the Special Programme for Research and Training in Tropical Diseases (TDR) of World Health Organization has therefore been supporting field studies to operationalize this technology since it could be very useful in monitoring control programmes (WHO, 1996b).

2.1.8 Social and Economic Aspects.

The social and economic aspects of the disease are more difficult to assess. The distribution and transmission of the disease are known to be closely related to socio-economic and behavioural factors in endemic populations (Evans *et al.*, 1993; Gyapong M *et al.*, 1996a; Muhondwa, 1983). Urban *W. bancrofti* is related to poor sanitation, which leads to intense breeding of *Culex quinquefasciatus*, the principal vector. Rural strains of *W. bancrofti* are transmitted primarily by *Anopheles* and *Aedes* species. Brugian filariasis is mainly rural and is transmitted by *Mansonia*, *Anopheles* and *Aedes* species mosquitoes (WHO, 1992). A substantial review of the economics of malaria, filariasis and trypanosomiasis by Prescott (1987) cited a few qualitative judgements about the impact of filariasis on production but there is not much data to support these empirical data. In the above review, direct costs were estimated from physician fees, laboratory examinations and treatment costs while indirect estimates were made from loss of working time or inactivity as a result of an acute or chronic filarial disease. In a study conducted in the Philippines, it was found that the economic losses estimated for filariasis were potentiated by the social attitudes towards the disease (WHO, 1992). There have been reports of people being ostracised because of chronic manifestations such as elephantiasis of the leg.

Until recently, very little was known about the social determinants of acceptance or about the cost effectiveness of the alternative options (Evans *et al.*, 1993; Rauyajin *et al.*, 1995). In order to design cost effective and acceptable interventions for the control of filariasis, the WHO co-ordinated a multi-country study to evaluate the social and economic impact of lymphatic filariasis with Ghana as one of the sites (Gyapong, 1992). These studies looked in detail at perceptions of the disease, attitudes towards the disease, the community's role in the management of the disease and determinants of the treatment seeking behaviour, in order to design the most cost effective and acceptable control method using both quantitative and qualitative research methods. Results from the Ghana study show that disease is mainly attributed to supernatural and spiritual factors. Similar findings have been reported from South India where only 9.3% of affected people associated the disease with the mosquito vector (Ramaiah *et al.*, 1996a).

Except for a few instances of neglect, the community was generally caring towards people with the disease, on the other hand, people with chronic disease had problems related to marriage, stigma, concealment, and leadership. They have a lesser chance of getting married or, when the disease manifests itself during marriage, it may lead to divorce. Moreover, persons with extremely large legs or hydrocele are not able to work or even take care of themselves. They are a burden on the family and community. The acute clinical episode which may last up to 2 weeks or more with a fulminating episode, usually results in prolonged inability to work (Gyapong M *et al.*, 1996a). As filariasis is more prevalent in rural areas and in the slums of cities, and as it predominantly affects the young and active working section of the population, it can result in significantly decreased productivity of the poorer sectors of the community; those who can least afford it. On the whole, the importance of social and cultural perceptions of a disease and its relevance to control can not be over emphazised.

Despite the large number of people affected, and the gross disfigurement associated with lymphatic filariasis, the disease has not received much attention from health planners in endemic countries. This might be because the disease does not result in obvious mortality, and also because good evidence about the prevalence, distribution, and the

socio-economic impact of the disease has not been widely available. In these studies it was shown that lymphatic filariasis imposes a major burden, both social and economic to materially poor community of subsistent farmers. The study exposed for the first time, some aspects of the disease which hitherto had been underestimated when looking at the social and economic impact of the disease, among which are disability associated with acute adenolymphangitis (ADL), and the indirect economic loss through inactivity. In subsistent farming communities where there is only one raining/ farming season, total incapacitation during such a period means inability to grow food for the entire family for the whole year. These statistics become reality when one takes a walk through some of the endemic communities to see patients who have become totally incapacitated as a result of an ADL episode and all his/her economic activity comes to a stand-still (Gyapong JO *et al.*, 1996d).

Disability associated with obvious chronic manifestations does not appear to be as debilitating when compared with the ADLs on a daily basis, because of coping mechanisms adopted by the affected people. Most of the people with elephantiasis, work for frequent shorter hours with long hours of break on their farms, however their output is not as good as the non-affected people. Some however take up relatively sedentary jobs like basket weaving when the elephantiasis or hydrocele totally impede their farming activities, or in the very advanced state, they are just confined to their homes. A much higher proportion of chronic patients reported being able to perform their normal activities compared to ADL on a daily basis, plausibly due to their acquired coping ability with the disease (Gyapong JO *et al.*, 1996d; Muhondwa, 1983). In South India, it has also been shown that the productivity of males with chronic filariasis can be reduced by as much as 27.4% in the cloth weaving industry and thus reduce wage earning capacity (Ramu *et al.*, 1996).

The direct cost for treating lymphatic filariasis in most communities is relatively very low. Very few people travel to seek treatment for their condition. This is mainly due to local concepts on the perceived cause of the disease and treatment seeking behaviour (Gyapong M *et al.*, 1996a; Ramaiah *et al.*, 1996a). In typically traditional society, most

people rely on traditional healers and soothsayers for treatment. Even when data on all payments made in kind are collected and costed, in most instances, it is not possible to put value to the medicines. Secondly because of the extended family system most people have free access to the expertise of the traditional healers who are relatives. For hydroceles, most people know of the availability of corrective surgical procedures but cost is usually a major deterrent to use of such facilities.

2.2 Control of Lymphatic Filariasis.

Lymphatic filariasis has been identified by the International Task Force for Disease Eradication as one of the world's six "eradicable" or "potentially eradicable" infectious diseases. This recognizes that appropriate interventions can be effectively linked with pre-existing national and local public health infrastructures to promote chemotherapy programmes and vector control activities (CDC, 1993). The large endemic areas in the Pacific, Caribbean, China and Southeast Asia are under reasonable control while in much of India, Africa, Papua New Guinea and other smaller areas, transmission continues virtually unhindered and disease rates remain high (WHO, 1992). There are two general strategies to reduce transmission of filarial infection. These are:

- Treatment of Human Populations and
- Vector Control

The main advantages of these strategies are that, they can be easily integrated into pre-existing control programmes aimed at other public health problems like onchocerciasis and intestinal parasites. For countries with existing programmes, reallocation of resources to these new approaches can lead to greater population coverage and cost effectiveness; a particularly important factor given the low priority often accorded filariasis by health authorities. Where there are no programmes as yet, costs for filariasis control will be more justifiable if it is integrated into other health care delivery packages. Treatment with ivermectin, for example, will offer the additional benefits of acting on other helminth and ecto-parasites as well (WHO, 1996b).

2.2.1 Treatment of the Human Population.

The World health Organization currently recommends that mass distribution programmes should completely replace programmes based on selective treatment; that is treating only microfilaraemics who have been detected (Ottesen and Ramachandran, 1995; WHO, 1996b). Diethylcarbamazine (DEC) continue to remain the mainstay of treatment in most endemic countries, its use is however limited in onchocerciasis endemic communities due to the severe adverse reactions it causes under such circumstances. The drug ivermectin, which has proven highly successful in treating onchocerciasis, is expected to be approved for use against lymphatic filariasis as well, since several studies have shown it to be equally effective (Cao *et al.*, 1997; Cartel *et al.*, 1992; Chodakewitz, 1995; Eberhard *et al.*, 1992; Nguyen *et al.*, 1994). The WHO (1996b), recommends the following regimens for mass treatment:

- Ivermectin (400 μg/kg) plus DEC (6 mg/kg): Optimal single-dose regimen; results in 99% reduction of microfilaraemia even after one year.
- Ivermectin alone (400 μg/kg): For use where onchocerciasis or loasis coexists; results in 90% decrease of microfilaraemia even after one year.
- DEC alone (6 mg/kg): For use if ivermectin is not available; results in 90% decrease of microfilaraemia even after one year.
- DEC-fortified salt: Used daily as a substitute for regular table/cooking salt for 9-12 months; results in 99% decrease of microfilaraemia for more than one year after use has stopped.

2.2.2 Vector Control.

In certain places, reducing mosquito populations has played an effective support role and can be an important factor in achieving long-term interruption of transmission. Improved techniques are now available for enhancing the effectiveness of vector control, such as bednets and curtains impregnated with insecticides, long-lasting indoor sprays, and community participation in vector management. It is recommended that

control should not be based on vector reduction alone, but must be used only as a supplement for treatment programmes. Use of these and other techniques has enabled the elimination of lymphatic filariasis in Japan, Taiwan and South Korea. China is now in the final stages of an exceptionally effective control programme, having seen a dramatic reduction in infection levels during the past decade (WHO, 1996b).

2.3 Filariasis in West Africa.

W. bancrofti infection is widespread in West Africa and constitutes a serious health hazard. The principal endemic foci are spread along the Gulf of Guinea, in some inland regions and in the northern savannah. To date, the microfilariae are all known to be nocturnally periodic. The parasite is a type more adapted for developing in anopheline vectors but less so in *Culex* species (Hawking, 1977). Pfister (1954), examined the blood (daytime) of 10,169 adult Africans in various parts of French West Africa. He found that about 4% of these soldiers carriers of *W. bancrofti* microfilaria. Those from the forest zone had the lowest prevalence of filarial infections, and those in the savannah frequently harboured one or more filariae, but were generally healthy in appearance.

Brengues & Gidel (1973) classified the land of western Africa into seven zones according to climatic features, and discussed their relationship to the epidemiology of bancroftian filariasis. Zone A is situated north of the region where only *An. gambiae* is present. This species is quite localised and very rare because the annual rainfall is less than 300 mm. The daily temperature exceeds 30°C, which is over the range of normal development of filarial larvae in the vectors. In this region, bancroftian filariasis is practically absent.

Zone B is within the northern border of the region where *An. gambiae s.l* and *An. funestus* coexist, but the annual precipitation is less than 500 mm and is restricted to the months of July, August and September. The temperature often exceeds 30°C throughout

the year. Therefore, transmission can take place only during a short period, and endemic foci of filariasis occur only in certain restricted areas.

Zone C is the region with annual rainfall between 500 and 750 mm, distributed over the months of June, July, August, and September. The average temperature is at least 1°C lower than in Zone B. Endemic foci of bancroftian filariasis are scattered and isolated from each other, occurring especially in areas where the population is gathered and fixed in the vicinity of important water sources, as in Dori (Burkina Faso) and Niono (Mali). Similar foci probably exist in the regions of Yelimane (Mali) and Kaya (Burkina Faso). In these endemic foci, the incidence of clinical cases is usually low.

Zone D includes the whole savannah region, where the annual rainfall exceeds 750 mm and the temperature is between 25°C and 28°C. This zone is most favourable for filarial transmission, the vectors are abundant throughout, and there are many endemic foci of filariasis.

Zone E corresponds to the region of tropical rain forest. The population density of both *An. gambiae* (species A) and *An. funestus* is much lower than in the savannah, and the human population density is also very low. Therefore, filariasis is rare, except for certain areas in the valleys of large rivers where the people are gathered for cultivation, and many breeding places for the vectors are formed on the river bed after the high water subsides.

Zone F is the highland region with an altitude between 500 m and 1,000 m surrounding the four large mountains: le Fouta Djaloon, les Monts Loma, le Massif de Seredou, and le Mont Mimba. The average temperature is below 25°C, and often goes below 20°C in the winter season. The development of filarial larvae in the vectors is greatly retarded or completely stopped under these conditions, even though the vector population may be high. Filariasis is almost non-existent in this zone.

Zone G represents the coastal region, where the rainfall exceeds 750 mm, often over 1,500 mm per annum. The temperature rarely exceeds 30°C, and usually stays between 26 and 27°C. There exist two species of the *An. gambiae* complex, namely *An. gambiae* A, whose larvae develop in fresh water, and *An. melas*, whose larvae develop in brackish water. Both serve as excellent vectors of *W. bancrofti* (Gelfand 1955), and although the two species appear throughout the year, *An. melas* predominates during the dry season and *An. gambiae* A does so during the rainy season. The zone is very favourable for the transmission of *W. bancrofti*, and there are many endemic foci of bancroftian filariasis.

According to Brengue and Gidel (1973), the incidence of bancroftian filariasis varies greatly according to these zones and to the countries in western Africa. They suggested, based on the geographical distribution of the vectors and parasite described above, that there were probably no endemic foci in Mauritania and very few, if any, in Niger. The Gambia, Guinea Bissau, the southern regions of Senegal and Mali, the western and the eastern parts of Guinea, the north-west of Sierra Leone, the centre and south of Burkina Faso, the north of Ivory Coast, the north, centre and south-west of Ghana, Dahomey and Togo, and the centre of Nigeria, could have some filariasis but the extent of the problem was not well known. Foci could possibly exist in certain coastal regions of these countries. In the forest zone of Sierra Leone, Liberia, Ivory Coast, and Nigeria, the foci may also be present, but they were probably rare and only localised.

2.4 Filariasis in Ghana.

2.4.1 Introduction.

In Ghana, very little work on lymphatic filariasis has been done and documented until recently. Clinical reports indicated that elephantiasis of the leg and hydroceles were very common, at least in some areas of the country, especially in the northern regions and the western part of the coastal belt. The Gold Coast Medical Reports even indicate that as

early as 1936 there was a suspicion of filariasis being a big problem in the northern sector of the country (Gold Coast Medical Department 1937). It is stated in this report that:

> *"Filariasis is moderately common and is widespread but it has not attracted much attention. It is said to be especially common at Navrongo in the northern territories. During 1936 and 1937, out of 55,000 inhabitants admitted to hospital in the whole territory, there were 147 cases admitted for hydrocele and 134 cases admitted for elephantiasis; the true frequency of these condition is probably higher than this".*

The management of hydroceles in the hospitals has been hydrocelectomies, while elephantiasis is managed with antibiotics and analgesics when there is a super-infection or an acute-on-chronic adenolymphangitis. These were anecdotal reports based only on clinical cases and no epidemiological and parasitological studies were done in the area until recently. In fact, it was not known whether the elephantiasis was due to lymphatic filariasis or podoconiosis, since soil maps show high amounts of laterite throughout substantial parts of northern Ghana.

2.4.2 Filariasis in Northern Ghana.

The first qualitative, population-based survey of elephantiasis of the leg in northern Ghana was carried within the Ghana Vitamin A Supplementation Trials' Survival Study which had a demographic surveillance system. This was a cross-sectional survey in January to April 1990 in which 5846 compounds (extended families) were visited by trained field workers. 735 (12.6%) of the compounds had at least one resident compound member with visible or reported elephantiasis of the leg (Gyapong *et al.*, 1995). This study was initiated at the request of the Regional Health Administration because of a simple observation of cases of leg elephantiasis in the market places and

also because hydrocelectomies accounted for more than 20% of all surgery done in the district hospital.

As a follow up to this, two community-based filariasis prevalence surveys were conducted in the district. In the first survey, conducted by the Ministry of Health, 531 people above the age of ten were clinically examined and blood was taken for thick blood smears between 2100-0200hrs. All the blood slides were dehemoglobinized, stained with Geimsa, and examined. The results showed an average microfilaria prevalence of 41.1%. The only species identified was *W. bancrofti.* Elephantiasis of the leg was found in 3.6% of the examined population and hydroceles were found in 30.8% of the males (Gyapong *et al.*, 1993). The second survey, also conducted by the Ministry of Health in collaboration with the Danish Bilharziasis Laboratory, revealed similar findings even after including all ages. This study examined 100 µl of night blood in 1754 people using the counting chamber technique. The overall microfilaria prevalence was 32.4% with a geometric mean density of 794 mf/ml for infected persons. Elephantiasis occurred in 4.6% of the study population and 32.2% of males had hydroceles (Gyapong *et al.*, 1994).

Detailed studies on the socio-economic impact of the disease have also been done in this same region of the country as part of a WHO initiative. These studies actually played a key role in unravelling the burden of filariasis in rural communities especially in terms of:

- the prevalence of chronic disease and incidence of acute episodic attacks (Gyapong JO *et al.*, 1996c);
- the social problems such as marriage, stigma, concealment, and leadership (Gyapong M *et al.*, 1996a); and
- the economic cost reflected in direct costs of treatment and indirect costs resulting from incapacitation (Gyapong JO *et al.*, 1996d).

2.4.3 Filariasis in Southern Ghana.

Muirhead-Thomson (1954), observed that in villages outside of Accra, 9 out of 28 adults were carrying *W. bancrofti* microfilariae, and 4% of wild *An. gambiae* and 1.7% of wild *An. funestus* contained mature larvae.

In the western region of the country, as a result of recent press reports of elephantiasis in the Ahanta west district, a team was sent to collect baseline data and identify the vector responsible for the transmission of the disease. Standard light trap and pyrethrum spray catch methods were used to collect the mosquitoes which were later dissected to identify infective larvae of the parasite. A larval survey was also done to find out the breeding sites of mosquitoes. The main vector found were *Anopheles gambiae* and *An. melas*, the salt-water breeding *Anopheles* mosquito and the only parasite identified was *W. bancrofti* (Aba Baffoe-Wilmot, personal communication). Parasitological surveys using night blood showed a microfilaraemia prevalence of 10% in the 15 sampled villages. Clinical examinations in the same communities showed leg elephantiasis prevalence of 5.2% and a hydrocele prevalence of 17% among males (Regional Director of Health Service, Western Region, 1993).

As a follow-up to this, Dunyo *et al.* (1996), also conducted some detailed clinical, parasitological and entomological studies along the coast of Ghana. The studies were done in 9 communities. They found no infection in communities to the east of Accra. However, *W. bancrofti* mf were common in communities along the coast, west of Accra with prevalences of 9.2-25.4%, and the geometric mean intensity of infection ranging from 321 to 1172 mf/ml of blood. Disease prevalence was also very high in the infected communities. The prevalence of hydrocele ranged from 8.5 to 27.9% and prevalence of elephantiasis was between 5.6 and 6.6%. *Anopheles* mosquitoes (*An. gambiae s.l.*, *An. funestus* and *An. Melas*) were the main vectors identified.

2.4.4 The Importance of Filariasis on the National Health Agenda.

Until now, filariasis has not been a disease of priority in the country. This is changing however, and the results of the studies in the Upper East Region and in the Western Region have meant that more attention is being paid to the disease. The Ministry of Health in Ghana has certain criteria which determines whether a disease should be considered important enough to be on the national health agenda. Apart from the political will, the main deciding factors include:

- the level of morbidity or mortality due to the disease,
- the degree of disability due to the disease,
- the socio-economic impact of the disease,
- the availability and feasibility of a control strategy to be embarked on, and
- the cost effectiveness of the intervention programme for the disease.

In 1994, as a culmination of the factors discussed above, a national survey was organized to provide information as a basis for designing a national control programme.

2.4.4.1 National Filariasis Survey.

This survey was done by tagging it onto an ongoing survey looking at the health needs of children aged 5-14 years (Adjei *et al.*, 1995). The main objective was to document the extent of the distribution of lymphatic filariasis as a basis for planning a control programme in Ghana. A three-stage sampling methodology was used to randomly sample all the 10 regions of the country. The sample was weighted according to the rural-urban distribution of the total population (Gyapong JO *et al.*, 1996b).

From the listing of selected households, all residents aged 10 years and above were interviewed and examined by a public health nurse for the study. The data collected include:

- History of acute adenolymphangitis in the preceding two weeks.
- Presence or absence of clinical disease such as:
    - elephantiasis of the limbs,

- hydrocele,
- elephantiasis of scrotum, and
- elephantiasis of breasts.

- Examination of night blood for microfilaria.

In all there were a total of 3,779 respondents, 44.2% of whom were males and 55.8% females. The national prevalence of microfilaraemia was 3.0% (95% CI 2.5-3.5%) with a regional variation of between 0.0% in Brong Ahafo and Greater Accra Regions to 20.0% in the Upper West Region. Even within the regions there was variation in the prevalence of parasitaemia. The two week period prevalence of acute adenolymphangitis (ADL) was 5.5% (95% CI 4.8-6.2%) with a range of 1.3% (Ashanti Region) to 19.7% (Brong Ahafo Region). There was a trend of increasing prevalence from the 10-19 years age group (3.8%) to the 60+ age group (9.7%) [χ^2 trend = 21, $p<0.001$]. The main symptoms associated with the ADL were pain 85.2%, tenderness 27.1% and total loss of function 16.3%.

The prevalence of reported elephantiasis was 0.6% (95% CI 0.3-0.9%) with a range of 0.0%-1.5%. The findings from the clinical examination however, revealed many more people with elephantiasis, a prevalence of 2.1% (95% CI 1.6-2.6%) ranging from 0.0% to 11.8% in the Upper East Region. The prevalence increased with increasing age [χ^2 trend = 41, $p<0.001$]. 2.1% of the females had chronic lymphoedema of the breast (95% CI 1-5-2.7%), with a range of 0.6% in the Brong Ahafo Region to 6.6% in the Upper East Region. This prevalence increased with increasing age [χ^2 trend = 8.7, $p=0.03$]

The prevalence of hydrocele among males was 5.5% (95% CI 4.3-6.7%) ranging from 0.0% in the Brong Ahafo Region to 19.5% in the Upper East Region. There was an increase in prevalence from 4.2% in the 10-19 age group to 7.1 in the 60+ age group. This trend was however not statistically significant [χ^2 trend = 2.6, $p=0.11$].

The prevalence of infection was statistically much higher in males than in females, but the prevalence of elephantiasis was higher in females than in males, although not statistically significant. When hydroceles which occur differentially in males is added, then males have more disease than females. Educational status was an important determinant of infection and disease status.

Though the sampling procedure used for the survey was not the most appropriate for a disease which has been shown to a have a focal distribution, it was evident from the findings that lymphatic filariasis is a problem at least in the coastal savannah and the northern Guinea savannah (Gyapong JO *et al.*, 1996b).

2.5 Rapid Assessment Procedures (RAP).

2.5.1 Introduction.

Extremely important advances have been made in the diagnosis and management of communicable diseases. Novel serological tests, the development of simple field tests in parasitology and serology and the application of gene probes, have substantially improved clinical and community diagnosis. There is however the need to strengthen the application of tools which will give health managers timely and accurate information to make decisions on launching, monitoring and evaluating disease control programmes. This is because, many of the established health information systems are cumbersome for health personnel and as a result they are hardly utilised. The use of information in the health services, the traditional methods of obtaining epidemiological, sociological and anthropological data are often beyond the resources of most Ministries of Health. This highlights the potential role of rapid assessment methods in improving the community effectiveness and sustainability of health interventions (Vlassoff and Tanner 1992). They can provide information for all aspects of categories of data required in health care and service management, notably:

- Health status - frequency, distribution, causes/determinants of morbidity and mortality;
- Health impact - efficacy and effectiveness of policies, strategies and programmes;
- Health service - availability, supply, utilization and cost of services; and
- Health behaviour - health seeking and risk taking behaviour of individuals and communities, determinants of behaviour, need and demand patterns.

2.5.2 The Evolution of Rapid Assessment Methods.

The development of rapid assessment methods evolved in response to a sense of urgency for social science input in disease control programmes and the growth of interaction between programme managers and the scientific research community in an attempt to bridge the existing gap between them (Manderson and Aaby 1992b). They identified four methods which have been used so far in collecting health related information. These are:

- Knowledge Attitude and Practice (KAP) Surveys,
- Community Diagnosis,
- Rapid Anthropological/Ethnological Methods, and
- Rapid Epidemiological Assessment (REA) Methods.

2.5.2.1 Knowledge Attitude and Practice (KAP) Surveys.

Knowledge Attitude and Practice (KAP) surveys have been popular over the past two decades within family planning and related demographic, and more recently epidemiological research in gathering social data for large, statistically representative populations. Although not designed initially as a rapid assessment tool, it has been the sole tool for gathering information regarding knowledge, beliefs, attitudes, opinions, and reported behaviour and practices relatively rapidly. Despite the limitations of KAPs in generating reliable data on behaviour and attitudes as elucidated by population

researchers and others, this has remained the major technique used in health related research to collect social data (Bleek 1987; Stone and Campbell 1984; Vlassoff and Vlassoff 1978). In spite of this, they are efficient and appropriate in collecting sociological variables such as income, educational status, and occupation.

2.5.2.2 Community Diagnosis.

The concept of community diagnosis was developed in response to the inadequacies of KAPs in generating valid and appropriate social information for development of health programmes (Nitcher, 1984). Community diagnosis emphazises the participatory nature of the research, and hence the use of local assistants to help researchers in gathering data; the maintenance of a flexible design in order to take advantage of serendipitous information for further enquiry; and a mix of qualitative and quantitative methods, primarily in-depth interviewing and surveys. The scope and sequence of participatory research flow from local notions of propriety and lay reasoning patterns in order to be meaningful and evoke community interest. This builds a capacity to transfer skills to develop a core of para-professional workers and generate data that both responds to the needs of health planners while avoiding being structured by those needs.

2.5.2.3 Rapid Anthropological/Ethnological Methods.

This method provides more rapid anthropological data for use in health research than standard techniques which are both time consuming and require expensive field investigations. The methods isolate specific behavioural and cultural variables of relevance to the research topic, which because of the nature of culture, are presumed to be generalizable across a wider population base. They use people with high technical competence, and for this reason, are not able to cover a big enough sample. The issue of how representative these findings are continues to be debated in the literature (Manderson and Aaby 1992a).

2.5.2.4 Rapid Epidemiological Assessment (REA) Method.

In 1981, the US National Board of Sciences Advisory Committee on Health, Biomedical Research and Development (ACHBRD), a joint committee established by The Board of Science and Technology for International Development (BOSTID), and the Institute of Medicine identified Rapid Epidemiological Assessment (REA) as an area that could improve health in developing countries. The term Rapid Epidemiological Assessment (REA) was coined by the committee for this new area of methodological research. REA was conceived as a means of providing health information more rapidly, simply and at a less cost than the standard collection methods, and yet still yielding reliable results (Selwyn *et al.*, 1987). This is because they identified the need for the science of epidemiology in playing a major role in the planning and delivery of health care services, but acknowledged that the standard epidemiological techniques may not always be appropriate in developing countries. REA began as an amalgam of concepts and techniques borrowed from the fields of health services research and operations research as well as traditional epidemiology. It was largely inspired by the 'quick and dirty' methods of epidemiology utilised for disease outbreaks (Smith, 1989).

One area identified by ACHBRD was the need for further work with some of the new epidemiological sampling techniques and methods used in the Expanded Programme of Immunization (EPI). Epidemiological sampling and surveillance methods developed during the smallpox eradication programme and the WHO-EPI programme provided models for the use of innovative techniques for gathering health information which improved health (Cutts, 1988; Henderson and Sundaresan, 1982; Rothenberg *et al.*, 1985). The standard formula applied particularly to assess immunization coverage has been the 30 X 7 cluster sampling frame, although subsequently there have been some modifications of this, to for example 30 X 14 (Frerich and Khin, 1989). There has also been other suggested variations, all of which aim at improving the representativeness of the sampling procedure (Brogan *et al.*, 1996; Kok, 1986; Turner *et al.*, 1996). This specification has enabled the rapid generation of relevant and comparable information

for monitoring the WHO-EPI programme. Frerich and Khin (1989), for example, using their modified WHO-EPI sampling frame and lap-top computers, were able to gather and enter data for 417 Burmese children over a period of three and a half days to submit a full report within two weeks. In this study interviewers were provided with four hours training, and over the next four days conducted between 37 and 73 interviews each, visiting 920 households to generate the requisite data. Further to this Frerich (1989), undertook similar rapid evaluation studies (which he prefers to call Rapid Survey Methodology, RSM) in other parts of Burma and Thailand.

2.5.3 Potential Uses of RAP in Tropical Diseases Control.

Vlassoff and Tanner (1992), identified five areas in tropical disease research where rapid assessment could be of considerable use. These are:

- Estimation of Disease Prevalence,
- Estimation of Causes of Death,
- Assessment of High Risk Situations,
- Pre-Intervention Assessments, and
- Monitoring and Surveillance of Disease Control Programmes.

2.5.3.1 Estimation of Disease Prevalence.

Most tropical diseases are prevalent among poor people in rural areas, who usually don't have access to health services. Disease in such populations are therefore under-reported or mis-reported. Malaria for example is very often self-treated even in areas where health facilities exist and can be confused with other causes of fever. Thus depending on the situation, it may either be under-reported or over-reported. Diseases like leprosy and filariasis on the other hand are often under-reported because of fear of stigmatization. Better methods of estimating and monitoring disease prevalence are therefore required, but since large scale epidemiological surveys are expensive and time consuming, rapid assessment methods could fill an important gap in providing such information quickly.

2.5.3.2 Estimation of Causes of Death.

In many developing countries, vital registration on cause of death are incomplete. In as much as morbidity rather than mortality is the main problem associated with diseases like filariasis, leprosy, schistosomiasis, and leishmaniasis; mortality associated with malaria is very important in endemic areas particularly among infants and children. Mortality due to Chagas' disease is also often under-reported and classified as 'sudden cardiac arrest'. Having more reliable estimates of mortality by cause is not only important because current knowledge is poor, but also because it will enable assessment of the impact of interventions such as bednets on malaria mortality, or in the case of Chagas' disease, housing improvements or the use of insecticides in rural areas. If rapid methods for obtaining better estimates of death were available, it could provide a basis for monitoring, assessing and reassessing health needs and priorities on a more regular basis. The recent development and use of verbal autopsies in research settings have been very useful in providing vital information on probable cause of death (Chandramohan *et al.,* 1994; Mirza *et al.,* 1990; Snow *et al.,* 1992). Unfortunately however, the rich experiences from these research settings have not been translated into the health delivery systems of most developing countries.

2.5.3.3 Assessment of High Risk Situations.

In the recent past, attention has been given to preventing, and evaluating epidemics, political strife and natural disasters, but techniques are also required to provide more accurate and timely data on changing morbidity profile for disease control strategies. This requires people who are working in disease control programmes who have a good knowledge of the socio-cultural and ecological characteristics of the population at risk to develop tools which can be applied with more precision and comprehensively both in emergencies and as part of existing services.

2.5.3.4 Pre-Intervention Assessments.

It is now well recognised that the understanding of local conditions, peoples' beliefs, practices and needs is paramount to the success of any intervention programme (Vlassoff, 1979). In the Kassena Nankana district of northern Ghana, a rapid pre-intervention assessment of an insecticide impregnated bednet intervention revealed that, people preferred darker coloured nets to white ones, because the white nets easily became dirty. They would therefore wash the nets as often as they became dirty and thereby wash-out the insecticide impregnated into the nets. This was later found to be crucial for the success of this intervention trial (Gyapong M *et al.*, 1996b). Rapid assessment would therefore be extremely useful in situations where interventions are about to be introduced.

2.5.3.5 Monitoring and Surveillance of Disease Control Programmes.

There is also the need to develop tools that could be used to assess the progress and impact of control programmes. Such a tool would be used to collect relevant information which could be easily analysed to provide up-to-date records of the heath status of the population, the effectiveness of the control activities, particular problems experienced and other relevant issues. In order that such a tool will be of immediate use, it requires the data processing system to be carried out in the field, rather than in an institution which is far away from the site of the control activities.

2.5.4 Some Examples of Rapid Epidemiological Assessments.

2.5.4.1 Rapid Epidemiological Method of Onchocerciasis (REMO).

The distribution of onchocerciasis and the endemicity levels attained are largely determined by ecology and behaviour of the *Simulium* vectors. Of particular importance is the vector's requirement for breeding sites in fast-flowing, relatively unpolluted rivers

and streams. In addition, the vector has an effective flight range, when seeking a blood-meal, which is very unlikely to exceed 15 km and usually, is much less. This means that severely affected communities are almost invariably located with 10 km of a vector breeding site (De Sole *et al.*, 1991). Given these facts, random choice of communities to be surveyed is ineffective and inappropriate. Unless resources are substantial, and many communities are examined, a simple random sample of communities will lead to an inadequate description of the prevalence and distribution of the disease.

In the Rapid Epidemiological Mapping of Onchocerciasis (REMO) method, selection of communities to be surveyed is optimally biased towards those at highest risk with due regard being given to adequate geographical coverage. With the aid of topographical maps, it is possible to identify villages at risk and sample from such a list. The REMO method consists of :

- the division of country into bio-geographical/bio-climatic zones,
- the selection of communities to be surveyed per zone, and
- rapid epidemiological assessment (REA) of endemicity in selected communities (Ngoumou and Walsh, 1993).

Information on bio-geographical/bio-climatic zones is usually available from detailed country atlases or could be deduced from standard ecological and climatological texts. For logistic reasons, the zones are subdivided into sub-zones after exclusion of empty areas which are without significant human population and unsuitable for vectors. Communities at risk are then selected giving priority to the following criteria:

- closeness to river banks,
- closeness to rapids marked on maps,
- "first line" communities *i.e.* without other human settlements between them and the river, and
- isolated communities.

The objective of the REA is to ascertain by a rapid, non-invasive technique, applied to those most at risk, whether onchocerciasis is present in the community, and if so, to obtain a measure of the level of endemicity. This involves selection of 30-50 males over the age of 20 years who have been engaged in rural occupations and been resident in the community for at least 10 years. Males are preferred because they are more likely to be heavily infected than females and are more amenable to examination by palpation. They are then examined systematically for nodules using a standard criteria (Ngoumou and Walsh, 1993). Nodules are chosen because the public health importance of onchocerciasis, both in terms of skin and eye lesions is directly related to the degree of endemicity of infection in a community which is in turn related to the number of nodules. Recording the presence of 'leopard skin', a mottled depigmentation of the shin, has also been used as a rapid diagnostic index for estimating the endemicity of African onchocerciasis (Edungbola *et al.*, 1987).

2.5.4.2 Rapid Epidemiological Assessment (REA) of Leprosy.

Rapid assessment of the prevalence of leprosy has been described by Sundaresan (1992). He suggests that the rapid methods of estimation depend on three types of situations:

- before multi-drug therapy (MDT),
- less than 5 years after MDT, and
- 5 years or more after MDT.

In the first situation, one or more of the following methods are suggested:

- extrapolation from registered cases,
- extrapolation from child prevalence, and
- conducting rapid village surveys.

This involves education of the population on the symptoms of leprosy and the efficacy of modern drugs, followed by asking all with suspected symptoms to report to a central point for examination with the help of key local persons. In situations where MDT has been introduced for 5 years or more, the registered cases plus a small number, depending on local experience seems to be adequate. Where MDT was introduce less

than 5 years before, it is suggested that the prevalence rates be obtained by statistical interpolation drawing on the experience from local areas which have had more than 5 years of MDT.

2.5.4.3 Rapid Epidemiological Assessment of Malaria.

Agyepong *et al.* (1992), produced a manual for the guidelines for the rapid assessment of social, economic and cultural aspects of malaria. This uses mainly anthropological data gathering methods such as focus group discussions, key person interviews, observations and other quantitative methods like questionnaires. Pilot studies in Ghana suggest that the guidelines are very useful.

2.5.4.4 Rapid Epidemiological Assessment of Schistosomiasis.

Lengeler *et al.*, (1991a&b), demonstrated using the "indirect interview approach" that simple, self-administered questionnaires could be distributed through an existing administrative system, and that their diagnostic performance for identifying high risk communities was very good. In this example, two questionnaires investigating the disease perceptions of primary school head teachers and school children were used. This method has since been tried in seven African countries, Cameroon, Congo, Ethiopia, Malawi, Zaire, Zambia and Zimbabwe, through a WHO/TDR initiative, with good results (Lengeler 1992). It makes use of the high correlation between blood in the urine and *Schistosoma haematobium* infection in children.

2.5.4.5 Rapid Epidemiological Assessment of Lymphatic Filariasis.

There is no documentation in the literature of rapid methods for assessing the community burden of lymphatic filariasis. Current literature suggest that most people with the easily identified chronic filarial disease such as elephantiasis or hydrocele are

usually negative for parasitaemia, but no studies have been done to correlate the community prevalence of these conditions and the community microfilaria prevalence. The relationship between the community burden of infection as measured by microfilaria prevalence, and the community burden of disease as measured by the prevalence of episodic adenolymphangitis, lymphoedema or elephantiasis, and hydrocele, was the main subject of investigation in this study.

Chapter Three

The Pilot Study: Objectives, Design, Main Findings, and Conclusions.

3. The Pilot Study.

3.1 Objectives.

The objectives of this phase of the study were:

1. To refine the rapid assessment tools being developed for the community diagnosis of lymphatic filariasis,
2. To test the tools in selected communities in one district, and
3. To validate the tool using existing data from the community.

3.2 Study Design.

One district where some data on filariasis was available, the Ahanta West District, a coastal district in the Western Region of Ghana was selected for this phase of the study. (The study area is described in detail later).

Timing: November 1994 - February 1995

Methods: The study was conducted in two phases.

Phase 1:- Further development of the tool.

Phase 2:- Testing and validation of the tool.

Hypothesis: The main hypothesis that was tested in this phase of the study was that, there would be a reasonably high correlation between the rapid assessment methods described below and the standard night blood smears at the community level.

3.2.1 Phase 1: Developing the instrument.

Based on the initial work done in the Kassena Nankana district, Navrongo, Ghana; an instrument was developed to be used to identify populations at risk (Gyapong, 1994). The main issues looked at were morbidity indicators of lymphatic filariasis in health facilities and the community such as:

- Hydrocelectomy rates in hospitals,
- Elephantiasis or lymphoedema, and hydroceles prevalence, and
- Acute adenolymphangitis period prevalence.

A series of consultations and workshops were organized to improve upon the initial instrument which had been developed in Navrongo (Gyapong, 1994). Participants included, physicians, epidemiologists, entomologists, biologists, social scientists, public health nurses, health educators, and health policy makers. The instruments that were used in this initial work are included in appendix I-IV.

3.2.2 Phase II: Testing and Validation of Instrument.

Data was collected from the following sources using discussion guides and questionnaires as and when appropriate [Appendix I-IV].

3.2.2.1 Qualitative Data (Key Person Interviews and Focus Group Discussions).

Informal discussions were held with community leaders, traditional health providers and key informants. Issues addressed included:

- common diseases of childhood and adulthood,
- the importance of filariasis is to the community as compared to other diseases,
- terms used to describe filarial disease,
- their knowledge of the cause and transmission of filariasis,
- their health seeking practice regarding the disease, and
- their perception of the burden of the disease - distribution, numbers and severity.

Information gathered from these semi-structured interviews were used as a basis for drawing up guidelines for focus group discussions [Appendix I] involving:

- women's groups,
- men's groups, and

- people with chronic disease.

All interviews were recorded onto audio cassettes in the local language, and later transcribed into English. The transcripts were typed onto a word processor and analyzed with Text Base Alpha®, a package for analyzing qualitative data (Tesch, 1989). This was done with the help of a social scientist.

3.2.2.2 Self Administered Questionnaires.

A. District Assemblies: District political assemblies have been established country-wide. They comprise representatives of populations of between two thousand and five thousand people. These representatives usually live in the community and are well known by the entire population and form the basis of local government. Assembly meetings are organized quarterly for about four days during which matters concerning the entire district are discussed. We proposed to use one such session to rapidly assess the prevalence of diseases in the communities they represent using a self-administered questionnaire [Appendix II], however, at the time the work was being done, the assembly was on recess and their next meeting was not due until March. The district director of administration therefore wrote to the representatives of the selected communities to convene a half day meeting for the work to be done. The questionnaire was introduced and explained to the assembly by the District Medical Officer of Health (DMOH), after which they completed them and handed them over to us.

B. School Teachers: All school teachers in the selected communities were served with a questionnaire [Appendix III]. The questionnaires were sent to the district education office for distribution, but in view of an impending meeting of all teachers in the selected communities, the district director of education decided to distribute them at the scheduled meeting. It was filled after the meeting by all participants and given back to the director that very day.

3.2.2.3 Routine Reporting at Health Facilities.

This included data from laboratories, out-patient departments, admission records and surgical operative procedures from health facilities in the catchment area of the district. This was done through interviewing key people in the hospital or health centre, and a review of existing health records [Appendix IV]. The reference period was the preceding twelve months.

3.2.2.4 Examination of Adult Males for Hydroceles.

A random sample of 30-40 adult males above the age of 20 years per community were examined for hydroceles using the EPI cluster sampling technique, but in some communities, it was difficult to keep to the sampling frame since most adult males wanted to be examined. Only men identified by the sampling criteria were however used in the analysis.

3.3 Main Findings.

3.3.1 Qualitative Data (Key Person Interviews and Focus Group Discussions).

3.3.1.1 Illnesses Common Among Children.

The most common illnesses among young children were reported to be fever, measles, diarrhoea and malnutrition. Among children of school age however, blood in the urine and fever topped the list. The ranking of the relative importance of these conditions, however, varied from one community to another.

3.3.1.2 Illnesses Common Among Adults.

The most common illnesses mentioned for adults were again "fever", scrotal swellings (a few people could not differentiate between hydrocele and hernia),

rheumatic pain (low back pain), asthma and elephantiasis. The ranking of these conditions also varied from one community to another. In most communities, even though elephantiasis was mentioned, it usually did not appear in the top three most important diseases they selected for control. In the view of one contributor:

> *"We did not know elephantiasis was such an important disease until a lot of noise was made about it in the media. We have had it for decades and neither our traditional healers nor the western medicine has been helpful. The more you treat it, the worse it becomes. We have therefore accepted it as something from the gods even though it worries us very much".*

3.3.1.3 Causes and Treatment of Elephantiasis of the Leg.

Even though they mentioned that the disease has been with them for a very long time, they admitted that they did not actually know the cause. Participants of the focus group discussions and elders who were interviewed individually said the only thing they knew about the illness is that it starts like a "fever" and painful swelling and after several episodes, the leg does not reduce in size any more. They actually described vividly, the signs of acute adenolymphangitis (ADL), and its progression to chronic lymphoedema. Only one elder mentioned that he has heard that it was caused by mosquito bites. Another said it could be inherited because there is a particular household which has the condition running through the family. Others also speculated that it could be caused by "evil forces".

Treatment in general was hard to come by. Apart from those caused by "evil forces" which could be reversed by "stronger evil forces", most of the traditional and orthodox treatment has not been very useful.

3.3.1.4 Causes and Treatment of Scrotal Swelling (Hydrocele and Hernia).

Most respondents knew that hydroceles and inguinal hernias were different conditions. Hernia, according to them, is caused by persistent hard work and by eating and drinking food and drink which is not good for the body. This usually come from the "stomach" (used loosely for the abdomen), and can become hard and painful from time to time. A hydrocele on the other hand is caused by bad fluid in the body which descends and settles in the scrotum. It believed to be common among people who drank palm wine and the locally distilled gin. There were however a few people who could not distinguish between the two and saw the distinction by their colleagues as an exaggeration. Most participants thought that the painful episodes associated with the hernia could be treated with herbs but, the best treatment is to have an operation.

3.3.2 Self Administered Questionnaires.

A. District Assemblies: There were 8 assembly members who represented the area covering the 17 communities that were studied, one of whom was female. They were able to provide reasonably accurate information on the population of their catchment area, the number of school and other facilities available. On the whole they seemed to have reasonably good information on the population they represented. They also provided reasonable estimates of number of people with elephantiasis when their figures were compared with data available from the district health management team (DHMT) (Table 3.3.1). Reports on hydroceles were grossly under-estimated. Only gross scrotal enlargements were reported.

B. School Teachers: There were 49 school teachers who completed this questionnaire in the 17 communities with an average of about 3 per community. The information provided by the teachers from each community were very similar and comparable in most instances. Difference observed were minor and insignificant. The figures provided in Table 3.3.1 is the mean of the estimates per community. Their estimates of numbers of people affected by elephantiasis was nearer to figures from the DHMT

than those reported by the assembly representatives. Table 3.3.1 shows the comparison between reports of the number of cases of elephantiasis by school teachers, assembly representatives, and the results from a case search by the DHMT. The experience on reports on hydroceles was similar to that of the district assembly representatives. Fifteen out of the 49 school teachers reported ADL among some of their school children. 25 of them responded "Not Known" and 9 said "No". Most of them did not appreciate the concept of ADL.

3.3.3 Routine Reporting at Health Facilities.

There were only two government health facilities within the catchment area of the study population. These were the District Hospital at Dixcove, and a Health Centre at Agona. In the district hospital, out of 8,564 out-patient visits in the 12 months under review, there was no diagnosis as acute adenolymphangitis (ADL), there were 18 cases of lymphoedema or elephantiasis and 42 cases of hydrocele. Of the 3,532 admissions, none was primarily due to elephantiasis nor hydrocele. There had been 27 surgical operations, all of which were done in the first two months of the 12 review period when there was a doctor who could perform these operations at post. The breakdown is shown in Table 3.3.2. No laboratory investigations were done for lymphatic filariasis for the 12 month period.

At the Agona Health Centre, there were 7,379 OPD attendance, out of which 4 were diagnosed as lymphoedema or elephantiasis, with no ADLs nor hydroceles. The centre is run by a medical assistant, a cadre of senior nurses with special training in diagnosis and treatment of common ailments. It has no facilities for laboratory investigations, surgical operations nor admissions, except for the maternity wing which admits women in labour for at most 2 days.

Table 3.3.1: Reported number of elephantiasis cases in various communities by the District Health management Team (DHMT), school teachers, and community representatives.

Town/Village	*Population*	*DHMT report: case search*	*Teachers' estimate*	*Community Rep's estimate*
Upper Dixcove	1,972	7	7	8
Lower Dixcove	2,322	8	7	Too many
Busua	1,488	17	20	Too many
Achowa	501	6	6	8
Achinim	345	4	4	Don't know
Butre	750	12	10	15
Old Akwidaa	1,305	8	7	5
New Akwidaa	865	4	5	Don't know
Cape Three Points	1,289	5	5	5
Asemko	564	4	5	5
Adjoa	1,810	2	1	0
Funkoe	1,465	3	4	2
Aketechi	2,926	9	10	Many
Princess Town	2,980	14	15	Too many
Mpatano	509	4	5	2
Miamia	678	10	7	Many
Agyambra	1,838	3	2	5

Table 3.3.2: Surgical operations performed at Dixcove hospital in the first two months of the review period.

Type of Surgical Operation	*Number of Cases*
Hydrocele only	10
Hernia only	7
Hernia and Hydrocele	4
Obstetrics and Gynaecology	4
Other	2
Total	27

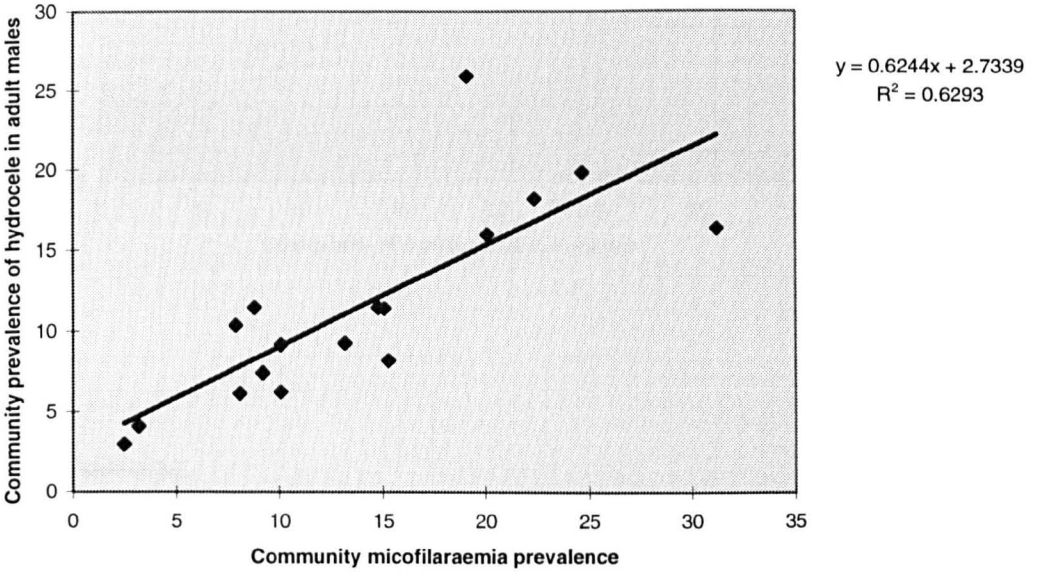
Table 3.3.3: Comparison between community microfilaria prevalence and the prevalence of hydroceles in males aged 20 years and above.

Town/Village	*Community Microfilaria Prevalence*	*Prevalence of Hydrocele amongst adult Males*
A. Upper Dixcove	13.2	9.2
B. Lower Dixcove	15.1	11.3
C. Busua	24.7	19.8
D. Achowa	19.1	25.9
E. Achinim	22.4	18.1
F. Butre	20.1	15.9
G. Old Akwidaa	8.8	11.4
H. New Akwidaa	7.9	10.3
I. Cape Three points	10.1	9.1
J. Asemko	14.8	11.4
K. Adjoa	2.5	3.0
L. Funkoe	8.1	6.1
M. Aketechi	9.2	7.4
N. Princess Town	10.1	6.2
O. Mpatano	15.3	8.1
P. Miamia	31.2	16.4
Q. Agyambra	3.2	4.1

3.3.4 Hydrocele and Microfilaraemia.

The prevalence of hydroceles among adult males (aged 20 years and above) was quite high in most communities, ranging from between 3.0% to 25.9% (Table 3.3.3). Over 50% of them were larger than the size of a tennis ball. Community microfilaria prevalence correlated very well with the prevalence of hydroceles amongst males, with a correlation coefficient *r*, of 0.79 (Figure 3.3.1). The prevalence of hydroceles among adult males in the community, thus gave the most reliable quantitative estimate of community microfilaria prevalence (Gyapong JO *et al.*, 1996a).

Figure 3.3.1 Community microfilaria prevalence Vs prevalence of hydrocele in adult males.

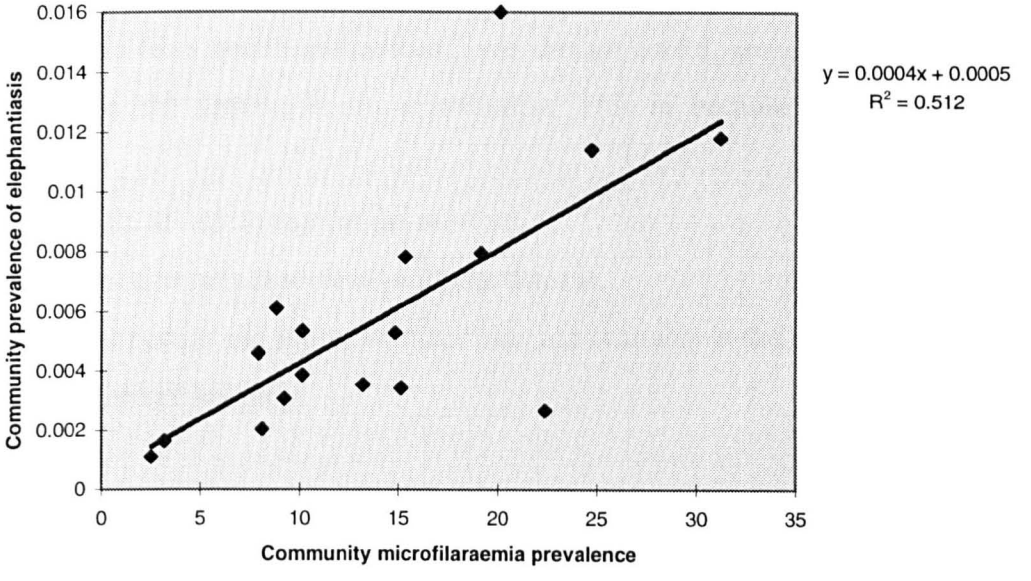


3.3.5 Elephantiasis and Microfilaraemia.

The prevalence of elephantiasis in the communities as reported was lower than expected, given the microfilaria prevalence (Table 3.3.2). It is likely that only gross

cases were included, and that lower grades of lymphoedema were not reported. A similar correlation between community microfilaria prevalence and prevalence of elephantiasis had a correlation coefficient *r*, of 0.71 (Figure 3.3.3).

Figure 3.3.2: Community microfilaria prevalence Vs prevalence of elephantiasis.



3.4 Conclusions.

The findings of this pilot study (Gyapong JO *et al.*, 1996a) suggests that, it was possible to obtain reliable and valid estimates of the burden of lymphatic filariasis at community level using a combination of cheap and non-invasive methods such as:

- key person interviews,
- focus group discussions,
- self-administered questionnaires to teachers and community representatives, and
- examination of a random 30-40 adult males for hydrocele.

In this study, the prevalence of hydroceles amongst males provided the best quantitative estimate of community microfilaria prevalence. Since there was no data on the intensity of infection (geometric mean density of microfilaraemia), it was not possible to compare with the rapid assessment methods. The conclusions have been drawn on the premise that there has been no substantial change in the epidemiology of the infection in the district. This is because there has been no specific intervention programme for the disease to affect the intensity of transmission.

Routine reports from health institutions, even though useful, grossly under estimated the burden on the disease in the community. This is because these reports are influenced by:

- accessibility, ability to pay for the services,
- socio-cultural beliefs associated with the disease,
- technical expertise and laboratory facilities and available at the institution, and
- quality of record keeping.

The experiences from this pilot study were very useful in modifying the tools for testing in the main study which is described in the next chapter.

Chapter Four

The Main Study: The Study Area, Design, Field Operations, Data Management, and Statistical Analysis.

4. The Main Study.

4.1 The Study Areas.

Ghana is situated in West Africa between 5° N and 11° N, bounded on the south by the Gulf of Guinea, on the east by Togo, on the west by Ivory Coast, and on the north by Burkina Faso. It has a land area of 239,000 km^2 and the 1995 projected mid-year population was estimated as 16,631,600 with a growth rate of 3.1%. About 63% of the population live in rural areas and are primarily farmers. It is divided administratively into ten regions and one hundred and ten districts. There are three main ecological zones corresponding roughly to vegetations of coastal savannah, forest and Guinea savannah with gradation between forest and Guinea savannah zones with savannah woodland. The age-sex distribution of the population is that of a typical developing country, with about 47.5% being children under the age of 14 years. The main study was conducted in three different districts within the three different ecological zones (Figure 4.1.1). They were:

- Ahanta West District,
- Winneba District, and
- Bawku East District.

4.1.1 Ahanta West District.

The Ahanta West district is one of eleven administrative districts of the Western Region of Ghana. It is bounded in the north by Wassa West and Mpohor Wassa East districts; in the east by Shama Ahanta East district; in the west by Nzema East district; and in the south by the Gulf of Guinea. It lies in the equatorial rain forest belt, with secondary forest vegetation and primary forest reserve. The main vegetation along the coast is mangrove trees. The coast line is indented with lagoons and major rivers (Butre, Yanney, Howin and Suni), entering the sea. The low lying nature of the coast line, coupled with the characteristic abundance of mangrove trees give rise to stagnant pools and ponds, which facilitate the breeding of the *Anopheles gambiae* and *An.*

melas mosquito. The estimated population of the district is 85,000, most of whom are farmers and fishermen.

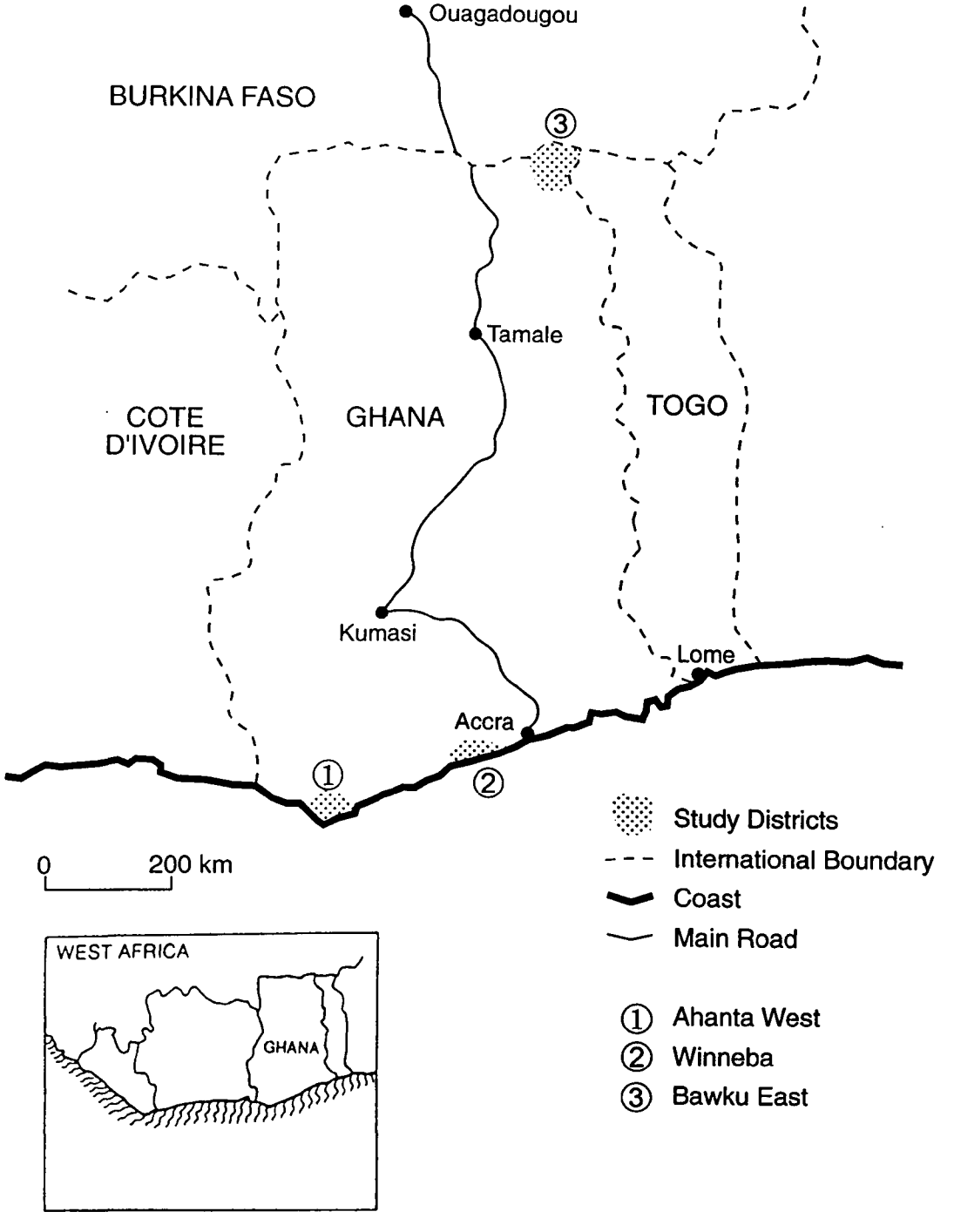
4.1.2 Winneba District.

It is one of twelve districts in the Central Region. Its borders are Gomoa district to the west, Agona district to the north, Ga district (Greater Accra Region) to the east, and the Gulf of Guinea to the south. There are striking differences and similarities between this district and Ahanta West district (described above). The coast line is similarly indented with lagoons and major rivers entering the sea. Some parts of the coast line are also of a low lying nature, with the characteristic abundance of mangrove trees, stagnant pools and ponds, which also facilitate the breeding of the *Anopheles gambiae* and *An. melas* mosquito. Unlike Ahanta West however, the main vegetation in most parts of the district is of the savanna grassland type.

4.1.3 Bawku East District.

Bawku East district is one of six administrative districts of the Upper-East Region. Its borders are Burkina Faso in the north, Bawku West district in the west, Togo in the east and East Mamprusi district in the south . There are 2 main seasons, a wet and dry season. It is in the Guinea savanna woodland area. The wet season is short, with an average rainfall of 850-1000 mm, most of which falls between June and September. The mean monthly maximum temperature ranges from 29^{o}C to 38^{o}C and the minimum 17^{o}C to 27^{o}C. The estimated population of the district is 341,000. The district has several dug-out dams which provide water for drinking and farming during the prolonged dry season but also facilitate mosquito breeding. The people are mainly subsistence farmers who grow cereals for domestic consumption and raise some poultry, sheep, goats and cattle. Over 80 percent of the population are illiterate.

Figure 4.1.1: Map of Ghana showing the three study districts.



4.2 Study Design.

4.2.1 Experimental Design and Methods.

4.2.1.1 Timing.

The study was conducted between June 1995 and August 1996.

4.2.1.2 Objective.

Based on the findings of the pilot study (Gyapong JO *et al.*, 1996a), the objective was to determine the correlation between disease states associated with lymphatic filariasis such as acute adenolymphangitis, elephantiasis and hydroceles, and the standard diagnostic procedures at the community level. This protocol sought to identify any such relationship between measures of infection and measures of disease. It also sought to examine surrogate measures and make use of sentinel populations to achieve its objectives. These measures were validated by comparing the results with the "gold standard" of blood microfilaraemia and with antigenaemia detected by the newly developed Og4C3 assays. The sets of data collected were based on:

- Structured interview of key informants,
- Physical examination of a target population by trained health workers,
- Physical examination of same the individuals by a physician,
- Night blood examination of the same individuals, and
- Filarial antigen assays of the same individuals.

4.2.1.3 Sample Size.

Sample size determination for the various variables described below was based on the formula for population survey to estimate the prevalence of a disease (Lemeshow *et al.*, 1990) given below:

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

where

n = sample size,

Z = number of standard errors away from the mean,

P = estimated prevalence of the condition being investigated, and

D = precision.

4.2.1.3.1 Microfilaraemia Prevalence by Blood Smears and Antigenaemia.

Based on findings from the national survey (Gyapong JO *et al.*, 1996b), the microfilaraemia prevalence was estimated to be 10% in the districts involved in the study, and the worst acceptable results was set at 8%. Using Epi-Info software (Dean *et al.*, 1995) the sample size was estimated to be 863, at 95% confidence interval.

Table 4.2.1: Sample size estimation.

Variable	*Population*	*Estimated Prevalence*	*Worst acceptable Prevalence*	*Confidence Interval*	*Estimated Sample Size*
MF	600,000	10%	8%	95%	863
ADL	600,000	5%	4%	95%	1,819
Elephantiasis	600,000	5%	4%	95%	1,819
Hydrocele	300,000*	10%	8%	95%	862

*This is because hydroceles occur only in males

4.2.1.3.2 Disease Prevalence.

The disease states closely associated with lymphatic filariasis that were investigated are acute adenolymphangitis (ADL), elephantiasis and hydrocele. The required

samples were estimated using similar methods as in the section above. The summary of the sample size requirements is given in Table 4.2.1. Based on these figures and availability of funding, the total sample size was set at 2,000.

4.2.1.4 Sampling.

Based on the results of the national survey (Gyapong JO *et al.,* 1996b), three districts found to have substantial prevalence of filariasis were selected, one each from the three bio-geographical zones of the country. These zones are the southern coastal savannah, the forest and the northern savannah. This is because the density, spatial distribution and host seeking behaviour of the vector, and the physiology of the parasite, could vary in different bio-geographical areas. These factors in turn determine the prevalence, and severity of the disease (Brengue and Gidel, 1973).

Villages with a population of at least 400 residents were identified for the study. Within each district, it was planned to randomly select 10 villages for the study. Thus in all, 30 villages with different endemicity levels ranging from low to high were the units of study. However, due to financial constraints, only 20 villages could be covered, 7 each in the first two districts, and 6 in the last district. The villages used for the pilot study in the Ahanta West district were excluded from the main study.

At the village level, based on the estimated sample size of 2,000, approximately 100 people were covered in the 20 villages. Each village was divided into 4 clusters usually using natural boundaries such as roads or paths. Based on the average household size in the village (estimated from the census data), the number of households to be surveyed was determined and divided among the four clusters after making adjustments for the fact that some people may not be available at the time of the examination. Within each cluster, the specified number of households were then systematically and randomly selected (starting from the chief's house) and informed to attend for examination on a specified day. For example if the average household size

in a village was 4, approximately 7 households per cluster were systematically and randomly selected to achieve the targeted sample of 100.

4.3 Organization of Fieldwork.

4.3.1 Community Entry.

The study was conducted in close collaboration with the District Health Management Teams (DHMT) of the three selected districts. A series of meetings were held at various levels of authority in all three districts to explain the rationale of the study and seek their support. All these meetings were organized through the DHMT. At the village level, the meetings were held in two stages, first with the chief and his elders and opinion leaders, followed by a mini durbar with a cross-section of community members.

4.3.2 Field Operations.

Data collection was done in one district at a time and lasted for approximately three months each. In each district a field office was set up to supervise the implementation of the study. There was usually a team of five people comprising the Principal Investigator (PI), a Laboratory Technician (LT) and a driver who were available for the entire period of the study, and two people from the disease control team of the particular district. The Laboratory technician also doubled-up as the Research Assistant (RA) because of his experience in earlier field studies. Depending on the activities going on, one or two more people were recruited to join the team from the district health service. At the village level two to three people were usually identified by the elders to help with the data collection.

4.3.3 Training of Field Workers.

The training of field staff was the same in all three districts and it usually took about one week. Trainees were taken through:

- the objectives of the study,
- collection of good quality data,
- mapping and census,
- interviewing techniques,
- clinical examinations for elephantiasis and hydrocele, and
- the schedule of field activities such as the night blood surveys, antigen assays and clinical examinations.

4.3.4 Mapping and Census.

Each village was assigned an alphabet letter code. Houses in all 20 villages were mapped and a census conducted. In each village, all houses were serially numbered from 001 to 999 with paint, boldly enough to read from a distance of about 40 meters. At the household level, information was collected on the head of the house, and all resident members were then listed and given identification numbers. This data was processed to generate unique six character identification numbers for all residents in the study area. This ID number was used to trace all participants throughout the study. This is further explained in the section on data management. Information was collected on individuals on various variables such as year of birth, sex, highest educational level attained, marital status, occupation and religion [Appendix V].

4.3.5 Key Informants Interviews.

Based on the experience of the pilot study, it was intended to assess the community prevalence of filarial disease using preferably the indirect interview approach, wherever possible, through existing administrative systems. In cases where there was no reliable

administrative system, it was proposed to use the direct interview, using trained interviewers. However, as we spent approximately two weeks in each village, it was easier to conduct direct interviews in all circumstances. Five persons were selected per village. They were usually:

- the chief or his representative,
- the community representative of the district assembly,
- a local school teacher,
- a traditional health practitioner, and
- a women's group leader.

To avoid biased reporting, the questionnaire did not only focus on filariasis but rather enquired about common disease states that are easily recognised in the area, especially those with locally recognised terminologies. It also included other general questions on the village to test the respondent's knowledge on other common issues in the village [Appendix VI].

4.3.6 Clinical and Laboratory Examinations.

4.3.6.1 Preparation.

Approximately 100 people were examined per village. Depending on the average household size, between 30 and 50 households were randomly selected using the EPI-cluster survey technique for the examinations (Henderson and Sundaresan, 1982). The same individuals who were clinically examined had their blood samples taken for detection of microfilaria and circulating filarial antigen. As we wanted to do both clinical and laboratory examinations concurrently, all examinations were done in the night (between 10.00 p.m. and 2.00 a.m.) because of the nocturnal periodicity of the parasite. A lot of preparatory work had to be done before these examinations. These included:

- pre-selecting the household with the aid of the household database already created,
- informing the selected households,
- identifying suitable sites for the examinations, and

- arranging for all the necessary logistic supplies.

None of the 20 villages had electricity supply. Arrangements therefore had to made for a generator, fuel and a lighting system.

The days of the examinations were fixed in consultation with the DHMT and the community leaders. The community leaders had their own way of disseminating the information to residents, usually through the beating of the *"gong gong"* (drumming). On the days of the examinations the research team arrived in the community during the day to send reminders to the selected households and set up the place for the examinations including the lighting system. It was observed that most people went to bed by 7.30 p.m. in these villages, so in order to keep them awake till 10.00 p.m. the research team in collaboration with the district and regional health education teams showed health educational videos (usually in the local languages), on various health issues such as:

- the importance of immunization of the six major childhood diseases,
- management of diarrhoea,
- malaria control, and
- HIV/AIDS prevention.

Unfortunately there were no documentaries on lymphatic filariasis to show. As it was an unusual occurrence to have video shows in these communities, this activity was useful in keeping community members awake till the examinations were over.

4.3.6.2 Data collection at the Clinic.

Data collection followed the flow chart in Figure 4.3.1. The registration assistant identified the name of the participants in the household database, and issued the permanent identification number (PERMID). He was then sent to the health worker who enquired about:

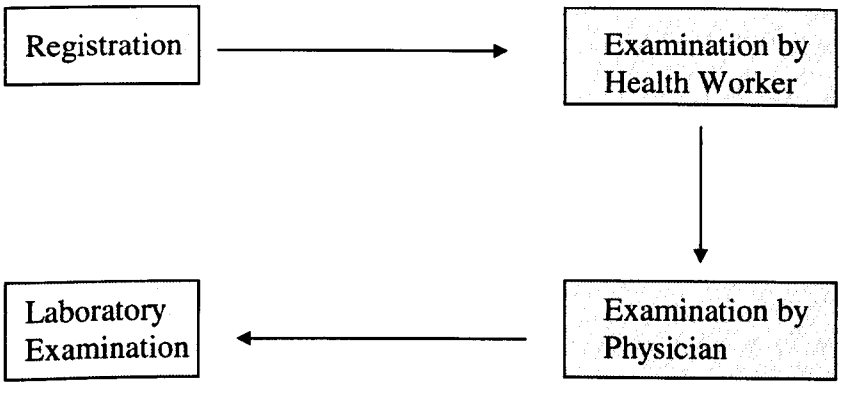
- History of ADL in the last month by use of local terminology, and
- Lymphoedema/elephantiasis in a family member.

He then examined the respondents for:

- Lymphoedema/ elephantiasis of the limbs,
- Hydrocele in males, and
- Breast lymphoedema/ elephantiasis in female

The participant then went to the physician (PI) for a similar history and examination to validate the health workers ability to elicit a good history and signs of chronic filariasis [Appendices VII & VIII].

Figure 4.3.1: Flow Chart for data collection during clinical examination.



From the physician, the participant went to the laboratory where the technician made a thick blood smear from two drops of blood (approximately 20 µl). At the same time, blood was collected onto 6 different spots of a specially designed filter paper for the detection of circulating filarial antigens. All blood slides and filter paper samples were labeled with unique laboratory identification numbers which were recorded on the laboratory form.

At the end of each clinic, forms were checked for completeness and consistency. The completed forms were submitted to the field office at the district capital for further checks.

4.3.6.3 Processing, Storage and Examination of Specimens.

After drying, the blood films were dehaemoglobinized and fixed with methanol. They were usually packed in slide boxes for staining and examination at a later date, using Geimsa stain at pH 7.2. The entire field was examined and all microfilariae counted and recorded.

The filter paper samples were dried for about 12 hours, stored in small self-seal poly bags and stored in a freezer at -4^{0}C up to about one week in the district cold chain system. They were later transported in cold boxes to Accra and stored at -20^{0}C until they were ready to be shipped by courier to the James Cook University's Tropical Biotechnology Pty Ltd., Townsville, Queensland, Australia for analysis for circulating filarial antigens. Details of how specimens were processed are in the Appendix X.

4.3.6.3.1 Quality Control.

An experienced technician from the university who has been working with the PI on filariasis parasitology for the last 5 years was used throughout the study. Approximately 10% of all slides were randomly selected and re-examined blindly by the technician. The PI also examined the same 10%. The results from the quality check readings were processed separately.

4.3.7 Treatment.

For ethical reasons, all the communities were treated by current WHO recommended treatment regimen. They were given Ivermectin alone (400 µg/kg) because most parts of the study area are known to be endemic for onchocerciasis. Pregnant women and children under 5 years were however not treated for safety reasons.

4.4 Data Management.

All data collection instruments were designed by the PI. This was done based on the experience from the pilot study. A log was kept of all forms that were sent to the field and likewise all completed forms from the field and study clinics were logged in at the field office for checking for accuracy and completeness by the PI. All checked forms were sent to the Computer Centre of the Health Research Unit (HRU) in Accra for data entry. The forms were assigned unique numbers and batched for data entry independently by the two Data Entry Clerks. Data entry screens were designed with help from the data Manager at the HRU. This was done in Epi-Info with built in logical checks. Each form had a separate data entry screen. A verification programme was run on both entries at specific intervals and any inconsistencies that occurred were corrected.

Table 4.4.1: Generation of unique ID numbers.

Village Code	*House Number*	*Individual number in the Household*	*PERMID*
A	004	01	A00401
M	011	10	M01110
T	108	17	T10817

The unique identification field for all participants was the PERMID. This consisted of the village code (an alphabet letter), the house number, and the individual number in the household. This was generated by the data entry programme to avoid typographical errors. For example a PERMID of H02305 would be the unique number of the fifth person in house number 023 in village H. Other examples are given in Table 4.4.1.

4.5 Statistical Analysis.

Analysis was done using Epi-Info and SPSS-PC. All the data sets were analysed separately to get a feel of the prevalence of the various conditions at individual and community level. The main data sets were:

- HOUSE database: a listing of all households in the various villages,
- MEMBER database: a listing of all individuals in the study area and their characteristics,
- KI database: data processed from the structured Key Informant interviews,
- CLINICHW database: Health Worker examination data,
- CLINICP database: Physician examination data, and
- LAB database: a database of all laboratory information.

To describe and summarize information from the Key Informants (KI) data, a score system was developed that ranked the importance of the various diseases in young children, school going children, and adults for disease control in the village. The highest rank was scored 3 points, the second rank was scored 2, and the lowest rank was scored 1. The total score was then computed for each condition to determine the priorities for disease control as perceived by the Key informants.

The prevalence of the clinical filariasis was examined at community level, for both the Health Worker's and the Physician's examination. The age-group and sex distribution of the various diseases were examined in all communities. To compare the prevalence in the various communities, age and sex standardization was done, using the total population from census data as the standard population (Kirkwood, 1988).

The prevalence of microfilaraemia and antigenaemia status were also assessed at community level. In addition, the geometric mean intensity (GMI) of microfilaraemia in the community was calculated as antilog $[\Sigma \log (x+1)/n]$, where x is the number of

microfilariae per millilitre of blood in microfilaraemic individuals, and n is the number of people examined.

The findings from the two clinical examination databases (CLINICHW and CLINICP) were compared to assess the level of agreement between the Physician and Health Worker in eliciting the signs and symptoms of filarial disease. The inter-observer variation was statistically assessed by the Kappa statistic k. By convention, a kappa score $k < 0$ was interpreted as indicating discordance between the two observations, $k = 0.00\text{-}0.39$ represented poor agreement, $k = 0.40\text{-}0.74$ meant good agreement, and $k > 0.75$ meant an excellent agreement (Fleiss, 1981). Quality control checks on blood slide readings were also assessed using a similar procedure.

A new database, VILLAGE, was generated with information from all the other databases for the main analysis of the relationship between infection and disease at the village level. Pearson correlation tests were performed to assess the closeness of association between the community prevalence of infection and disease (Armitage and Berry, 1994). A simple linear regression model was fitted for the relationship between measures of infection and disease at the village level. The independent variables for these analysis were the village level measures of infection, i.e. prevalence of microfilaraemia, prevalence of circulating antigens, and geometric mean intensity of infection (a measure of intensity of infection). The dependent variables were the various measures of village burden of disease such as the prevalence of elephantiasis, ADL, and hydrocele.

Chapter Five

Findings and Discussion I: The Characteristics of the Study Population and Sample, Sampling Procedure, Clinical and Laboratory Findings.

5. Findings and Discussions I.

5.1 Characteristics of the Study Population and the Sample.

The total population of the study villages was 7,809, of whom 52.6% were females. Of the targeted sample size of 2,000, 1,972 was achieved, 56.7% of whom were females (Table 5.1.1). Thus there was an over-representation of females in the study sample. This over-representation of females was found to be statistically significant and was therefore controlled for in the analysis. The populations and sample per village are also shown in Table 5.1.1. The sample achieved per community was fairly representative of the targeted sample size, except for villages R and X, where the estimated sample was not achieved for various reasons.

Population data of the villages obtained from the District Administration was found not to be very reliable. From the data available from the District Administration, all the selected villages had an estimated population of about 400, but the actual census conducted gave a wide range between 104 and 834. Communities which were found to have a much lower population than expected (district administration records), incidentally were closer to big towns than the other communities. It is therefore possible that people might have migrated from these small communities to the bigger town to seek jobs, but this is unlikely to account for all the observed differences.

The zonal distribution of the sample was also representative of the zonal populations (Table 5.1.2). The age and sex distribution of the population and sample are shown in Table 5.1.3. Figures 5.1.1 and 5.1.2 give a graphical view of the population structures of the study population and the study sample. There is an under-representation of children aged 0-9 in the sample. This problem arose mainly because the examinations were held late in the night when most children were asleep. Even though a lot of effort was put into tracing people form the selected households, some parents were reluctant to wake their children up for the examinations for various reason. It was believed in some communities that young children (especially toddlers) should not be sent out of the

house in the middle of the night. In addition, there were also taboos relating to young children and injections, and as the finger pricking for the blood sample was seen as an injection, many children were not brought for the examinations. There is also an over-representation of females in the sample. This was more the case in the coastal villages where the men went fishing at sea in the night, and it was especially so in zone 2 (Table 5.1.2). Between the study villages, there was also variation in population structures (Table 5.1.1). For the purpose of comparison between the different populations, direct age-sex standardization was done for the prevalence of disease and infection.

Table 5.1.4 shows some of the socio-economic characteristics of the study population in the different zones. Educational level in all the zones were very low, and especially so in the Bawku East district (Zone 3). Most of the residents were subsistent farmers and fishermen (coastal area only i.e. zones 1 & 2). Children and the elderly who did not work were classified as "Not Applicable" for occupation. They accounted for about 50% of the entire population. Other factors looked at were religion and marital status. There were clear differences in religious affiliations between the zones.

Table 5.1.1: Sex distribution of population of the study area and the study sample.

	Study Population				*Study Sample*			
Area Code	**Total Population**	**Females (%)**	**Males (%)**	**M/F ratio**	**No. Exam**	**Females Exam (%)**	**Males Exam (%)**	**M/F ratio**
A	547	344 (62.9)	203 (37.1)	0.67	109	67 (61.5)	42 (38.5)	0.63
B	321	168 (52.3)	153 (47.7)	0.91	131	73 (55.7)	58 (44.3)	0.79
C	154	78 (50.6)	76 (49.4)	0.97	123	63 (51.2)	60 (48.8)	0.95
D	834	489 (58.6)	345 (41.4)	0.71	101	53 (52.5)	48 (47.5)	0.91
G	531	254 (47.8)	277 (52.2)	1.09	92	56 (60.9)	36 (39.1)	0.64
H	405	213 (52.6)	192 (47.4)	0.90	106	56 (52.8)	50 (47.2)	0.89
J	474	244 (51.5)	230 (48.5)	0.94	117	65 (55.6)	52 (44.4)	0.80
K	296	135 (45.6)	161 (54.4)	1.19	106	63 (59.4)	43 (40.6)	0.68
L	460	228 (49.6)	232 (50.4)	1.02	100	68 (68.0)	32 (32.0)	0.47
M	409	207 (50.6)	202 (49.4)	0.98	85	52 (61.2)	33 (38.8)	0.63
N	822	426 (51.8)	396 (48.2)	0.93	157	96 (61.1)	61 (38.9)	0.64
P	104	70 (67.3)	34 (32.7)	0.49	80	57 (71.3)	23 (28.8)	0.40
Q	155	86 (55.5)	69 (44.5)	0.80	120	68 (56.7)	52 (43.3)	0.76
R	528	280 (53.0)	248 (47.0)	0.89	54	23 (42.6)	31 (57.4)	1.35
S	235	124 (52.8)	111 (47.2)	0.90	74	36 (48.6)	38 (37.3)	1.06
T	309	164 (53.1)	145 (46.9)	0.88	102	64 (62.7)	38 (37.3)	0.59
U	244	116 (47.5)	128 (52.5)	1.10	86	40 (46.5)	46 (53.5)	1.15
V	273	140 (51.3)	133 (48.7)	0.95	74	35 (47.3)	39 (52.7)	1.11
W	391	185 (47.3)	206 (52.7)	1.11	90	51 (56.7)	39 (43.3)	0.71
X	317	160 (50.5)	157 (49.5)	0.98	65	33 (50.8)	32 (49.2)	0.97
Total	7809	4111 (52.6)	3698 (47.4)	0.90	1972	1119 (56.7)	853 (43.3)	0.76

All percentages are row percentages

Table 5.1.2: Sex distribution of the of the study population and the study sample in the three zones.

Zone	*Study population*				*Study Sample (%)*			
	Total pop	Female	Male	M/F ratio	No. Exam	Females Exam	Males Exam	M/F ratio
One (Ahanta West)	2643 (33.8)	1515 (36.9)	1128 (36.9)	0.74	718 (36.4)	404 (36.1)	314 (36.9)	0.78
Two (Winneba)	3397 (43.5)	1707 (41.5)	1690 (45.7)	0.99	763 (38.7)	456 (40.8)	307 (36.0)	0.67
Three (Bawku East)	1769 (22.7)	889 (21.6)	880 (23.8)	0.99	490 (24.9)	259 (23.1)	231 (27.1)	0.89
Total	7809 (100)	4111 (100)	3698 (100)	0.90	1972 (100)	1119 (100)	853 (100)	0.76

All percentages are column percentages

Table 5.1.3 Age and sex distribution of the study population and the study sample.

	Study Population			*Study Sample*		
Age group	Total Population (%)	Females (%)	Males (%)	No. Exam (%)	Females Exam (%)	Males Exam (%)
1 = 0-9	2275 (29.1)	1115 (27.1)	1160 (31.4)	266 (13.5)	131 (11.7)	135 (15.8)
2 = 10-19	1599 (20.5)	719 (17.5)	880 (23.8)	498 (25.3)	246 (22.0)	252 (29.6)
3 = 20-29	1093 (14.0)	608 (14.8)	485 (13.1)	362 (18.4)	215 (19.2)	147 (17.3)
4 = 30-39	953 (12.2)	558 (13.6)	395 (10.7)	326 (16.5)	203 (18.1)	123 (14.4)
5 = 40-49	630 (8.1)	351 (8.5)	279 (7.5)	216 (11.0)	127 (11.3)	89 (10.4)
6 = 50-59	462 (5.9)	274 (6.7)	188 (5.1)	136 (6.9)	86 (7.7)	50 (5.9)
7 = 60-69	405 (5.2)	241 (5.9)	164 (4.4)	89 (4.5)	60 (5.4)	29 (3.4)
8 = 70+	392 (5.0)	245 (6.0)	147 (4.0)	78 (4.0)	51 (4.6)	27 (3.2)

All percentages are column percentages

Figure 5.1.1: Age and sex structure of the study population.

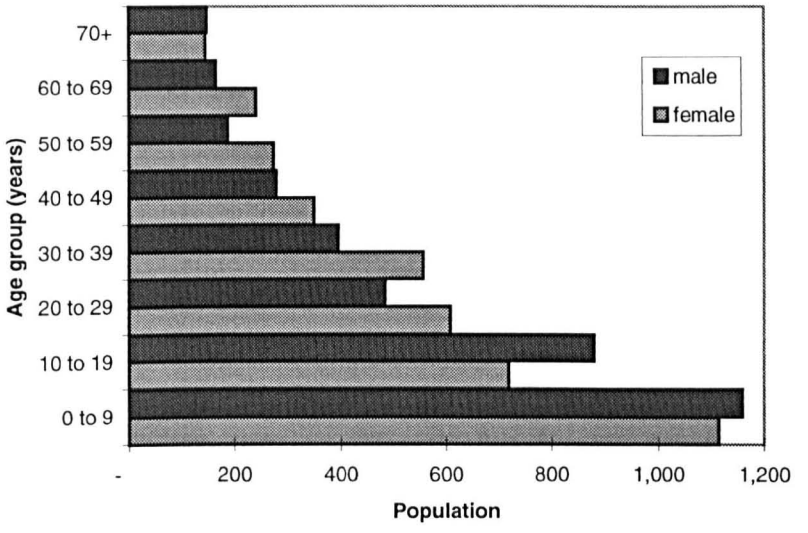


Figure 5.1.2: Age and sex structure of the study sample.

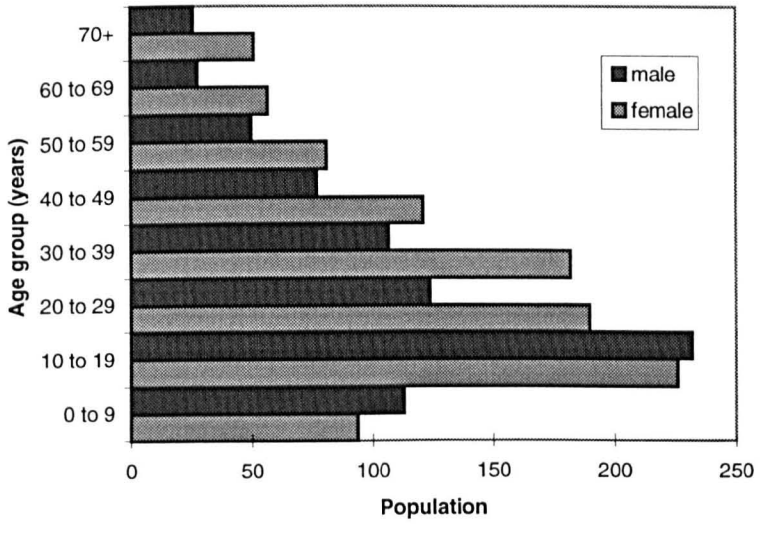


Table 5.1.4: Socio-economic characteristics of the study population.

Factor	*Zone 1 (Ahanta West)*	*Zone 2 (Winneba)*	*Zone 3 (Bawku East)*
Education			
None	54.7	64.6	84.2
Primary	33.4	25.2	12.2
Secondary	11.2	9.9	3.1
Tertiary	0.7	0.3	0.6
Occupation			
Not Applicable	47.2	50.8	47.1
Farmer	31.5	27.2	47.3
Fisherman	6.9	7.4	0.0
Artisan	4.8	2.1	1.0
Gov't Employee	1.5	1.0	0.8
Trader	4.7	8.2	9.8
Unemployed	1.9	2.6	1.1
Other	1.3	0.9	0.1
Religion			
Christian	72.9	45.3	10.5
Muslim	6.2	0.8	34.5
Traditional	17.7	44.8	54.0
Other	3.1	9.1	1.0
Marital Status			
Not Applicable	47.9	50.8	41.7
Married	30.6	34.1	43.1
Divorced	4.8	6.5	0.9
Single	7.4	6.0	11.4
Widowed	9.3	2.6	2.9

All figures are column percentages

5.2 Clinical Findings.

5.2.1 Disease Prevalence.

At the clinical examinations, we inquired for a history of an episode of acute adenolymphangitis, a family history of elephantiasis of the limbs, and then examined the respondent for elephantiasis of the limbs, elephantiasis of the breast (females only), and hydrocele (males only). The crude prevalences in the 20 communities as found in the examinations conducted by the physician are presented in Table 5.2.1. There were only 3 cases of elephantiasis of the breast (not shown in table), two in zone 1 and one in zone 2.

The sex prevalence of ADL and elephantiasis is shown in Table 5.2.2. Females had more ADL episodes and elephantiasis than males (ADL: $\chi^2 = 2.94$, $p = 0.086$; elephantiasis: $\chi^2 = 3.88$, $p = 0.049$). After controlling for age group and zone of residence using logistic regression, these difference in sex prevalence for ADL and elephantiasis became statistically insignificant (ADL: Coefficient of regression $\beta = 0.325$, S. E. = 0.248, $p = 0.189$; elephantiasis: $\beta = 0.384$, S. E. = 0.277, $p = 0.167$). When hydroceles which occur only in males are added, then males had more disease than females. This sex difference in total disease prevalence, was statistically significant after controlling for age group and zone (Coefficient of regression $\beta = 2.187$, S. E. = 0.184, $p < 0.001$). The age prevalence of the various clinical conditions were examined. Clinical disease increased with increasing age for all conditions investigated. These trends were statistically significant for all the clinical conditions (χ^2 for trend > 19 in all instances, $p < 0.001$) [Table 5.2.3, Figure 5.2.1].

Data on the prevalence of a family history of elephantiasis are not presented because the respondents interpreted the word 'family', differently. It was obvious in the analysis that some took it to mean the nuclear family, while most people took it to mean the extended family. Further analysis of this information was therefore not possible.

Table 5.2.1: Crude prevalence (%) of clinical filariasis (Physician Examination).

Area	*ADL*	*Elephantiasis*	*Hydrocele*	*Total Chronic disease*
Zone 1				
G	13.8	6.9	43.8	31.0
H	5.7	7.6	32.0	20.8
J	7.7	6.0	38.5	22.2
K	7.6	1.9	48.8	21.7
L	4.0	9.0	43.8	22.0
M	2.0	1.4	17.0	7.4
N	10.8	6.4	27.9	15.3
Total	6.8	5.2	33.9	18.1
Zone 2				
A	7.3	6.4	19.1	13.8
B	0.8	1.5	6.7	4.6
C	3.3	0.8	5.0	3.3
D	1.0	2.0	8.3	5.9
P	3.8	6.3	4.4	7.5
Q	2.5	0.8	5.8	3.3
R	1.9	3.7	16.1	7.4
Total	2.8	2.7	8.6	6.3
Zone 3				
S	2.7	2.7	35.5	17.6
T	1.0	0	2.6	1.0
U	0	0	22.7	12.5
V	0	0	21.1	10.0
W	0	0	7.9	3.4
X	1.5	4.6	15.6	12.3
Total	1.0	1.2	16.9	9.2
Total (All Zones)	3.9	3.3	20.0	11.6

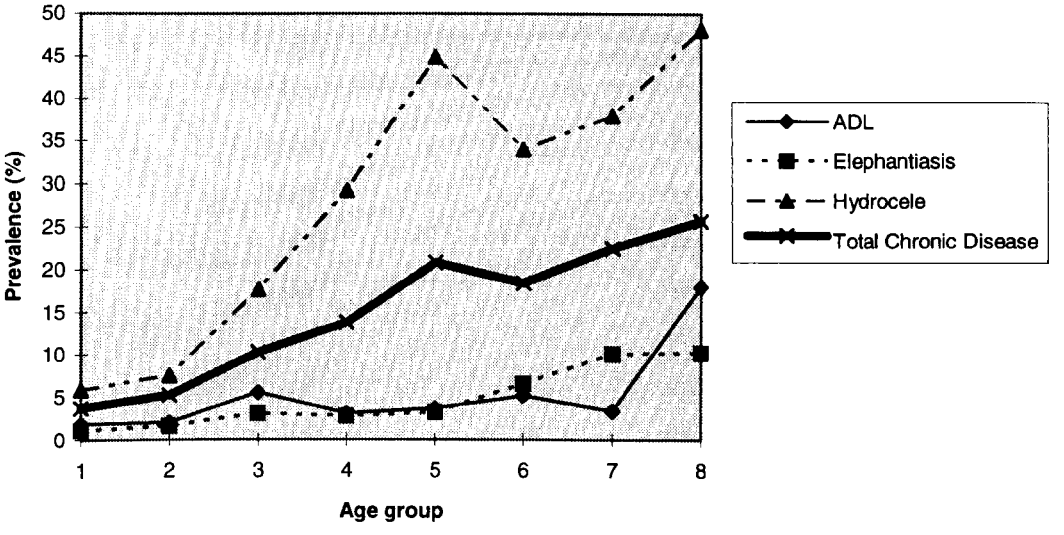
Table 5.2.2: Sex prevalence (%) of clinical filariasis (Physician Examination).

Sex (n)	*ADL Prev.*	*Elephantiasis Prev.*	*Total chronic disease Prev*
Female (1119)	4.6	3.9	4.1
Male (853)	3.1	2.3	21.6
Total (1972)	3.9	3.3	11.6

Table 5.2.3: The age prevalence (%) of clinical filariasis (Physician Examination).

Age group	*ADL*	*Elephantiasis*	*Hydrocele*	*Chronic disease*
1 = 0-9	1.9	1.1	5.9	3.8
2 = 10-19	2.0	1.6	7.5	5.2
3 = 20-29	5.5	3.0	17.7	10.2
4 = 30-39	3.1	2.8	29.3	13.8
5 = 40-49	3.7	3.2	44.9	20.8
6 = 50-59	5.2	6.6	34.0	18.4
7 = 60-69	3.4	10.1	37.9	22.5
8 = 70+	18.0	10.3	48.2	25.6
χ^2 Trend	19.1	29.0	19.1	127.5
P value	<0.001	<0.001	<0.001	<0.001

Figure 5.2.1: Age trends of clinical filariasis.



For the purpose of comparing the prevalences in the different villages and zones, age-sex standardization was done using the sum of the age and sex specific populations of the 20 villages (total census population) as the standard population. Standardized disease prevalence were obtained by applying the age-sex specific prevalence observed in each of the villages to the standard population. This weighted average of the age-sex specific prevalence, with the weights taken from the standard population, provided for each site a single summary prevalence that reflected the number of cases that would have been expected if the populations being compared had identical demographic characteristics (Kirkwood, 1988).

The standardized prevalences are presented in Table 5.2.4. Except for a few instances, the crude prevalences were not very different from the age-sex standardized prevalences. Disease prevalence was highest in zone 1 followed by zone 3. Zone 2 had the lowest disease prevalence. The zonal differences in disease prevalences were statistically insignificant after controlling for sex and age using logistic regression ($p > 0.05$ for all conditions).

Table 5.2.4: Age-sex standardized prevalence of clinical filariasis (Physician Examination).

Area	*ADL*	*Elephantiasis*	*Hydrocele*	*Chronic disease*
Zone 1				
G	13.0	6.2	30.5	20.7
H	10.5	12.5	35.6	20.4
J	5.5	4.3	38.7	22.0
K	6.6	1.5	36.4	18.7
L	5.2	9.7	40.8	26.9
M	1.4	1.4	10.5	6.4
N	8.0	5.9	30.0	17.9
Total	7.0	5.8	33.3	20.3
Zone 2				
A	6.8	5.4	17.2	13.5
B	0.8	1.7	7.2	5.1
C	3.3	0.8	5.4	3.4
D	1.0	1.7	7.6	5.3
P	3.0	4.4	4.5	6.5
Q	3.1	0.7	8.8	4.9
R	2.2	4.1	18.7	7.2
Total	2.8	2.5	9.7	6.9
Zone 3				
S	1.8	2.0	17.6	10.3
T	0.7	0	6.8	3.2
U	0	0	20.1	9.5
V	0	0	8.3	4.0
W	0	0	7.8	3.7
X	1.0	3.0	21.2	13.1
Total	0.8	1.1	12.9	7.2
Total (All Zones)	**3.7**	**3.0**	**17.8**	**11.1**

5.2.2 Comparison of Physician and Health Worker Examinations.

The findings of the health workers' clinical examinations were compared with those of the physician. Three health workers were used in the study, one in each zone, and the same physician examined all the cases. The findings from the comparison are presented in Table 5.2.5.

In general, there was a good agreement between the health workers and the physician. There were no obvious differences in agreement between the three zones, an indication that the training of the health workers was consistent and comparable across the zones. The agreement was better for ADL and elephantiasis, than for hydrocele. The overall kappa, k was high for all the conditions investigated (ADL: k =0.87, elephantiasis: k = 0.86, hydrocele: k = 0.66, total chronic disease: k = 0.79) [Table 5.2.5]. Using the standard interpretation of the kappa statistic (Fleiss, 1981), the agreement for ADL and elephantiasis are excellent (>0.75) and that for hydrocele is good (0.4-0.75).

The lower agreement with hydrocele arose mainly because the health workers found it difficult to diagnose the very early stages of the disease. Thus most of the disagreements were with stage 1 hydrocele rather than with stage 2. Of the total 19.9% crude prevalence of hydrocele recorded by the physician, 13.0% was stage 1 and 6.9% was stage 2. The health workers recorded a total of 14.7% hydroceles, 7.5% stage 1 and 7.2% stage 2. When stage 1 hydroceles were excluded from the analysis, the agreement between the physician and the health workers was much higher (k = 0.95), on the other hand the agreement for only stage 1 hydrocele was not very high (k = 0.58).

Table 5.2.5: Comparison between physician and health worker examinations.

Area	*Physician Prevalence*	*Health Worker Prevalence*	*Difference*	*Kappa Score*
Zone 1				
ADL	6.81	6.82	0.01	0.90
Elephantiasis	5.24	5.63	0.49	0.86
Hydrocele	33.88	23.45	10.43	0.64
Total Chronic Disease	18.07	14.28	3.79	0.76
Zone 2				
ADL	2.79	3.06	0.27	0.85
Elephantiasis	2.65	2.37	0.28	0.83
Hydrocele	8.60	4.76	3.84	0.58
Total Chronic Disease	6.27	4.46	1.81	0.71
Zone 3				
ADL	1.02	0.78	0.24	0.57
Elephantiasis	1.22	0.81	0.41	0.89
Hydrocele	16.88	15.96	0.92	0.69
Total Chronic Disease	9.18	8.55	0.63	0.89
Total (All Zones)				
ADL	3.91	3.85	0.06	0.87
Elephantiasis	3.25	3.25	0.00	0.86
Hydrocele	19.95	14.53	5.42	0.66
Total Chronic Disease	11.57	9.28	2.29	0.79

5.3 Laboratory Findings.

5.3.1 Prevalence and Intensity of Infection.

Infection was measured as community microfilaraemia prevalence, geometric mean intensity of microfilaraemia, and community prevalence of antigenaemia. The crude prevalences are presented in Table 5.3.1. Due to logistic reasons, blood could not be collected in two communities (V and W) for the antigen assays. Again, as there were differences in the age and sex structure of the populations, age-sex standardization was done for comparison purposes. The age-sex standardized prevalences are presented in Table 5.3.2.

The prevalence of infection was significantly higher in males than in females (Microfilaraemia: $\chi^2 = 11.61$, $p < 0.001$; Antigenaemia: $\chi^2 = 8.80$, $p = 0.003$) [Table 5.3.3]. This remained so, even after controlling for differences in age group and zonal prevalence using logistic regression (Microfilaraemia: Coefficient of regression $\beta = 0.525$, S. E. = 0.124, $p < 0.001$; Antigenaemia: $\beta = 0.508$, S. E. = 0.147, $p < 0.001$). The prevalence of microfilaraemia and antigenaemia were highest in zone 1, followed by zone 3, and then zone 2. This was consistent with the clinical findings. The geometric mean intensity of infection was also higher in males than females (*F* statistic = 11.39, $p < 0.001$) [Table 5.3.3]. The geometric mean intensity of microfilaraemia was also highest in zone 1, but lower in zone 3 than in zone 2.

Age stratified prevalence of microfilaraemia, antigenaemia and intensity of infection are presented in Table 5.3.4. In general, there was a trend for increasing prevalence of microfilaraemia (χ^2 Trend = 68.31, $p < 0.001$) and antigenaemia (χ^2 Trend = 13.03, $p < 0.001$) with increasing age. There was no such trend for geometric mean intensity of infection (Figure 5.3.1).

Table 5.3.1: Crude prevalence (%) of infection.

Area	*Microfilaraemia*	*Geometric mean microfilaraemia*	*Antigenaemia*
Zone 1			
G	34.5	457	24.1
H	34.9	792	34.0
J	28.2	782	18.8
K	27.4	841	23.6
L	31.0	1807	25.0
M	2.7	629	6.8
N	13.4	448	8.9
Total	21.8	803	19.1
Zone 2			
A	10.1	925	9.2
B	16.0	348	6.1
C	9.8	551	7.3
D	10.9	470	10.9
P	7.5	500	6.3
Q	8.3	500	5.0
R	14.8	718	9.3
Total	11.0	506	7.5
Zone 3			
S	27.0	568	2.7
T	6.9	251	1.0
U	36.7	226	5.8
V	22.5	429	*
W	5.6	629	*
X	13.9	646	9.2
Total	19.2	344	3.3
Total (All Zones)	17.2	570	11.5

* No antigen assays done in these communities.

Table 5.3.2: Age-sex standardized prevalence (%) of infection.

Area	*Microfilaraemia*	*Antigenaemia*
Zone 1		
G	28.5	15.5
H	39.7	37.9
J	28.0	21.6
K	25.8	21.0
L	30.6	24.0
M	1.9	5.0
N	15.7	8.1
Total	24.3	19.6
Zone 2		
A	9.7	8.7
B	15.1	6.5
C	9.9	7.4
D	9.6	9.4
P	5.8	4.3
Q	8.8	5.2
R	15.8	11.0
Total	11.3	7.5
Zone 3		
S	17.2	1.8
T	4.9	10.8
U	28.8	3.6
V	12.4	*
W	4.4	*
X	11.5	9.4
Total	14.2	3.1
Total (All Zones)	16.0	11.0

* No antigen assays done in these communities

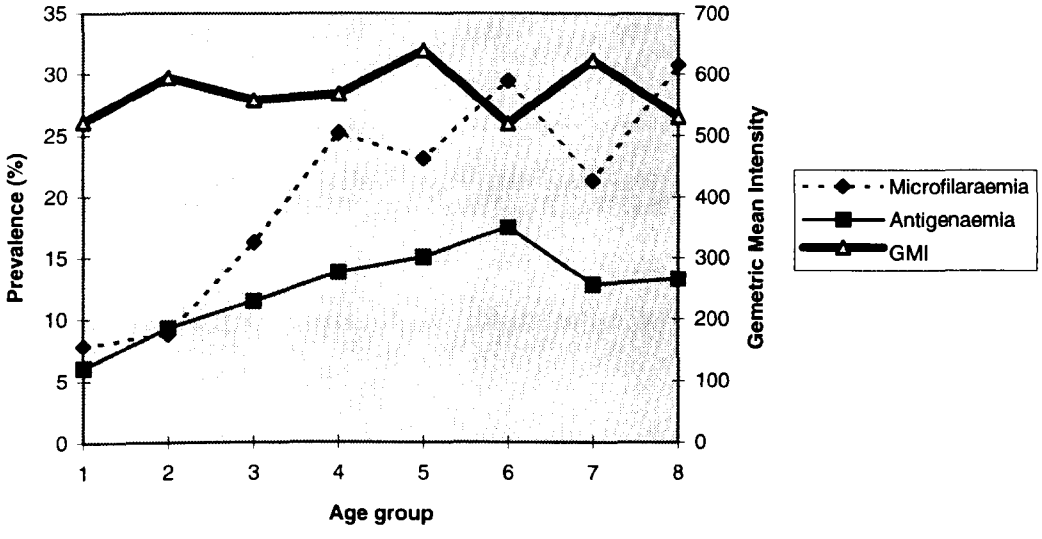
Table 5.3.3: Sex differences in prevalence (%) of infection.

Sex (n)	*Microfilaraemia Prevalence*	*Antigenaemia Prevalence*	*Geometric Mean Intensity*
Female (1119)	14.7	9.6	541
Male (853)	20.5	14.0	600
Total (1972)	17.2	11.5	570

Table 5.3.4: The age differences in infection prevalence (%).

Age group	*Microfilaraemia*	*Antigenaemia*	*Geometric Mean Intensity*
1 = 0-9	7.9	6.1	522
2 = 10-19	8.8	9.3	594
3 = 20-29	16.3	11.5	557
4 = 30-39	25.2	13.8	568
5 = 40-49	23.1	15.1	638
6 = 50-59	29.4	17.5	518
7 = 60-69	21.3	12.8	622
8 = 70+	30.8	13.3	530
χ^2 Trend	68.3	13.0	
P value	<0.001	< 0.001	

Figure 5.3.1: Age trends in prevalence and intensity of infection.



5.3.2 Quality Checks on Blood Slide Readings.

Quality control checks on the blood slide readings were excellent on the random 10% of slides selected for this purpose. In all, 200 slides were re-examined by the laboratory technician and the principal investigator. The agreement between the different examinations were assessed using the kappa statistic *k*. The kappa score between the two readings of the laboratory technician was 0.92, and that between the PI and the first reading of the laboratory technician was 0.89. The few instances where the readings were different had very low density microfilaraemia.

5.3.3 Comparison Between Microfilaraemia and Antigenaemia.

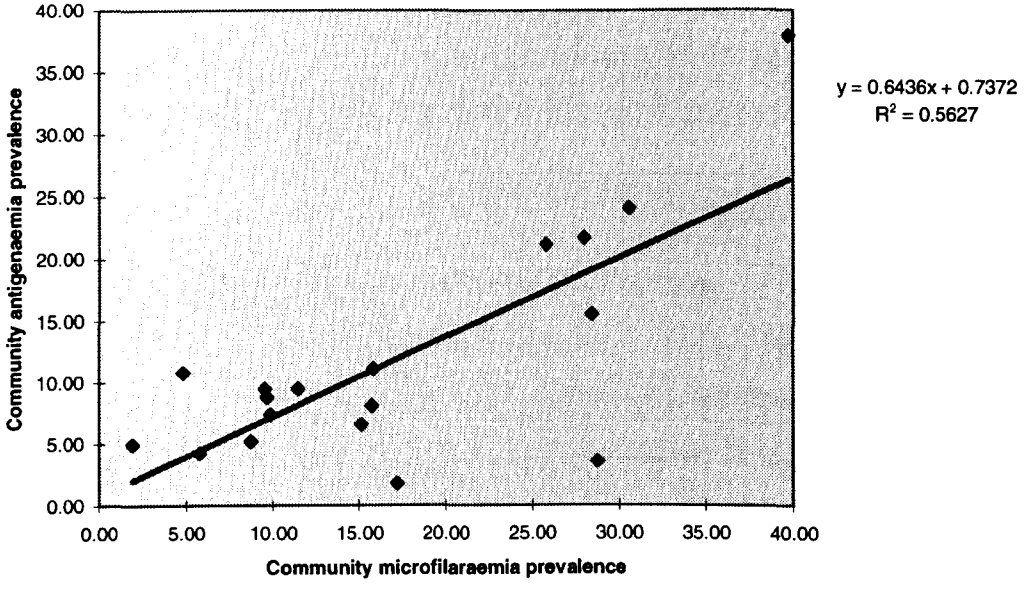
In all, both blood films and filter paper samples were collected on 1880 individuals. In general, the level of agreement between the two methods of assessing infection prevalence was low (Table 5.3.5). Using the microfilaraemia status as the gold standard, the sensitivity of the filter paper test works out to approximately 49.7%, with a specificity of about 96.5% (PPV = 75.1%, NPV = 90.1%).

Table 5.3.5: Comparison between microfilaraemia and antigenaemia.

Status	*Antigen Positive*	*Antigen Negative*	*Total*
Microfilaria Positive	163	165	328
Microfilaria Negative	54	1498	1552
Total	217	1663	1880

Figure 5.3.2 shows the correlation between the blood slides readings and the antigen assays (Coefficient of linear regression, $r = 0.75$). Even though the correlation was good, the antigenaemia prevalence was consistently lower than the microfilaraemia prevalence.

Figure 5.3.2: Correlation between community prevalence of microfilaraemia and antigenaemia.



5.4 Discussion

5.4.1 The Study Population and Sampling Procedure.

The social and economic aspects of filariasis has been highlighted recently. The distribution and transmission of the disease are known to be closely related to socio-economic and behavioural factors in endemic populations (Evans *et al.*, 1993; Gyapong M *et al.*, 1996a; Rauyajin *et al.*, 1995). This study did not attempt to document in detail nor quantify the socio-economic status of individuals but qualitatively, it was obvious that all the communities were very rural and people were generally very poor (mostly subsistent farmers or fishermen). In these communities, knowledge on the cause and transmission, and treatment of lymphatic filariasis appeared to be very low (assessed qualitatively), probably because of the very low educational standards. Low educational level has been reported to influence treatment seeking behaviour (Gyapong M *et al.*, 1996a; Ramaiah *et al.*, 1996a). The rural environment of over-grown bushes and stagnant puddles of water, appeared to be very suitable for the breeding of the various species of *Anopheles* mosquitoes, which transmit filariasis in these communities. In some the coastal villages, the low lying nature of the coast line has given rise to stagnant pools and ponds which facilitate breeding of *An. melas* mosquitoes especially in the dry season.

The zonal stratification of the sample provided villages with a broad spectrum of prevalence and intensity of infection, and burden of disease for the investigation of a relationship between infection and disease. This was especially useful because the prevalence, intensity of infection and transmission of the disease have been shown to vary in the different bio-geographical zones of the coastal savannah, the forest, and the northern savannah belts (Brengues and Gidel, 1973). Within the selected districts however, there was a problem with the selection of the villages/communities. This was because the data available on the population of the villages was not very reliable, and as a result, the initial aim of selecting only villages with a population of about 400 people was abandoned.

The use of the modified EPI-cluster survey technique for selecting the households was found to be very useful in this study. This was more so because, the census which was done provided more accurate figures of the population base. It was therefore possible to estimate the average size per household and thus, it was easier to estimate the approximate number of households that had to be selected to achieve the approximate sample of 100 people per village. There were however difficulties in explaining to the members of the non-selected households that they could not participate in the study, especially households where people had chronic diseases such as elephantiasis and hydrocele. The way around this, was to examine and treat all non-selected household members who turned up for the clinical examinations, but to exclude them from the analysis. This was found to be important for the success of the study, but increased the total cost of the study.

Conventionally, most reported population based surveys of lymphatic filariasis have attempted to cover entire communities in order to get reliable estimates of the community prevalence of infection and disease. This is because, in most places such examinations are done in the middle of the night, when it is almost impossible to do any systematic sampling of community members. Secondly, most affected communities don't have reliable census data from which to do the sampling. All community members are therefore usually encouraged to report at examination centres, in an attempt to overcome selection bias which may result if only particular groups of people report for the examinations. For this reason, it has been difficult to conduct surveys of large communities. Most investigators therefore attempt to cover about 80% of the study community. Even when the 80% target is achieved, it can not be guaranteed that the prevalence of disease and infection will not be under- or over-represented. The sampling procedure used in this study, allows one to randomly and systematically select households to represent the community being studied, and thus there was no need to examine everybody in the community. However, there was the need sometimes to follow up some members of the selected households to come for the examinations. This was a comparatively easier task to do. Epidemiologically, it should be possible to conduct such rapid sample surveys even when accurate census data

is not available. Such a methodology could provide health information more rapidly, simply, and at a less cost than the standard data collection methods, and yet still yield reliable results.

In the routine health delivery system, the use of the science of epidemiology, should be strengthened to play a major role in the planning, delivery, and evaluation of disease control programmes. Apart from immunization coverage assessment, using the EPI-cluster sample survey techniques, which have been institutionalised in most Ministries of Health in developing countries, most statistics on health status, health service coverage, and health behaviour are usually hospital (or institution) based. As the use of these facilities is usually limited to a minority of the population, the real picture remains unknown. It is however possible to borrow from the fields of health services research, and operations research, as well as traditional epidemiology, to design simple, reliable and appropriate survey techniques to provide reliable statistics, which is important for planning, monitoring, and evaluation of health programmes (Materia *et al.*, 1995; Selwyn *et al.*, 1987; Smith, 1989).

5.4.2 Clinical Disease.

The standardization procedure provided a better comparison for the results from the twenty villages in the three zones than the crude prevalences. This is because crude prevalence were confounded by differences between individual population structures, and thus any observed differences between the various villages were difficult to interpret. This was especially so, given the different male/female ratios observed across sites and the difference in the proportion of the population in the different age categories (Table 5.1.1). Standardization therefore provided a summary value that removed the effect of difference in population structure, to allow for valid comparisons on the disease spectrum in the different populations. Direct standardization was preferred because age and sex specific data were available for all the villages, and it was therefore possible to establish a standard population.

The first clear pattern is the marked age-dependent nature of ADL, elephantiasis and hydrocele in the study population (Figure 5.2.1). This is a well documented fact associated with all chronic diseases with low or negligible mortality, and the present studies just confirm it, as has been reported previously regarding lymphatic filariasis (Pani *et al.,* 1991). Even though ADL is an acute illness, it also showed a marked age trend, because its incidence has been shown to be closely related to the prevalence of chronic filarial disease (Gyapong JO *et al.,* 1996c; Pani *et al.,* 1991; Pani *et al.,* 1997).

Sex differences in chronic filarial disease presentation have also been reported. Brabin (1990) reviewed published literature on the prevalence of filariasis, where she found that males had a higher disease prevalence than females. In the recent global estimates, chronic disease due to bancroftian filariasis was found to be more prevalent in males than females because of the large number of hydrocele cases, but when the actual numbers of elephantiasis cases are compared, the bias appeared to be in the opposite direction with significantly more (18% more) disease in females (WHO, 1994). Gyapong *et al.,* (1994), also reported that females were significantly more infected and had more elephantiasis than males in northern Ghana. The findings from this present study, though not statistically significant, are consistent with these findings. The reasons for the observed sex difference in elephantiasis is still unclear, but could be related to the gender differences in exposure to the vector mosquito, as a result of differences in activity patterns. Secondly, they could be due to differences in physiological/ immunological response by the host to the parasite causing the disease.

5.4.3 Agreement Between Health Workers and Physicians.

The use of lay interviewers to collect information on the prevalence of elephantiasis of the leg has earlier been described by Gyapong *et al.* (1995), and shown to be reliable in a community-based research setting in northern Ghana. In that study, two surveys conducted one year apart with different interviewers yielded very similar results. A validation study of a sub-sample by a physician showed high levels of agreement with the lay interviewers' findings. This was especially so in the second survey when they had received more training (Survey I $k = 0.67$; Survey II, $k = 0.82$). They therefore proposed

that the prevalence of several other chronic diseases could also be assessed by lay people as long as they have obvious manifestations.

Lay people have been shown to provide valid estimates of urinary schistosomiasis in surveys enquiring for haematuria (Lengeler *et al.,* 1991), and have been used to screen for diseases such as Guinea worm (Ogunniyi *et al.,* 1992), African onchocerciasis by screening for "leopard skin" (Edungbola *et al.,* 1987) or skin nodules (Taylor *et al.,* 1992; Ngoumou and Walsh, 1993) and xerophthalmia for vitamin A deficiency (Ghana VAST Study Team, 1993; Sommer, 1982). It is therefore not surprising, that health workers who have a good working knowledge of health issues managed to diagnose clinical filariasis. It should be possible to improve their diagnostic skills through simple specific training programmes, especially regarding grade 1 hydrocele. The use of middle and peripheral level personnel in disease mapping and control activities need to be seriously considered in Ministries of Health in developing countries, where data on the prevalence and distribution of disease is lacking.

5.4.4 Infection Prevalence.

Again, the standardization procedure provided a better comparison for the results from the twenty villages in the three zones by removing differences between individual village population structures, that confounded the findings and made observed differences between the various villages difficult to interpret.

As was observed with disease prevalence, there was a marked age-dependent pattern with infection measured by both microfilaraemia and antigenaemia (Table 5.3.4 and Figure 5.3.1). This observation has also been documented in several previous studies (Dunyo *et al.,* 1996; Gyapong *et al.,* 1994; 1997; McMahon *et al.,* 1981a; Pani *et al.,* 1991; WHO, 1994). Most of these studies also reported a similar age-dependent pattern with intensity of infection, however, in this present study, no such trend was found.

Sex differences in prevalence and intensity of infection has also been described. The last global estimates suggests that males have more infection than females (WHO, 1994).

The national survey in Ghana also reported similar findings (Gyapong JO *et al.,* 1996b). These findings are consistent with the present study, but other studies done in northern Ghana suggests that, at least in some communities, females have more infections than males (Gyapong *et al.,* 1994). The sex differences in infection and clinical filariasis in general, is still very confusing. Even though the findings of this study appear to be consistent with the main trends established so far, there are no clear cut biologically plausible reasons to explain these differences in terms of exposure, nor with regard to biological/physiological differences between males and females.

The filter paper antigenaemia test recorded lower prevalence of infection compared to the blood smears in all the communities (Table 5.3.1). These low prevalences remained so, even after standardization (Table 5.3.2). Since guidelines for the collection and storage of samples were strictly adhered to, it is rather unlikely that there was a problem with the blood collection procedure, or storage and transportation of the samples, and the laboratory in Australia confirmed that the samples arrived in excellent condition. Thus the antigen assay was not sensitive enough to adequately detect infection status. Incidentally similar test carried out in the same laboratory on samples from other countries (India, Philippines), doing similar studies, have reported very low sensitivities, and the laboratory has therefore admitted that the test should be further developed (Graham Burgess, Director , Tropical Biotechnology Pty, James Cook University , Townsville, Australia: Personal communication).

A number of possible explanations could be speculated. The test was initially developed using serum samples from endemic and non-endemic areas in Papua New Guinea and Australia. It is therefore possible that we are dealing with a different sub-species of *W. bancrofti* in Ghana, and as result, the surface antigens are slightly different. However, there is no strong evidence to support this speculation. It is also possible that the cut-off point between positive and negative has been set too high and may have to be reset after several tests with different serum samples from different parts of the world. Secondly, since this is the first time the test is being used under real field trial conditions, it is probable that some technical problems that might not have been considered need to be

looked at. For example, is 5µl of blood collected on one spot on the filter paper adequate enough to detect circulating filarial antigens?

The issue of how reliable the blood smear results are have been considered. The 219 discordant readings were re-examined independently by a parasitologist in a reference laboratory and the findings were consistent with the initial readings. The 54 samples that were microfilaria negative but antigen positive is understandable, as the serological test was expected to give a higher yield than the parasitological test, however the 165 samples classified as positive by parasitological examination, but negative for serology can not be explained. This finding is particularly worrying because, the blood slide examination is not the most sensitive test for the detection of microfilarae in the peripheral blood. It has been shown that quite a number of microfilarae are lost during the staining process, especially during the dehaemoglobinization phase (Abaru & Denham, 1976; Denham *et al.*, 1971; McMahon *et al.*, 1979). Secondly, 20 µl of blood used in the blood smears generally have a lower sensitivity than the 100 µl used in the counting chamber for detection of microfilaria. It however continues to play a major role in the detection of microfilaria in large field surveys, since the other concentration methods available require much larger volumes of blood, and thus co-operation from the community is usually low.

Detailed studies by Southgate (1974), suggested that the method and volume of blood used for assessing microfilaraemia status influences results on prevalence and intensity of infection. He found that the membrane filtration technique using one millilitre of venous blood was about three times as sensitive in estimating the prevalence of microfilaraemia when compared to conventional blood smears using 20µl of capillary blood (22.1% compared with 67.8%). Blood smears using 60µl of blood increased the prevalence to 29.8% while 60µl of blood using the counting chamber technique gave a prevalence of 38.8%. The sensitivity of the method used is also reduce when venous instead of capillary blood is used (Denham *et al.*, 1971; Desowitz *et al.*, 1973; Dreyer *et al.*, 1996b).

In this present study, for operational reasons, 20µl of capillary blood was used. The finding is therefore very likely to be an underestimate of the true prevalence and intensity of infection. We were compelled to use this small volume of blood to ensure maximum cooperation from the study communities who have their own beliefs about blood collection, especially when it is done at night. The second likely source of error is the fact that the 20µl was not measured but estimated to be equivalent to about two drops of blood. This error is likely to be random and therefore not likely to render the results invalid.

Finally, due to logistic reasons, this is the method usually used by the Ministry of Health in Ghana for its surveys and is likely to remain the method of choice for a while as has been discussed by several authors (Lim *et al.,* 1993; Partono *et al.,* 1973; Wamae, 1994; WHO Expert Committee on Filariasis, 1993). They admit that the blood smears will continue to be the mainstay of large scale field studies for a long time despite its relative insensitivity, since it requires a much smaller amount of blood, which is more acceptable to most communities. It was therefore decided to use the same method in order to produce comparable results for any future evaluation, bearing in mind its potential limitations.

A test which has a sensitivity of about 50% (such as the antigen assays using blood collected on filter paper) compared to one of the least sensitive methods available, will therefore require further development if it is to have a role in the epidemiology and control of filariasis. The main conclusions that can be drawn on the basis of this test is that, even though the antigen test has been shown in the laboratory to have a sensitivity of about 99% and specificity of a similar value, it was not possible to replicate such a high sensitivity under field conditions, using blood collected on filter paper. There is therefore the need for further work to improve sensitivity under field condition.

Chapter Six

Findings and Discussion II: The Relationship Between Infection and Disease.

6. Infection and Disease.

The relationship between infection and disease was evaluated at the individual and the community level to assess how well infection predicts disease. If any such relationship was found, then disease which is much easier to measure could be used to predict infection.

6.1 Infection and Disease at the Individual Level.

The relationship between infection, measured by microfilaraemia and antigenaemia positivity, and disease were investigated. The diseases were acute adenolymphangitis, lymphoedema/ elephantiasis, and hydrocele. Associations between intensity of infection and the diseases were also examined.

6.1.1 Infection and Acute Adenolymphangitis.

Table 6.1.1 shows the relationship between the occurrence of an episode of acute adenolymphangitis (during the one month recall period) and microfilaraemia status. There was no obvious relationship between the two variables (Mantel-Haenszel χ^2 = 0.005, p = 0.94). The sensitivity of using ADL period prevalence to screen for microfilaraemia was only 3.8% with a specificity of 96.1%.

Table 6.1.1: Relationship between ADL and microfilaraemia status.

	ADL present	*ADL absent*	*Total*
Microfilaria present	13	326	339
Microfilaria absent	64	1568	1632
Total	77	1894	1971

Table 6.1.2 also shows a similar relationship between occurrence of an episode of acute adenolymphangitis and antigenaemia status. The findings were very similar to that for microfilaraemia (Mantel-Haenszel χ^2 = 0.21, p = 0.64, sensitivity = 4.6%, specificity = 96.0%). Thus there was no association found between the two variables.

Table 6.1.2: Relationship between ADL and antigenaemia status.

	ADL present	*ADL absent*	*Total*
Antigen positive	10	206	216
Antigen negative	66	1596	1662
Total	76	1802	1878

The relationship between microfilaraemia and episodic acute adenolymphangitis did not improve even after controlling for age, sex, and zone of residence using logistic regression, but there was a significant improvement for the association between antigenaemia status and ADL. This positive association was statistically significant (Coefficient of regression, β = 0.677 S. E. = 0.335 p = 0.043).

The relationship between the occurrence of ADL and the intensity of infection in individuals was examined. Logistic regression was used to control for age, sex and zone of residence. There was a negative but insignificant relationship between the intensity of infection in an individual and the occurrence of an ADL episode (β = -0.004, S. E. = 0.245, p = 0.988).

6.1.2 Infection and Elephantiasis\ Lymphoedema.

Table 6.1.3 shows the relationship between elephantiasis/lymphodema status and the microfilaraemia status. This showed a negative association between the two variables. This relationship was however not statistically significant at 0.05 level (Mantel-Haenszel $\chi^2 = 2.84$, p = 0.09, sensitivity =1.8%, specificity = 96.4%).

Table 6.1.3: Relationship between presence of elephantiasis and microfilaraemia status.

	Elephantiasis present	*Elephantiasis absent*	*Total*
Microfilaria present	6	333	339
Microfilaria absent	58	1574	1632
Total	64	1907	1971

Table 6.1.4: Relationship between presence of elephantiasis and antigenaemia status.

	Elephantiasis present	*Elephantiasis absent*	*Total*
Antigen positive	8	208	216
Antigen negative	54	1608	1662
Total	62	1816	1878

Table 6.1.4 shows a similar relationship between elephantiasis/lymphoedema and antigenaemia status. No obvious association was found between the two variables (Mantel-Haenszel $\chi^2 = 0.12$, p = 0.72, sensitivity = 3.7%, specificity = 96.8%).

The relationships were re-examined after controlling for all the possible confounders (age, sex, zone of residence) using logistic regression. The observed negative association between elephantiasis/lymphoedema and microfilaraemia status became

stronger (Coefficient of regression, β = -0.988, S. E. = 0.441, p = 0.025). There was however no effect on the relationship between the presence of elephantiasis and antigenaemia status.

The relationship between the presence of elephantiasis/lymphodema and the intensity of infection in individuals was also examined. Logistic regression was used to control for age, sex and zone of residence. There was a negative but insignificant relationship between the two variables (β = -0.489, S. E. = 0.343, p = 0.153)

6.1.3 Infection and Hydrocele.

Table 6.1.5 shows the relationship between the presence of hydrocele and the microfilaraemia status. There was a strong positive association between the two variables. This relationship was statistically significant (Mantel-Haenszel χ^2 = 26.19, $p < 0.001$, sensitivity = 33.7%, specificity = 83.6%).

Table 6.1.5: Relationship between hydrocele and microfilaraemia status.

	Hydrocele present	*Hydrocele absent*	*Total*
Microfilaria present	59	116	175
Microfilaria absent	111	567	678
Total	170	683	853

A similar positive association was found between hydroceles and antigenaemia status (Table 6.1.6) This was also very significant at 0.05 significance level (Mantel-Haenszel χ^2 = 12.75, $p < 0.001$, sensitivity =32.7%, specificity = 81.6%).

Table 6.1.6: Relationship between hydrocele and antigenaemia status

	Hydrocele present	*Hydrocele absent*	*Total*
Antigen positive	37	76	113
Antigen negative	126	567	693
Total	163	643	806

The relationships were re-examined after controlling for age, and zone of residence using logistic regression. The observed positive association between hydrocele and microfilaraemia status remained strong. This association was statistically significant (Coefficient of regression, β = 0.681, S. E. = 0.202, p = 0.001). Similarly, the association between presence of hydrocele and antigenaemia status remained strong even after controlling for age and zone of residence (β = 0.721, S. E. =0.238, p = 0.002). This positive relationship between the presence of hydrocele and infection status (microfilaraemia or antigenaemia) was still strong after controlling for the stage of the hydrocele (p = 0.003).

The relationship between the presence of hydrocele and the intensity of infection in individuals was also examined. Logistic regression was used to control for age, and zone of residence. There was a statistically significant negative association between the two variables (β = -0.613, S. E. = 0.153, p < 0.001). There was no significant relationship between the intensity of infection and the stage of the hydrocele

6.1.4 Infection and Total Chronic Disease.

Table 6.1.7 shows the relationship between the presence of any chronic filarial disease and the microfilaraemia status. There was a strong positive association between the two variables (Mantel-Haenszel χ^2 = 23.14, p < 0.001, sensitivity = 19.2%, specificity

= 90.0%). A similar association was found between the presence of any chronic filarial disease and antigenaemia status (Table 6.1.8). This was also very significant (Mantel-Haenszel $\chi^2 = 14.60$, $p < 0.001$ sensitivity = 19.4%, specificity = 89.4%).

Table 6.1.7: Relationship between total chronic disease and microfilaraemia status.

	Chronic filarial disease present	*Chronic filarial disease absent*	*Total*
Microfilaria present	65	274	339
Microfilaria absent	163	1469	1632
Total	228	1743	1971

Table 6.1.8: Relationship between total chronic disease and antigenaemia status.

	Chronic filarial disease present	*Chronic filarial disease absent*	*Total*
Antigen positive	42	174	216
Antigen negative	176	1486	1662
Total	218	1660	1878

The positive associations were re-examined after controlling for age, sex, and zone of residence using logistic regression. The observed positive association between the presence of disease and microfilaraemia status remained. This significance of this association was however found weak (Coefficient of regression, $\beta = 0.321$, S. E. = 0.117, $p = 0.070$). This is because most chronic disease (hydrocele) occurred only in males and sex differences had been controlled for. However, the positive association with antigenaemia status remained strong even after controlling for age, sex and zone of residence ($\beta = 0.449$, S. E. = 0.208, $p = 0.031$).

The relationship between the presence of any chronic filarial disease and the intensity of infection in individuals was also examined. Logistic regression was used to control for age, sex and zone of residence. There was a statistically significant negative association between the two variables (β = -0.360, S. E. = 0.135, p = 0.008).

A new variable, "infection status" was defined. This was a combination of the microfilaraemia and antigenaemia results. Any body who was positive in either of the two test (microfilaraemia and antigenaemia) was classified as infection positive. All the relationships described above were re-examined for all conditions. There was no significant difference between the findings from this analysis and the findings form the microfilaraemia versus disease analysis.

6.2 Infection and Disease at Community Level.

The relationship between infection and disease was examined at community level. This was to test the main hypothesis of the study that there will be a strong association between infection and disease prevalence at the community level. This analysis made use of the new database, VILLAGE, which was generated with information from all the other databases. The database had age-sex standardized community prevalence data on all the disease states and microfilaraemia for the twenty communities, as well as community microfilarial intensity (geometric mean intensity of infection in the community). Pearson correlation tests were performed to assess the closeness of association between infection and disease at the community level. A simple linear regression model was fitted for the relationship between measures of infection and disease. Correlation between antigenaemia and disease is not presented here because the trends in the findings are not very different from that for microfilaraemia and also because antigenaemia data was not available for all twenty communities. All the data

used to establish the relationship are based on the findings of the physician since that is the gold standard.

In all the following correlation and regression analysis, infection (microfilaraemia prevalence or geometric mean intensity) was used as the dependent variable since it is infection which causes disease. In the event of using disease to predict infection, the axes of the graphs will change. Which ever way the data is presented, the correlation coefficients do not change but the slope of the lines will be different.

6.2.1 Infection and Acute Adenolymphangitis.

Figures 6.2.1 shows the relationship between the community prevalence of infection and the community period prevalence of ADL (Coefficient of linear regression, $r = 0.61$, $r^2 = 0.37$, $p = 0.005$). This relationship was statistically significant, and the r^2 of 0.37 implies that the community microfilaraemia prevalence accounts for about 37% of the total variation in the period prevalence of ADL in the community. Thus even though there was no relationship between infection status and ADL at the individual level, at the community level, infection prevalence correlates strongly with the period prevalence of ADL. There was however no significant association between the community intensity of infection and the period prevalence of ADL (Figure 6.2.2, $r = 0.36$, $r^2 = 0.13$, $p = 0.115$). This was probably because of one outline. When this outlier is excluded from the regression, the relationship becomes more significant (Figure 6.2.3, $r = 0.75$, $r^2 = 0.56$., $p < 0.001$).

6.2.2 Infection and Elephantiasis/ Lymphoedema.

The community prevalence of elephantiasis/lymphoedema was also closely associated with the prevalence of infection (Figure 6.2.4). This association was statistically significant ($r = 0.64$, $r^2 = 0.41$, $p = 0.002$). Thus microfilaraemia prevalence accounts

for 41% of the total variation in the community prevalence of elephantiasis. The intensity of infection at the community level also showed a close association with elephantiasis/ lymphoedema (Figure 6.2.5), and this was also statistically significant (r = 0.64, r^2 = 0.41, p = 0.002). The community intensity of infection therefore accounts for 41% of the total variation in the elephantiasis prevalence. These findings imply that even though at the individual level there is a negative association between infection and lymphoedema/ elephantiasis, the prevalence or intensity of infection in the community could be used to reliably predict the community prevalence of elephantiasis/ lymphoedema.

6.2.3 Infection and Hydrocele.

The relationship between community prevalence of infection and hydrocele was also examined (Figure 6.2.6). The trend was very similar to what was observed for elephantiasis and the association much stronger (r = 0.84, r^2 =0.71, p < 0.001). Thus microfilaraemia prevalence accounts for as much as 71% of the variation in community prevalence of hydrocele. Similarly, the intensity of infection at the community level was closely associated with the prevalence of hydrocele (Figure 6.2.7), and the association was statistically significant (r = 0.64, r^2 = 0.41, p = 0.002). Thus 41% of the variation in community prevalence of hydrocele can be explained by the variation in the community intensity of infection. This strong association between infection prevalence and hydrocele prevalence indicates that one could be reliably used to predict the other. The prevalence of hydrocele as recorded in the health workers clinical examination was also correlated with the community microfilaraemia prevalence. This relationship was also very strong (Figure 6.2.8, r = 0.78, r^2 = 0.61, p < 0.001).

There were too few hydroceles to allow for correlation of prevalence of the two different stages with microfilaraemia at the community level. For instance, there were

as many as four communities without any cases of stage two hydrocele (larger than a lawn tennis ball).

6.2.4 Infection and Total Chronic Disease.

Finally, the relationship between community prevalence of infection and the prevalence of all chronic filarial diseases, that is either hydrocele, or elephantiasis (limbs, breast, and scrotum) was examined (Figure 6.2.9). The association between the two variables was also very strong ($r = 0.79$, $r^2 = 0.62$, $p < 0.001$). The relationship observed implies that 62% of the variation in the prevalence of all chronic filarial disease can be explained by the variation in the prevalence of microfilaraemia. Similarly, the intensity of infection at the community level was closely associated with the prevalence of total chronic disease in the community (Figure 6.2.8), and the association was statistically significant ($r = 0.70$, $r^2 = 0.49$, $p = 0.001$). Thus, the variation in the intensity of infection in the community can explain about 49% of the variation in the prevalence of all chronic filarial illness in the community.

Figure 6.2.1: Correlation between community prevalence of microfilaraemia and period prevalence of ADL.

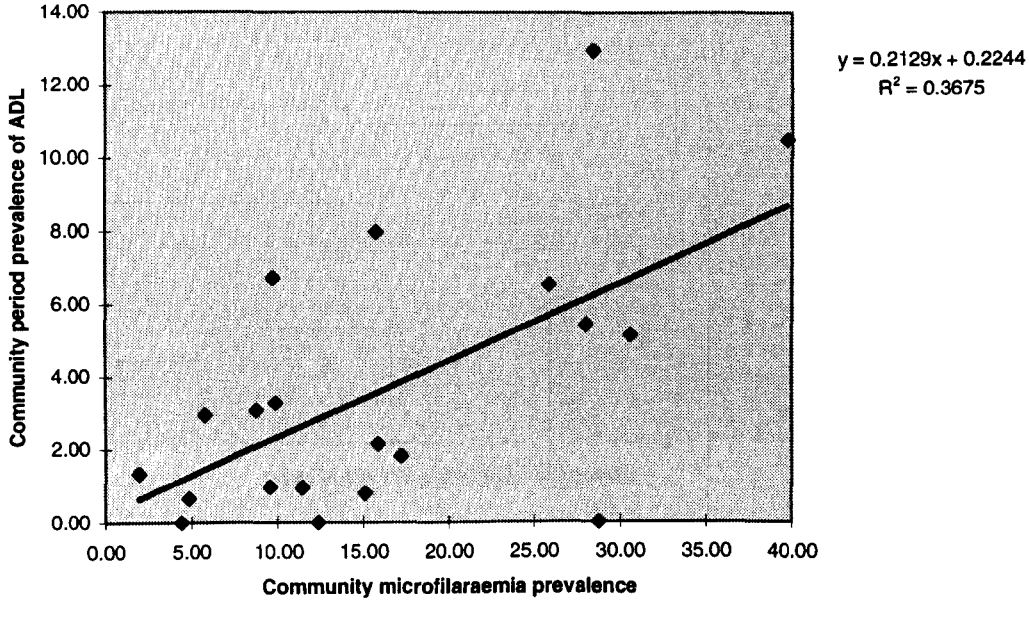


Figure 6.2.2: Correlation between intensity of infection and prevalence of ADL I.

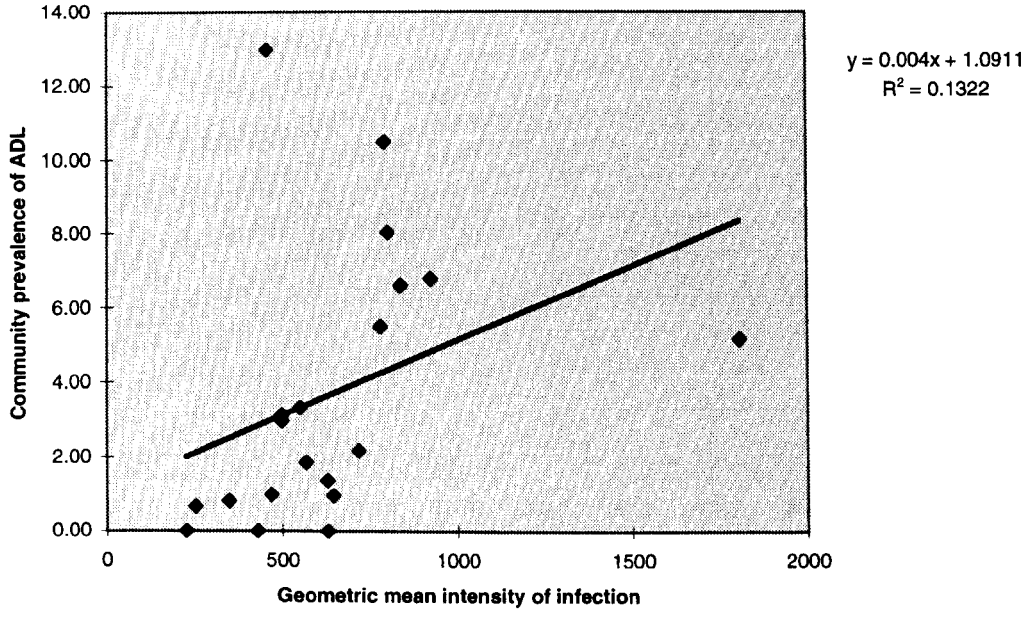


Figure 6.2.3: Correlation between intensity of infection and prevalence of ADL II.

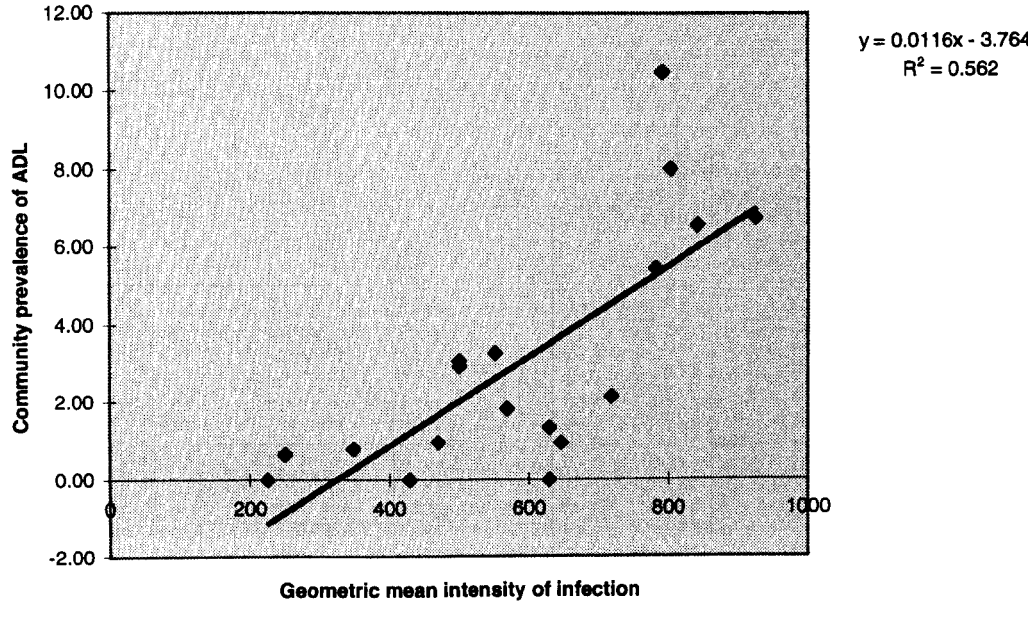


Figure 6.2.4: Correlation between community prevalence of microfilaraemia and elephantiasis.

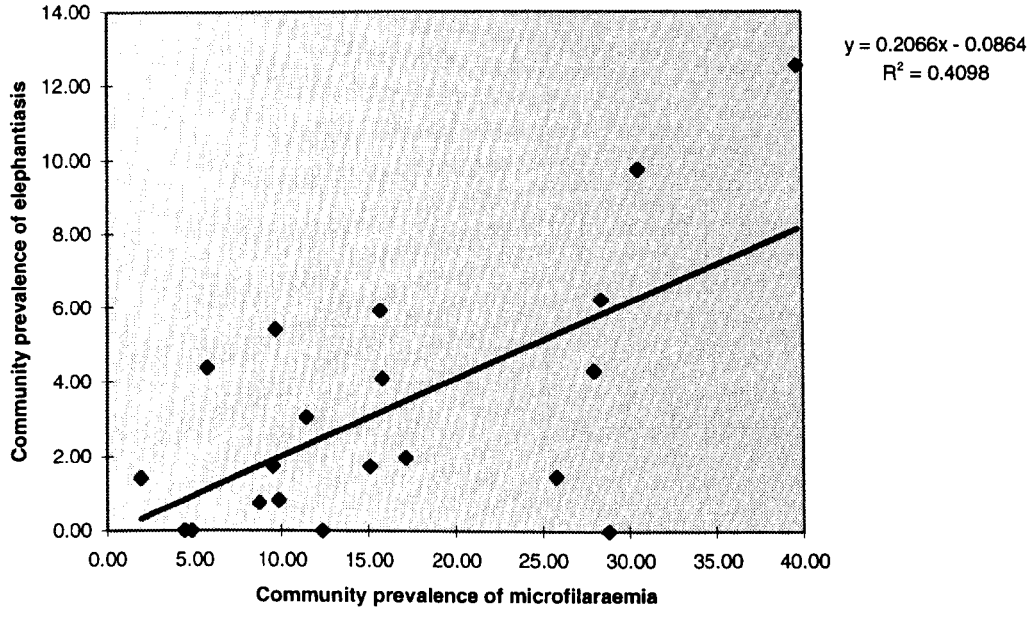


Figure 6.2.5: Correlation between intensity of infection and prevalence of elephantiasis.

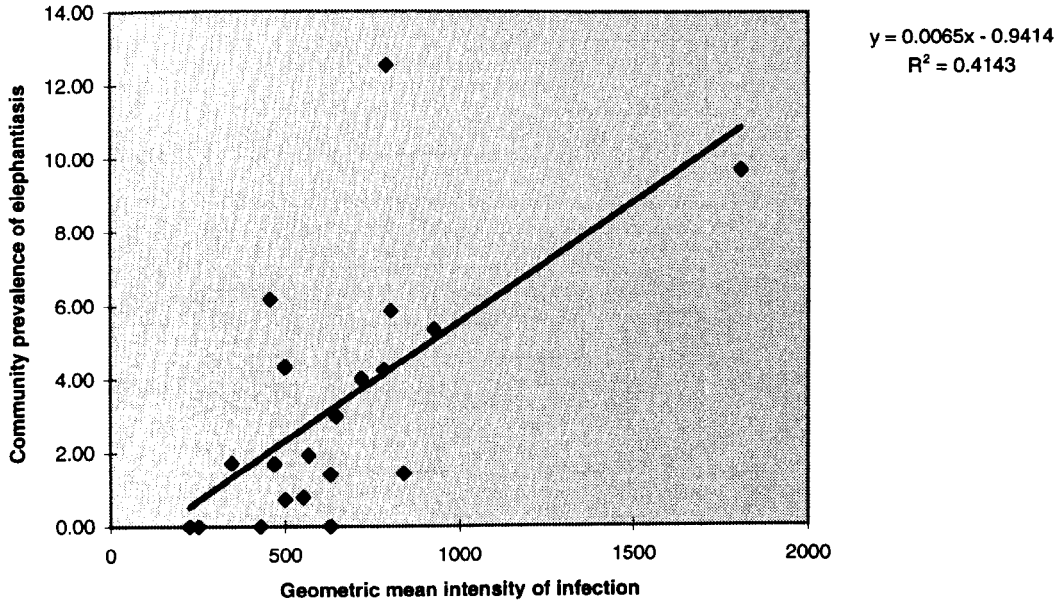


Figure 6.2.6: Correlation between community prevalence of microfilaraemia and hydrocele I.

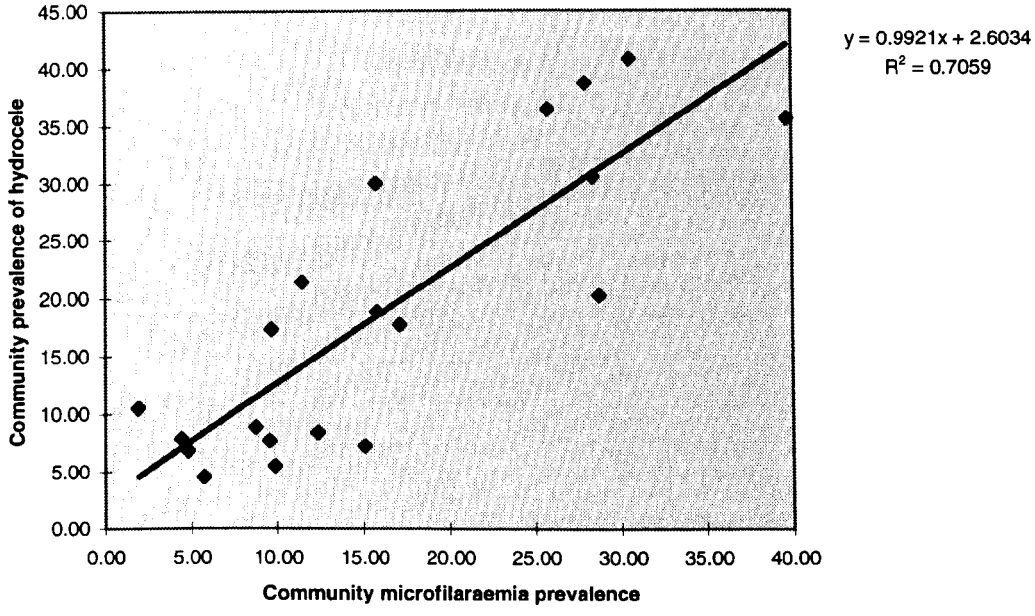


Figure 6.2.7: Correlation between intensity of infection and prevalence of hydrocele.

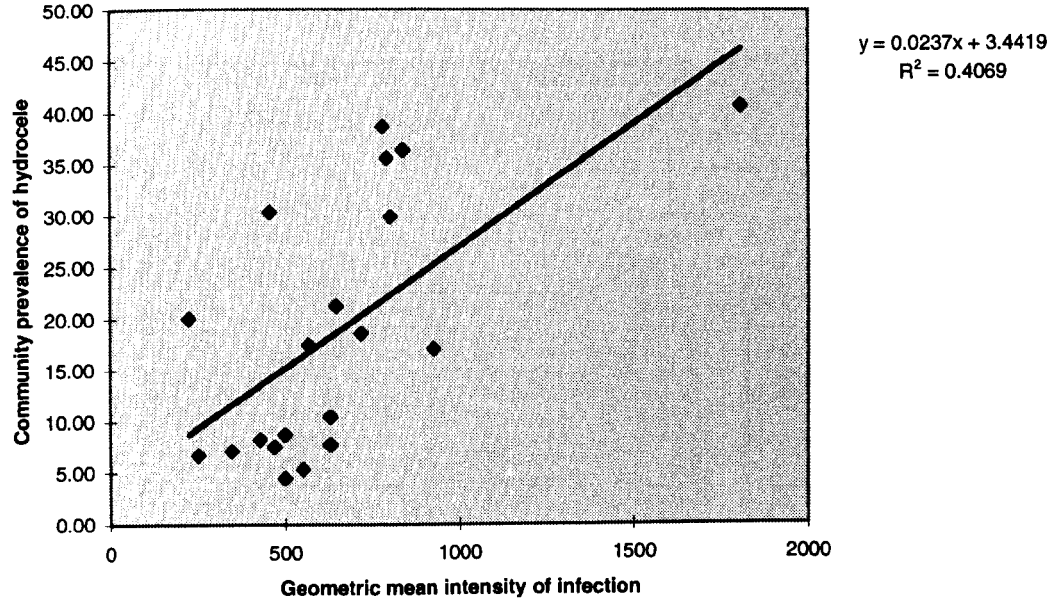


Figure 6.2.8: Correlation between community prevalence of microfilaraemia and hydrocele II.

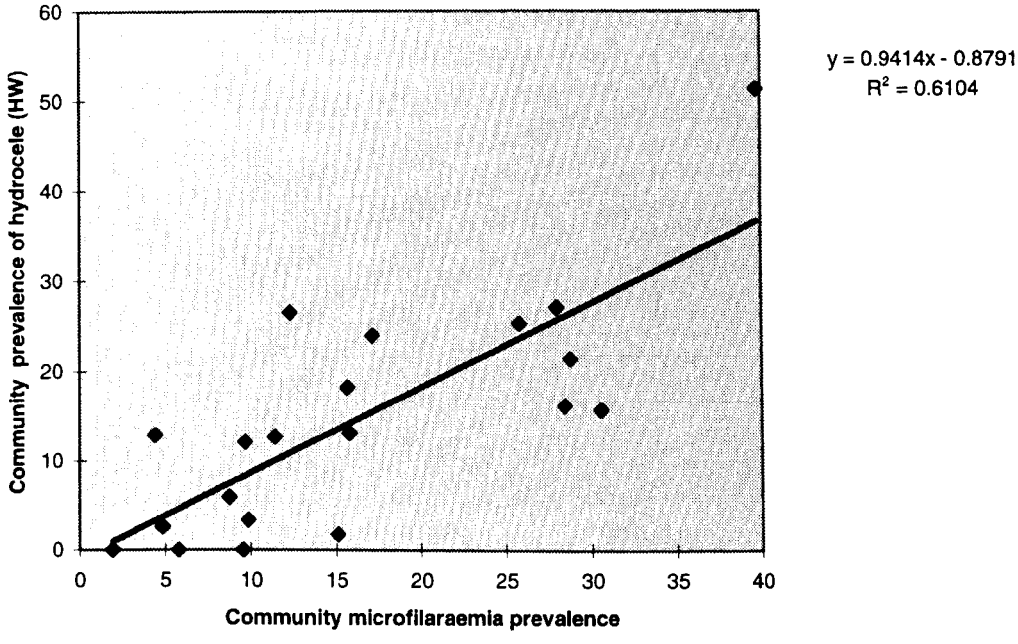


Figure 6.2.9: Correlation between community prevalence of microfilaraemia and total chronic disease.

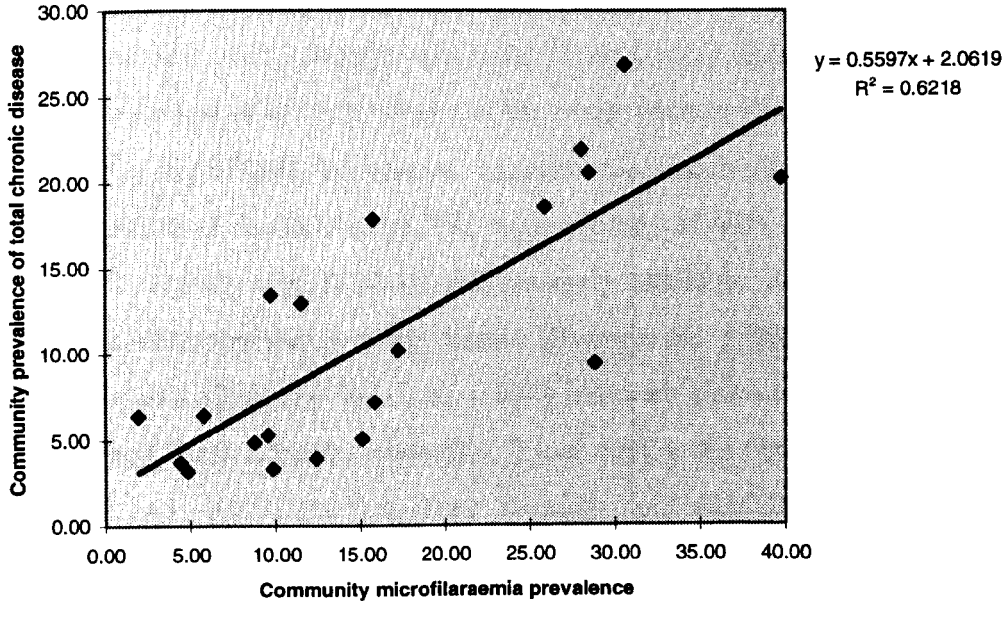
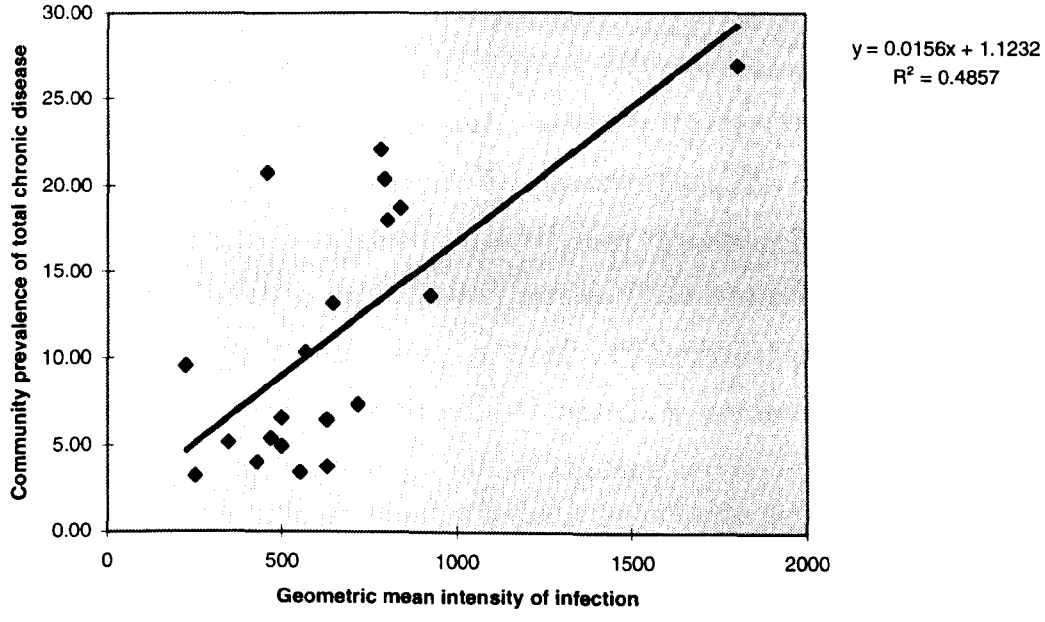


Figure 6.2.10: Correlation between intensity of infection and prevalence of total chronic disease.



6.3 Discussion

6.3.1 Infection and Disease at the Individual Level.

The findings of this study suggest that there is no direct relationship between the microfilaraemia status of an individual and the occurrence of an ADL episode. There was however a significant association between the occurrence of ADL and the antigenaemia status of the individual. The epidemiology of ADL has not been studied in detail until recently and most of the currently available data do not describe adequately the pathophysiology of the disease (Evans *et al.*, 1993; Gyapong JO *et al.*, 1996c; Pani *et al.*, 1995). Addis *et al.* (1994), reported that out of 8 patients they studied who had acute adenolymphangitis, 2 had circulating Og4C3 filarial antigen, one of whom had microfilaraemia. They therefore concluded that the syndrome of ADL associated with lymphatic filariasis may occur in the absence of current adult worm infection, and speculated that immune mediated responses to infection with the larval stages of the parasite (which may not be detected by the Og4C3 assay),

inflammatory processes initiated by previous filarial infection, or secondary bacterial infection could be responsible for the clinical syndrome of ADL.

In this present study, the strong association of ADL with antigenaemia (despite the low sensitivity of the filter paper method in detecting the Og4C3 surface antigen) is of particular interest and will require further investigation. The 8 people observed by Addis *et al.* (1994), which found no association between ADL and antigenaemia status is too small to draw any valid conclusions. Some clinical studies by Kar *et al.* (1993), on 62 patients in India, however support the immunological aetiology but did not find sufficient evidence for the role of bacteria in precipitating an ADL attack. There is therefore the clear need for further carefully designed studies to address this particular issue.

The study did not show any clear relationship between ADL and the intensity of infection. This is not very surprising since there was no relationship with microfilaraemia status as discussed above, and is consistent with other reported studies (Addis *et al.*, 1994).

This study has also demonstrated a negative association between elephantiasis/ lymphoedema status and infection status, as well as a negative but insignificant association with intensity of infection. Thus in these endemic areas in Ghana, a good proportion of people with elephantiasis or lymphoedema are likely to be amicrofilaraemic, and those with elephantiasis are likely to have low intensities of microfilaraemia. This is very consistent with reports from most epidemiological settings (Abaru *et al.*, 1980; Lammie *et al.*, 1993; McMahon *et al.*, 1981b; Simonsen *et al.*, 1995).

The study also shows a strong positive association between infection (both microfilaraemia and antigenaemia) status and the presence of hydrocele in males, and

an equally strong negative association between the intensity of infection and the hydrocele. Thus in these communities, men with hydrocele are more likely to be microfilaraemic, but those with microfilarae are very likely to have very low intensities of infection.

The sensitivity of using any of the disease states to screen for infection in individuals was very low (ADL = 3.8%, elephantiasis = 1.8%, hydrocele =33.7%). Thus filarial disease cannot be reliably used to screen for infected people in the community.

One very important aspect of the epidemiology of any infectious disease is the relationship between the infection and disease status in individuals. In most diseases the presence of disease correlate very well with infection status in the individual. For lymphatic filariasis however, this is not the case and the situation is quite confusing because the determinants of pathogenesis are not clearly defined. There are currently two explanatory models available; a static immunological model, and a dynamic model; both of which predict a negative association between infection and disease.

The immunological hypothesis has been described by several authors (Addis *et al.*, 1995; King & Nutman, 1991; Ottesen, 1980, 1984; Partono 1987). The conventional explanation for the negative association between infection status and the presence of disease in individuals is that, these individuals have a relatively strong response to the parasite, and this hyper-responsiveness is believed to induce the clinical pathology. On the other hand those with microfilaraemia are thought to be clinically asymptomatic because they are immunologically hyporesponsive to the parasite. A third group that has no evidence of infection despite high levels of exposure to the parasite has also been identified, and are believed to be 'putatively immune' and have the most marked T-cell response to filarial antigens. They are sometimes referred to as the endemic normals. The range of clinical manifestations and diversity of clinical responses to filarial infection is considered to reflect the type of immune response to

the parasite or its products. They are thought to reflect the host's predisposition which is determined genetically.

Recent epidemiological work has proposed a dynamic relationship between infection and disease (Bundy *et al.*, 1991; Srividya *et al.*, 1991). The authors propose a sequential progression from infection, microfilaraemia, amicrofilaraemia to elephantiasis or hydrocele in all individuals who develop microfilaraemia, and that only the probability of developing microfilaraemia is geographically variable, being dependent on the local incidence of the disease. Thus all microfilaraemic individuals could eventually develop disease depending on the local incidence of the disease.

Both the static and dynamic approach to the epidemiology and pathophysiology of elephantiasis and hydrocele have some setbacks because individually, they do not explain the whole picture of the clinical spectrum of disease and infection status of individuals. In most endemic countries (as shown in the present study) it is possible to find various combinations of infection status and disease status and the proportions of individuals in the different groups are known to vary (Day *et al.*, 1991; Denham & McGreevy, 1977).

In this study, the negative association between lymphoedema/ elephantiasis and infection status appears to be consistent with both models, but the positive association between hydrocele and infection status does not support the static immunological hypothesis nor the dynamic model, both of which predict a negative association between infection and hydrocele. Simonsen *et al.* (1995), also reported a negative association between infection status and elephantiasis/ lymphoedema but a positive association with hydrocele in studies conducted in coastal villages in Tanzania. Similar findings have been reported by several authors from East Africa (Abaru *et al.*, 1980; Estambale *et al.*, 1994; McMahon *et al.*, 1981b; Wegesa *et al.*, 1979) and from other parts of the world (Addis *et al.*, 1995; Lammie *et al.*, 1993; Weller *et al.*, 1982) which suggest a positive rather than a negative association between infection and

hydrocele. It is therefore possible that the pathophysiology of elephantiasis/ lymphoedema and hydrocele are completely different and not as straight forward as proposed by the two models.

In a review of 23 published studies from 1960 to 1982 from different endemic areas of the world by Michael *et al.* (1994), they found no evidence for the negative association between infection and disease. The empirical data rather showed an equal number of disease in both microfilaraemics and amicrofilaraemics. In fact, many more studies showed a positive rather than a negative association. There is clearly the need for longitudinal studies to establish the real relationships between infection and disease since this is crucial for the understanding of the epidemiology and hence control of the disease.

Despite significant progress in the development of immunological markers for infection status in man, part of the problem in our inability to explain fully the pathophysiology of elephantiasis and hydrocele may be due to our inability to measure the worm burden in individuals *in vivo* (Das *et al.*, 1990; Denham & Fletcher, 1987). There is therefore the need for further studies which will help to establish the worm burden in individuals. In the meantime microfilaraemia status and intensity of infection will continue to be the main method of determining infection status in most field settings even though it is known not to be 100% sensitive.

6.3.2 Infection and Disease at the Community Level.

The findings from the analysis of the relationship between infection and disease at the community level indicate that there is positive association between infection prevalence and intensity, and the

- Prevalence of episodic ADL,
- Prevalence of elephantiasis/ lymphoedema,
- Prevalence of hydrocele, and

- Prevalence of all chronic filarial disease.

This is the first systematic documentation of an association between the well recognized disease states associated with lymphatic filariasis and the prevalence and intensity of infection at the community level. Because of the confusing and not fully explained relationship between infection status and disease status in the individual, the basic tenet in the epidemiology of the disease has always been that, in lymphatic filariasis, patent infection is negatively related with chronic disease (Bundy *et al.*, 1991; Grenfell & Michael, 1992; Michael *et al.*, 1994; Ottesen, 1992; Srividya *et al.*, 1991; WHO, 1992), and as result, relationships between infection and disease at the community level has not been investigated.

The variation in intensity of infection (Figure 6.2.2, Figure 6.2.3, Figure 6.2.5, Figure 6.2.7, Figure 6.2.10) did not appear to be very wide probably because most of the communities were in the African Programme of Onchocerciasis (APOC) zone and were likely to have received at least one dose of ivermectin in the last two years. The APOC has been embarking on a community based distribution of ivermectin programme with variable success rates in different countries. Some recent studies indicate a coverage of about 37% in Ghana (WHO, 1996a). The yearly dose of 150µg/kg of ivermectin can have an impact on the intensity of microfilaraemia of *Wuchereria bancrofti* infection, though not much effect on the prevalence of infection.

The most likely interpretation for these findings is that, even though there may be no direct relationship between clinical disease and patent infection at the individual level, in any endemic community, the infection prevalence and disease prevalence are likely to result in some dynamic equilibrium, if there is no direct intervention like mass chemotherapy or an active hydrocelectomy programme. Thus the rate at which the community is gaining and losing infection is likely to be proportional to the rate at which it gains and loses disease (through death or migration).

These findings imply that at least in Ghana, disease prevalence at the community level could be used to predict the prevalence and intensity of infection. This is particularly

so with hydroceles because as much as 71% of the community prevalence of hydroceles is accounted for by the variation in microfilaraemia prevalence. Secondly, since men are culturally more amenable to physical examinations than women, it will be much easier to examine them at the community level. Thirdly, there are usually more cases of hydrocele than elephantiasis in endemic communities and therefore, the chances of sampling errors occurring are much smaller for hydrocele than for elephantiasis. Finally, in spite of the inability of health worker to identify very early stage 1 hydrocele, their recorded prevalence of hydrocele correlated very well with microfilaraemia prevalence. There is therefore a strong case for the use of hydrocele prevalence in predicting infection prevalence or identifying communities at risk, however, since 62% of total chronic disease is also accounted for by the variation in microfilaraemia in the community, it is possible to use both men and women in identifying the communities at risk, in case there should be any gender related problems in the choice of males only.

The association between the community prevalence of infection and disease was further examined using published data from Ghana and other parts of Africa. Dunyo *et al.* (1996), carried out detailed studies in nine communities on lymphatic filariasis along the coast of Ghana, where they document the prevalence of infection using the counting chamber technique. They also assessed the community prevalence of hydrocele and elephantiasis using standard assessment criteria. The correlation between infection and disease was assessed in these nine communities by fitting a simple linear regression model (Figure 6.3.1 and Figure 6.3.2). As much as 81% of the variation in the community prevalence of hydrocele was accounted for by the variation in microfilaraemia prevalence (Coefficient of linear regression, $r = 0.90$ $r^2 = 0.81$, $p < 0.001$). The association between the prevalence of microfilaraemia and elephantiasis was also very good ($r = 0.88$, $r^2 = 0.78$, $p < 0.001$).

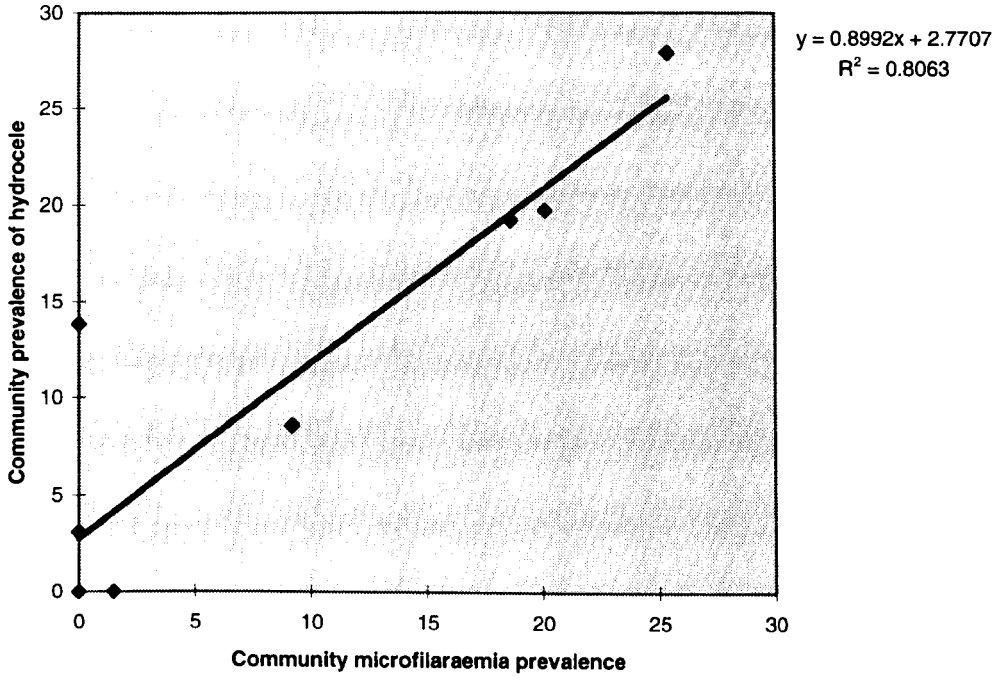
The observed relationship between infection and disease was further validated using published data from eight communities from East Africa (Tanzania and Kenya) which were summarized in a publication by Southgate (1992b), on the subject of intensity and efficiency of transmission and the development of microfilaraemia and disease

(Figure 6.3.3). The paper had data on community prevalence of microfilaraemia and hydrocele for all the communities but elephantiasis data was not present for some of the communities. The positive and highly significant association between infection and hydrocele was again confirmed at the community level ($r = 0.89$, $r^2 = 0.80$, $p < 0.001$). Thus 80% of the variation in the prevalence of hydrocele is accounted for by the variation in the community prevalence of microfilaraemia.

These findings are of great importance to the control of lymphatic filariasis. The current recommended control strategy is mass treatment of human population, and where possible, the use of vector control as an adjunct to chemotherapy. Using this strategy, the most important thing is to identify communities at risk by estimating the community prevalence of infection. Thus it is not very important to identify which individuals are infected. Given that the prevalence of disease (especially hydrocele) correlate very well with the prevalence of infection, an estimation of community prevalence of hydrocele could be reliably used to identify the communities at risk for control.

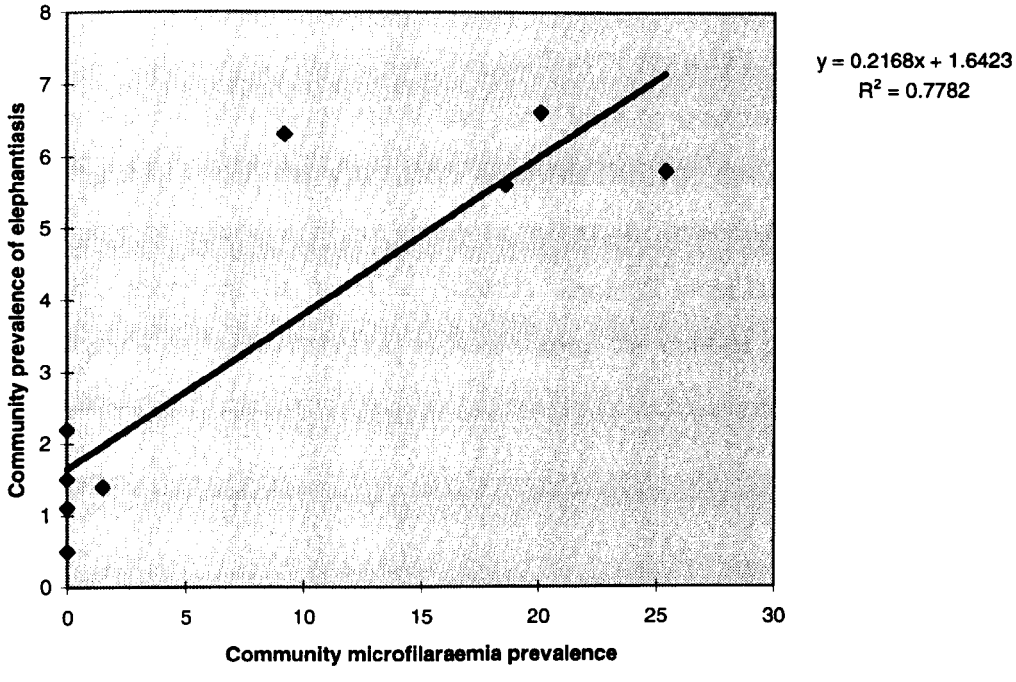
This study has also demonstrated (as described in chapter five) that, it is possible to use peripheral health staff to reliably estimate the community prevalence of disease using a simple but systematic sampling method (a modified EPI cluster survey method). Since the health system in Ghana is endowed with a lot of middle level peripheral health workers, it is possible with minimal training to use them to estimate disease prevalence during their normal duties in the field, and thus help to map the distribution of lymphatic filariasis in the country.

Figure 6.3.1: Correlation between prevalence of microfilaraemia and hydrocele in coastal Ghana.



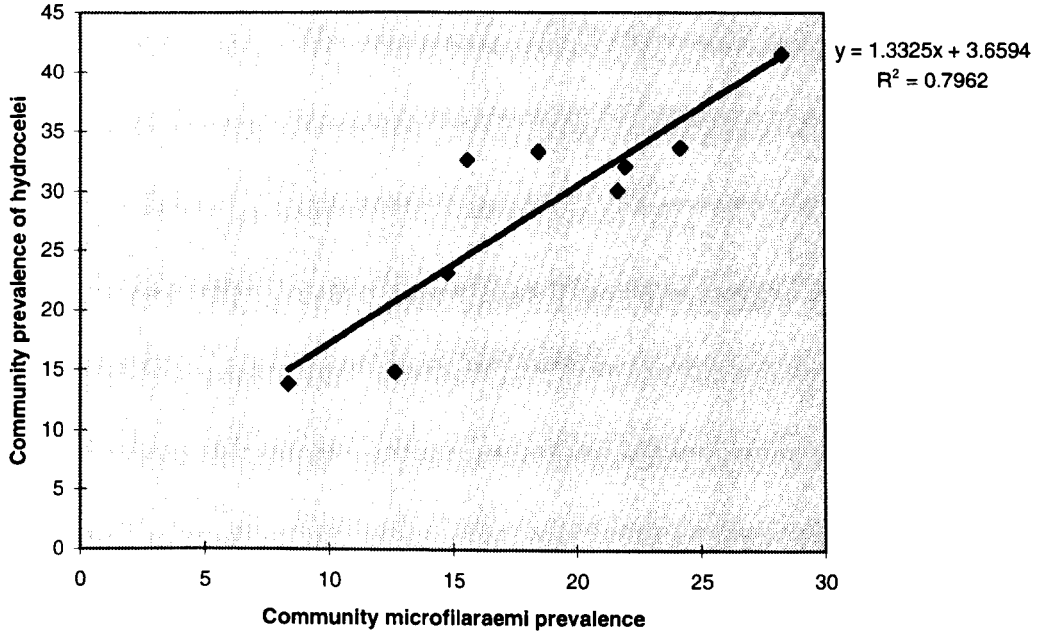
[Data from Dunyo *et al.*, 1996]

Figure 6.3.2: Correlation between prevalence of microfilaraemia and elephantiasis in coastal Ghana.



[Data from Dunyo *et al.*, 1996]

Figure 6.3.3: Correlation between prevalence of microfilaraemia and hydrocele in East African communities.



[Data from Southgate 1992b]

It must however be emphasized that this method of identifying communities at risk of infection will not be very useful in the short term to monitor a control programme. This is because within the short term of chemotherapy, the reduction in prevalence and intensity of infection is not likely to reflect in immediate reduction of disease. There will therefore be need to identify sentinel populations to monitor their parasitological and entomological indices during the control programme to assess its effectiveness.

Chapter Seven

Findings and Discussion III: The Role of Key Informants in Assessing Community Burden of Disease.

7. Key Informant Interviews.

There were 100 key informant interviews in all, 5 from each community. They usually comprised of the chief or his representative (an elder), the community representative at the district assembly (assembly man or woman), a local school teacher, a traditional health practitioner, and a women's group leader. The questionnaire inquired about common diseases and in the community in general and then asked about specific illnesses.

7.1 Common Diseases in the Community.

Table 7.2.1 shows the responses from the key informants on whether some six particular diseases were present in their communities (Appendix VI). Of the 100 respondents, as many as 86 knew of cases of hydrocele in their communities, and only 3 knew of case of Guinea worm in their communities. The responses to these simple questions gives a general overview of what is likely to be the health problems in the communities.

Table 7.1.1: Key informants' responses to the presence of six specific diseases in their communities.

Disease	*Number of Key informants who reported disease to be present*
Goitre	39
Elephantiasis	77
Hydrocele	86
Guinea Worm	3
Leprosy	49
Tuberculosis	42

To get a quantitative feel of how many cases of each disease were in each community, there was a further question asking them to estimate the number of people with each disease. The findings for elephantiasis of the limbs and hydrocele are presented in Table 7.2.2. This data suggests that communities in zone one have the highest number of clinical disease and zone two have the lowest number.

Table 7.1.2: Key informant responses for number of people with elephantiasis and hydrocele.

Area	*Elephantiasis present (n=5)*	*Mean number of cases*	*Hydrocele present (n=5)*	*Mean number of cases*
Zone 1				
G	5	6	5	10
H	4	4	5	8
J	5	7	5	9
K	4	2	5	5
L	5	10	5	9
M	5	1	5	5
N	5	6	5	11
Zone 2				
A	5	10	5	9
B	5	2	2	1
C	0	0	4	2
D	5	2	5	6
P	4	1	2	1
Q	0	0	3	2
R	5	2	5	9
Zone 3				
S	4	3	5	7
T	3	1	4	3
U	3	1	4	3
V	2	1	5	7
W	4	1	4	4
X	5	6	5	5

In order to compare the key informant reports with the findings from the clinical survey, the mean number of reported cases were divided by the total census population (for elephantiasis) and number of males (for hydrocele) in each village. These were then compared with the crude prevalence estimates from the clinical survey (Table 7.1.3). There appeared to be a consistent under-reporting by the key informants in all villages.

Table 7.1.3: Comparison between the prevalence of elephantiasis and hydrocele in the clinical examination and that reported by the Key Informants.

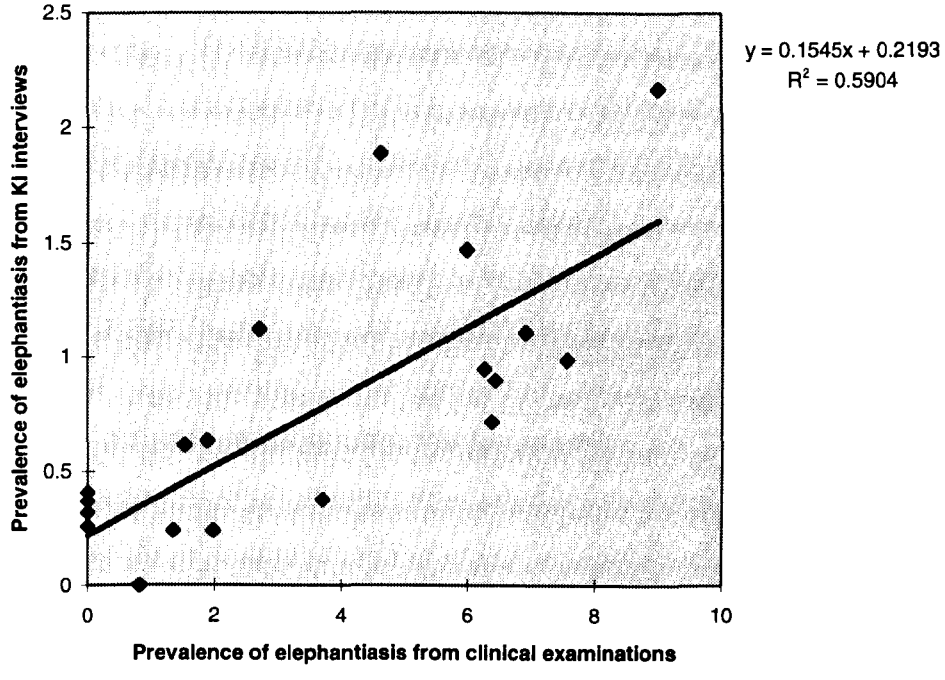
Area	*Elephantiasis survey (%)*	*Elephantiasis KI (%)*	*Hydrocele survey (%)*	*Hydrocele KI (%)*
Zone 1				
G	6.9	1.1	43.8	3.6
H	7.6	1.0	32.0	4.2
J	6.0	1.5	38.5	3.9
K	1.9	0.6	48.8	6.2
L	9.0	2.2	43.8	5.5
M	1.4	0.2	17.0	2.5
N	6.4	0.7	27.9	2.8
Zone 2				
A	6.4	0.9	19.1	4.4
B	1.5	0.6	6.7	0.7
C	0.8	0	5.0	2.6
D	2.0	0.2	8.3	1.7
P	6.3	1.0	4.4	2.9
Q	0.8	0	5.8	2.9
R	3.7	0.4	16.1	3.6
Zone 3				
S	2.7	1.1	35.5	6.1
T	0	0.3	2.6	2.1
U	0	0.4	22.7	2.3
V	0	0.4	21.1	5.3
W	0	0.3	7.9	1.9
X	4.6	1.9	15.6	3.2

The under reporting is not very surprising because these informants could report only gross and obviously enlarged swellings. The under-reporting was more for hydroceles than for elephantiasis because one normally needs a closer and physical examination to detect smaller hydroceles.

The more important point is the fact that this under reporting was consistent throughout all the 20 communities. The minor differences observed could be due to sampling variability in the clinical examinations or a true observer error by the key informants. When the key informant's disease prevalence is correlated with the crude prevalence from the clinical survey there is a very good agreement between the two reports. The correlation coefficient of linear regression r, was 0.77 for elephantiasis

and 0.74 for hydrocele, with p values < 0.001 in both instances (Figure 7.1.1 and Figure 7.1.2).

Figure 7.1.1: Correlation between the prevalence of elephantiasis from the clinical examination and the key informant interviews.



An r^2 of 0.59 suggests that at least 59% of the variation in the key informants' reported prevalence of elephantiasis in the 20 communities can be explained by the variations in the prevalence reported from the clinical examinations. Similarly 55% of the variation in key informants' reported hydrocele prevalence can be explained by the variations in the clinical examinations. These represent a statistically good enough correlation between the two methods of estimating disease prevalence in these communities.

Figure 7.1.2: Correlation between the prevalence of hydrocele from the clinical examination and the key informant interviews.

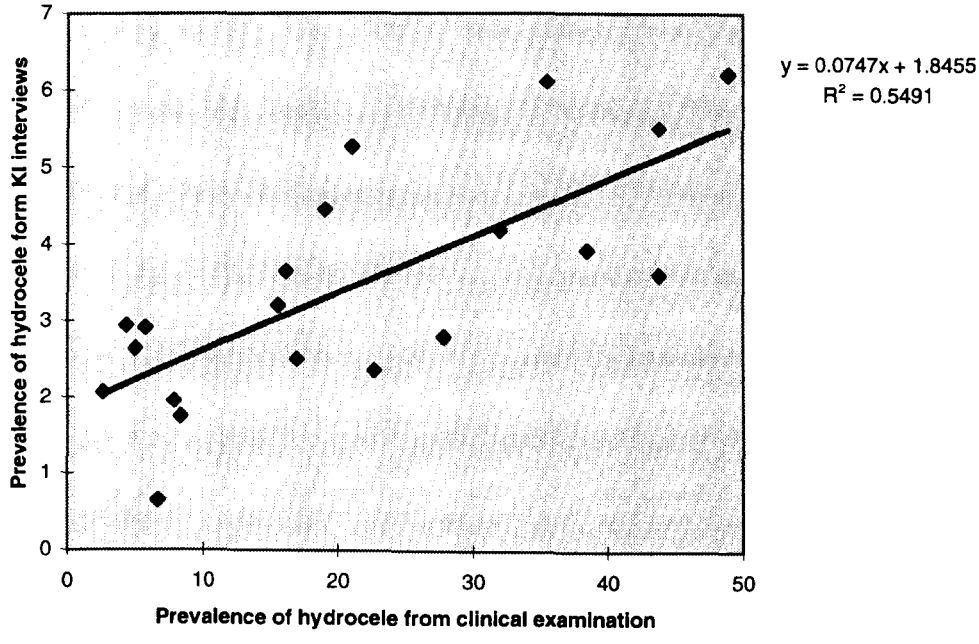


Figure 7.1.3 and Figure 7.1.4 show the correlation between community microfilaraemia prevalence and the estimated disease prevalence from the key informant interviews. Despite the strong correlation between infection and disease prevalence (chapter six section 6.2), and the equally good association between disease prevalence and the key informant reports (Figures 7.11 and Figure 7.12), there was no obvious correlation between community microfilaraemia prevalence and key informant reports. This is most probably due to the gross under-reporting of cases by the key informants which gives the estimated prevalences very wide confidence intervals. Thus the key informant reports though qualitatively very useful, was not found to be reliable in predicting the community prevalence of infection.

Figure 7.1.3: Correlation between microfilaraemia prevalence and key informant elephantiasis reports.

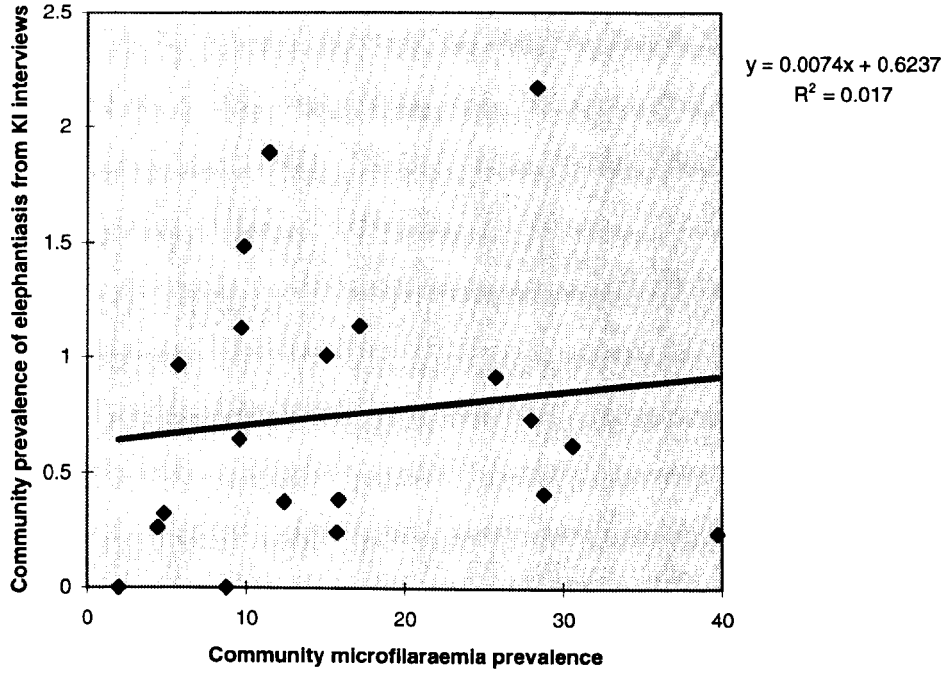
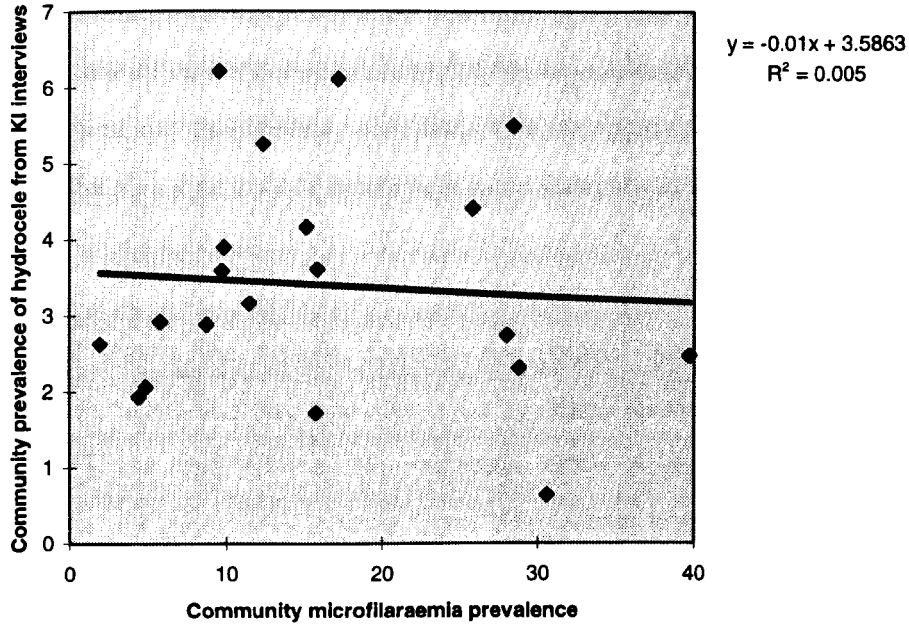


Figure 7.1.4: Correlation between microfilaraemia prevalence and key informant hydrocele reports.



7.2 Diseases Selected for Control.

The key informants were also asked to list diseases common among children under five years, children of school going age and adults. They were then asked to select three diseases in each category and rank them for prioritization for disease control (Appendix VI). The diseases were categorized into 16 main groups (usually based on symptoms). The scoring system has been described (Chapter Four Section 4.5) but briefly, the highest ranked disease was scored 3 points, the second rank was scored 2, and the lowest rank was scored 1. The total score was then computed for each condition to determine their priorities for disease control as perceived by the informants.

Table 7.2.1 shows the ranking of diseases for children under five in all three districts (zones). Malaria, measles and diarrhoea came up as the three top diseases prioritized for control in all districts. When compared with data from the respective district health services, there was a very good agreement with the top ten diseases reported in under fives in the most recent annual report. The only difference observed was that measles did not appear in the top ten diseases of any of the district records of the previous year but had been ranked so high by the community representatives. Apparently, despite a good immunization coverage in all the districts, there had been an outbreak of measles in the two coastal districts not too long before we collected our data, but this had not yet reflected in the institutional statistics. The community was therefore particularly worried about this and wanted something to be done about it urgently.

Table 7.2.2 shows the ranked diseases for control among school aged children. Malaria, skin rashes and diarrhoea were the top three diseases the community selected for control. These reports were also consistent within all the three different districts. It was however not possible to make a direct comparison with institutional data because data from this category of children is lumped with that of adults in the district statistics. Even though schistosomiasis was known to be common among school

children in all the districts, it did not receive a very high ranking (fifth). This may be linked to their beliefs of the causation of the haematuruia.

Table 7.2.1: Ranking of disease control priorities for children under five years in all zones by KI.

Disease	*Rank 1*	*Rank 2*	*Rank 3*	*Score*
Malaria	30	19	15	143
Measles	30	18	12	138
Diarrhoea	21	22	24	131
Abdominal Ache	6	13	17	61
Acute Respiratory Infections	6	13	13	57
Febrile Convulsions	7	9	11	50
Skin Rashes	2	5	9	25
Malnutrition	0	5	1	11
Other	1	3	7	16

Table 7.2.2: Ranking of disease control priorities for school children in all zones by KI.

Disease	*Rank 1*	*Rank 2*	*Rank 3*	*Score*
Malaria	49	23	19	212
Skin Rashes	10	24	21	99
Diarrhoea	12	20	21	97
Abdominal Ache	6	13	17	61
Schistosomiasis	4	9	7	37
Acute Respiratory Infections	7	7	3	31
Measles	3	0	2	11
Malnutrition	1	2	3	10
Oro-Dental Diseases	1	0	2	5
Eye Disease	1	0	1	4
Scrotal Swelling	1	0	0	3
Elephantiasis	0	0	1	1
Other	5	2	2	21

The rank order of diseases among adults is presented in Table 7.2.3. Scrotal swellings (hydrocele and hernia), low back pain, and malaria were the three top diseases. There were however some differences in the relative importance of the three in the various districts (Table 7.2.4, Table 7.2.5, and Table 7.2.6). Low back pain was found to be very important in all three district because as subsistent farmers, they till the ground and clear their farms manually using cutlasses and hoes. In the northern savannah district, the main farming implement is the hoe which requires more bending over for long hours, and thus the top ranking of low back pain in these communities.

Table 7.2.3: Ranking of disease control priorities for adults in all zones by KI.

Disease	*Rank 1*	*Rank 2*	*Rank 3*	*Score*
Scrotal Swelling	23	24	15	132
Low Back Pain	22	22	14	124
Malaria	22	18	22	124
Diarrhoea	2	13	9	41
Eye Disease	7	4	8	37
Abdominal Ache	6	4	7	33
Elephantiasis	5	5	2	27
Acute Respiratory Infections	1	2	3	10
Oro-Dental Diseases	3	0	1	10
Skin Rashes	0	0	4	4
Other	9	8	13	56

When the ranking is compared with institutional data from the districts, there was a quite a substantial difference. The top ten diseases from the district records did not have any record of low back pain, hydrocele, elephantiasis, eye disease, nor oro-dental disease. The ranking of scrotal swellings in the respective districts is consistent with reported numbers of hydroceles by the key informants, and the findings from the clinical examinations. Elephantiasis is also mentioned in all three districts but the ranking is not

consistent with the reported numbers in the communities nor the findings from the clinical examinations.

Table 7.2.4: Ranking of disease control priorities for adults by KI (Forest Zone).

Disease	*Rank 1*	*Rank 2*	*Rank 3*	*Score*
Scrotal Swelling	8	11	7	53
Low Back Pain	7	11	1	44
Malaria	7	3	7	34
Diarrhoea	1	8	3	22
Eye Disease	2	1	4	12
Elephantiasis	2	0	2	8
Oro-Dental Diseases	2	0	1	7
Abdominal Ache	0	1	3	5
Skin Rashes	0	0	3	3
Acute Respiratory Infections	0	0	1	1
Other	6	0	2	20

Table 7.2.5: Ranking of disease control priorities for adults by KI (Coastal Savannah Zone).

Disease	*Rank 1*	*Rank 2*	*Rank 3*	*Score*
Malaria	8	9	9	51
Scrotal Swelling	10	5	3	43
Low Back Pain	8	3	5	35
Elephantiasis	3	5	0	19
Diarrhoea	1	4	4	15
Abdominal Ache	2	1	2	10
Eye Disease	1	2	1	8
Oro-Dental Diseases	1	0	1	4
Acute Respiratory Infections	0	0	1	1
Skin Rashes	0	0	1	1
Other	1	6	8	23

Table 7.2.6: Ranking of disease control priorities for adults by KI (Northern Savannah Zone).

Disease	*Rank 1*	*Rank 2*	*Rank 3*	*Score*
Low Back Pain	7	8	8	45
Malaria	7	6	6	39
Scrotal Swelling	5	8	5	36
Elephantiasis	4	1	3	17
Diarrhoea	4	2	2	18
Eye Disease	2	2	3	13
Acute Respiratory Infections	1	2	1	10
Skin Rashes	0	1	2	4

7.3 Discussion.

The use of peripheral health workers in estimating disease prevalence in rural communities has been discussed (Chapter Five, Section 5.3.2). The data presented in this section also show that lay people who have had no formal medical training are capable of reporting the prevalence of certain diseases quite accurately. This is more so when the diseases have obvious manifestations (especially swellings), and well recognized terminologies exist for these diseases. In this study, the key informants were able to report reliable figures because both elephantiasis and hydrocele present as obvious swellings and there were well known local terminologies for both diseases.

Another very important factor which influenced the accuracy of the reports was the fact that most of the communities were small. The average population of each community was about 400 people. The people are closely knit together and seem to know a lot about each other. The traditional rural way of life where neighbours cared for each other was the predominant way of life. Most of the informants had lived in these communities almost all their life except for brief periods of absence. Thus it was easy to know almost everybody who lived in the community quiet well. This method of identifying disease problems in communities may therefore not work in bigger

towns where populations are likely to be bigger. Most of the teachers were however not natives of the communities, and had worked in these communities for an average of 3 years, but because of their role in other community activities, they also got to know the community quite well.

Thus lay people without any form of medical training who live in closely knit traditional settings could be reliably used to provide information on disease prevalence without doing any physical examination of the population, provided the disease has well recognized symptoms and local terminologies.

This study has demonstrated that key informants in a community could be used to assess the burden of diseases in different target groups or age categories. It has also shown that institutional records may not always reflect the true burden of diseases in the community since there are several other factors that affect access to these institutions. In the planning of health services therefore, there will be the need to consider what the community perceive to be their problem along side what has been documented in the institutions. Diseases like elephantiasis whose causation has been reported to have a lot of spiritual dimension is therefore not likely to feature prominently in routine health records. This is because, its perceived cause largely influences the health seeking patterns (Gyapong M *et al.*, 1996a).

Information on the health status of communities are essential for effective planning of the health delivery service in any country. Routine data from the various health institutions when collated together, usually provide the basis for decision making in most countries. In Ghana, and probably in other countries, the systems for gathering these data are usually cumbersome and the resulting summary of the information is usually difficult to interpret. Most often, the summary statistics do not reflect the true problems at the peripheral level where the data was collected from.

Health surveys are the usual alternatives when specific information for decision making are required, but these are generally expensive to conduct. This study has demonstrated

that it is possible to use local key informants to gather and rank common diseases in the communities quiet efficiently. In the pilot study, it was also demonstrated that it was possible to use existing administrative systems to gather this kind of information (Gyapong *et al.*, 1996a), as had been previously shown by Lengeler *et al.* (1992). In the main study, we did not use the administrative systems to reach the key informants because we worked in the communities for a reasonably long period to allow data collection by direct interviewing. Secondly, we wanted to diversify the group of people interviewed to include Chiefs, traditional healers, and women's group leaders who cannot be accessed through any formal administrative system.

Health care professionals' assessed health needs of communities have been found to be quite different from the perceived health needs of the communities themselves, and there is always the need to come to an agreement on what needs should be selected for intervention Kroeger (1985). This is important especially when community participation is an essential component of the programme. There will be the need to develop methodologies to examine how to operationalize the consultative process in combining the health care professionals' assessed health needs and that of the communities in order to come up with a single priority list.

If this could be done, it will facilitate greatly, the development and especially the implementation of targeted health programmes to identifiable populations like children under five, school children, mothers of child bearing age and many more groups.

Chapter Eight

Conclusions and Recommendations.

8. Conclusions and Recommendations.

8.1 Conclusions.

8.1.1 Relationship Between Infection and Disease.

- At the individual level, there is a strong positive association between microfilaraemia status and hydrocele, but a negative association with lymphoedema/ elephantiasis.
- At the community level, there is a strong linear relationship between infection prevalence and disease prevalence (especially hydrocele prevalence).
- Disease prevalence can therefore be reliably used to assess the community prevalence of infection.
- A random examination of approximately 30-40 adult males (>20 years) in a community for hydrocele prevalence can therefore be rapidly but reliably used to assess the community burden of filariasis in Ghana. This examination can be reliably done by peripheral health workers.

8.1.2 The Role of Peripheral Health Workers.

- Health workers involved in routine service delivery at the periphery are capable of identifying cases of elephantiasis/ lymphoedema and hydrocele reliably.
- The agreement between their assessment of chronic filaria disease and that of the physician was very high.
- It may be possible to use them (after targeted training) to map out diseases with obvious symptoms.

8.1.3 The Role of Community Key Informants.

- Community key informants have a good knowledge of health problems in their communities.
- They can also be used to assess qualitatively, the burden of filariasis in the community.

- Their priorities for disease control may not always be the same as the health professional's assessed priorities.

8.1.4 Laboratory Diagnosis of Filariasis.

- The filter paper technique for collecting blood samples for filarial surface antigen (Og4C3) assays was unreliable. This test will require further development if it is to have a role in filariasis control.
- Detection of parasites in the blood may remain the mainstay of laboratory diagnosis, especially under field conditions in the medium term.

8.2 Recommendations.

8.2.1 Community Diagnosis of Lymphatic Filariasis.

For the community diagnosis of lymphatic filariasis, a three stage method is proposed:

1. Firstly, community key informants could be used to qualitatively assess communities likely to be at risk, using the questionnaire method used in this study.
2. Secondly, once the at-risk communities have been identified, peripheral health workers can be used to quantify the burden of the disease by randomly examining about 40 adult males older than 20 years for hydrocele. The prevalence of hydrocele can then be used to estimate the prevalence of infection since the two parameters have been shown to have a good linear correlation.
3. Blood slide examination then only needs to be done to measure the prevalence and intensity of infection prior to the start of a control programme.

8.2.2 Further Research for Rapid Epidemiological Mapping of Filariasis.

Given the focal distribution of filariasis in most parts of Africa, it may be possible after identifying highly endemic communities, to come up with criteria which can be used to predict other endemic communities. This is because the density, spatial distribution and host seeking behaviour of the vector, and the physiology of the parasite, has been shown

to vary in different bio-geographical areas. These factors in turn determine the prevalence and severity of the disease (Brengue and Gidel, 1973). The key factors that could be used to predict levels of endemicity would include:

- Nearness to an endemic village,
- Presence of breeding sites,
- Water table levels, and
- Population density.

If these ideas are further developed and tested, it could lead to the rapid mapping of lymphatic filariasis using non-invasive methods that are acceptable to the community, and will throw more light on the distribution of the disease (especially in Africa) where such information is currently scanty (WHO, 1992).

References

References

Abaru DE and Denham DA (1976). Laboratory evaluation of a new technique for counting microfilariae in blood. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **70:** 333-334.

Abaru DE, McMahon JE, Marshall TF, Hamilton PJS, Vaughan JP, and Wegesa P (1980). Tanzania Filariasis Project. Studies on microfilaraemia and selected clinical manifestations of bancroftian filariasis. *Acta Tropica*, **37:** 63-71.

Addis DG, Eberhard ML, and Lammie PJ (1994). "Filarial" adenolymphangitis without filarial infection. *The Lancet*, **343:** 597.

Addis DG, Dimock KA, Eberhard ML, and Lammie PJ (1995). Clinical, parasitological, and immunologic observations of patients with hydrocele and elephantiasis in an area with endemic lymphatic filariasis. *The Journal of Communicable Diseases*, **171:** 755-758.

Adjei S, Bekui A, and Sackey SO (1995). Health needs of school aged children in Ghana. Project Report.

Agyepong IK, Aryee B, Dzikunu H, and Manderson L (1992). The malaria manual: Guidelines for the rapid assessment of social, economic and cultural aspects of malaria. Draft manual for field trials.

Amaral F, Dreyer G, Figueredo-Silva J, Noroes J, Cavalcanti A, Samico SC, Santos A, and Coutinho A (1994). Live adult worms detected by ultrasonography in human Bancroftian filariasis. *American Journal of Tropical Medicine and Hygiene*, **50:** 753-757.

Armitage P and Berry G (1994). Statistical Methods in Medical Research. Third Edition. Blackwell Scientific Publications, Oxford, UK.

Bleek W (1987). Lying informants: A fieldwork experience from Ghana. *Population Development Review*, **13:** 314-322.

Brabin L (1990). Sex differences in susceptibility to lymphatic filariasis and implications for maternal child immunity. *Journal of Epidemiology and Infection*, **105:** 335-353.

Brengues J and Gidel R (1973). Recherches sur *Setaria labiatopipillosa* en Afrique Occidentale. II. Dynamique de cette filariose dans les condition naturelles. *Annales de Parasitologie Humaine et Comparee*, **47:** 597-611.

Brogan D, Flagg EW, Deming M, and Waldman R (1994). Increasing the accuracy of the expanded programme on immunization's cluster survey design. *Annals of Epidemiology*, **4:** 302-311.

Bryan JH and Southgate BA (1988a). Factors affecting transmission of Wuchereria bancrofti by anopheline mosquitoes. 1. Uptake of microfilariae. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **82:** 128-137.

Bryan JH and Southgate BA (1988b). Factors affecting transmission of Wuchereria bancrofti by anopheline mosquitoes. 2. Damage to ingested microfilariae by mosquito foregut armatures and development of filarial larvae in mosquitoes. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **82:** 138-145.

Bundy DA, Grenfell BT, and Rajagopalan PK (1991). Immunoepidemiology of lymphatic filariasis: the relationship between infection and disease. *Immunoparasitology Today*, **12:** A71-75.

Cao W, Ploeg PBV, Plaisier AP, Sluijs IJS, and Habbema JDF (1997). Ivermectin for the chemotherapy of bancroftian filariasis: a meta-analysis of the effect of a single treatment. *Tropical Medicine and International Health*, **2:** 393-403.

Cartel JL, Nguyen NL, Mouliat-Pelat JP, Plichart R, Martin PMV and Speilgil A (1992). Mass chemoprophylaxis of lymphatic filariasis with a single dose of ivermectin in a Polynesian community with a high *Wuchereria bancrofti* infection rate. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **86:** 537-540.

CDC (1993). Recommendations of the International Task Force for Disease Eradication. *Morbidity and Mortality Weekly Reports*, **42:** 1-38.

Chan SH, Dissanayake S, Mak JW, Ismail MM, Wee GB, Srinivasan N, Soo-BH, and Zaman V (1984). HLA and filariasis in Sri Lankans and Indians. *Southeast Asian Journal Tropical Medicine and Public Health*, **15:** 281-286.

Chandramohan D, Maude GH, Rodrigues LC, and Hayes RJ (1994). Verbal autopsies for adult death: issues in their development and validation. *International Journal of Epidemiology*, **23:** 213-222.

Chodakewitz J (1995). Ivermectin and lymphatic filariasis. A clinical update. *Parasitology Today*, **11:** 233-235.

Cutts FT (1988). The use of the WHO cluster survey method for evaluating the impact of the expanded programme for immunization on target disease incidence. *Journal of Tropical Medicine and Hygiene*, **91:** 231-239.

Das PK, Manoharan A, Srividya A, Grenfell BT, Bundy DAP, and Vanamail P (1990). Frequency distribution of *Wuchereria bancrofti* microfilarae in

human populations and its relationship with age and sex. *Parasitology*, **101:** 429-434.

Day KP, Grenfell BT, Spark R, Kazura JW, and Alpers MP (1991). Age specific patterns of change in the dynamics of *Wuchereria bancrofti* infections in Papua New Guinea. *American Journal of tropical Medicine and Hygiene*, **44:** 518-527.

Dean AG, Dean JA, Coulombier D, Burton AH, Brendel KA, Smith DC, Dicker RC, Sullivan KM and Fagan RF (1995). Epi Info Version 6.03, A word processing, database and statistics program for public health on IBM-compatible microcomputers. Centre for Disease Control and Prevention (CDC), Atlanta, Georgia.

Denham DA, Dennis DT, Ponnudurai T, Nelson SG, and Guy F (1971). Comparison of a counting chamber and thick smear methods of counting microfilariae. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **65:** 521-526.

Denham DA, and Fletcher C (1987). The cat infected with *Brugia pahangi* as a model for human filariasis. *Ciba Foundation Symposium*, **127:** 225-235.

Denham DA and McGreevy PB (1987). Brugian filariasis: epidemiological and experimental studies. *Advances in Parasitology*, **15:** 243-308.

Desowitz RS, Southgate BA, and Mataika JU (1973). Studies on filariasis in the pacific, 3: Comparative efficacy of the stained blood-film, counting-chamber, and membrane-filtration techniques for the diagnosis of *Wuchereria bancrofti* microfilaraemia in untreated patients in areas of low endemicity. *Southeast Asian Journal of Tropical Medicine and Public Health*. **4:** 329-335.

Dennis DT, McConnell E and White GB (1976). Bancroftian filariasis and membrane filters: are night surveys necessary? *American Journal of Tropical Medicine and Hygiene*, **25:** 257-262.

Dreyer G, Ottesen EA, Galdino E, Andrade L, Rocha A, Medeiros Z, Moura I, Camisiro I, Beliz F, and Coutinho A (1992). Renal abnormalities in microfilaraemic patients bancroftian filariasis. *American Journal of Tropical Medicine and Hygiene*, **46:** 745-751.

Dreyer G, Amaral F, Noroes J and Medeiros Z (1994). Ultasonographic evidence for stability of adult worm location in bancroftian filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88:** 558.

Dreyer G, Amaral F, Noroes J, Medeiros Z and Addis D (1995). A new tool to assess the adulticida efficacy in vivo of antifilarial drugs for bancroftian

filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89:** 225-226.

Dreyer G, Addis D, Noroes J, Amaral F, Rocha A, and Coutinho A (1996a). Ultrasonographic assessment of the adulticidal efficacy of repeat high-dose ivermectin in bancroftian filariasis. *Tropical Medicine and International Health*, **1:** 427-432.

Dreyer G, Pimentael A, Medeiros Z, Beliz F, Moura I, Coutinho A, de Andrade LD, Rocha A, da Silva LM, and Piessens WF (1996b). Studies on the periodicity and intravascular distribution of *Wuchereria bancrofti* microfilariae in paired samples of capillary and venous blood from Recife, Brazil. *Tropical Medicine and International Health*, **1:** 264-272.

Dunyo SK, Appawu M, Nkrumah FK, Baffoe-Wilmot A, Perdeson EM and Simonsen PE (1996). Lymphatic filariasis in coastal Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **90:** 634-638.

Eberhard ML, Hightower AW, McNeeley DF and Lammie PJ (1992) Long term suppression of microfilaraemia following ivermectin treatment. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **86:** 287-288.

Edungbola LD, Alabi TO, Oni GA, Asaolu SO, Ogunbanjo BO, and Parakoyi BD (1987). 'Leopard Skin' as a Rapid Diagnostic Index for Estimating the Endemicity of African Onchocerciasis. *International Journal of Epidemiology*, **16:** 590-594.

Evans DB, Gelband H and Vlassoff C (1993). Social and economic factors and the control of lymphatic filariasis: a review. *Acta Tropica*, **53:** 1-26.

Estambale BBA, Simonsen PE, Knight R, and Bwayo JJ (1994). Bancroftian filariasis in Kwale District of Kenya. I. Clinical and parasitological survey in an endemic community. *Annals of Tropical Medicine and Parasitology*, **88:** 145-151.

Faris R, Ramzy RM, Gad AM, Weil GJ, Buck AA (1993). Community diagnosis of Bancroftian filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **87:** 659-661.

Fleiss JL (1981). Statistical Methods for Rates and Proportions. John Wiley, New York.

Frerich RR (1989). Simple analytical procedures fro rapid micro-computer-assisted cluster surveys in developing countries. *Public Health Reports*, **104:** 24-35.

Frerich RR and Khin TT (1989). Computer assisted rapid surveys in developing countries. *Public Health Reports*, **104:** 14-23.

Ganayni el- GA (1992). Evaluation of two different antigens in immuno diagnosis of bancroftian filariasis using ELISA and IHAT. *Journal of Egyptian Society of Parasitology*, **22:** 107-113.

Gelfand HM (1955). Studies on the vectors of Wuchereria bancrofti in Liberia. *American Journal of Tropical Medicine and Hygiene*, **4:** 52-60.

Gold Coast Medical Department Reports (1936-37).

Ghana VAST Study Team (1993). Vitamin A supplementation in northern Ghana: effects on clinic attendances, hospital admissions, and child mortality. *The Lancet*, **342:** 7-12.

Grenfell BT and Michael E (1992). Infection and disease in lymphatic filariasis: an epidemiological approach. *Parasitology*, **104:** S81-S90.

Gyapong JO (1992). A study of the Socio-economic impact of lymphatic filariasis in the Kassena-Nankana district of the Upper East Region of Ghana. Project proposal ID: 920358 WHO/TDR/SER.

Gyapong JO, Badu JK, Adjei S and Binka FN. (1993). Bancroftian filariasis in the Kassena-Nankana district of the upper east region of Ghana- a preliminary study. *Journal of Tropical Medicine and Hygiene*, **96:** 317-322.

Gyapong JO (1994). Developing and Testing Rapid Epidemiological Assessment Methods for Lymphatic filariasis. Report of a WHO Workshop held at the Navrongo Health Research Centre, Navrongo, Ghana.

Gyapong JO, Magnussen P, and Binka FN (1994). Parasitological and clinical aspects of bancroftian filariasis in Kassena Nankana district, Upper East Region, Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88:** 555-557.

Gyapong JO, Dollimore N, Binka FN and Ross DA (1995). Lay reporting of elephantiasis of the leg in northern Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89:** 616-618.

Gyapong JO, Adjei S, Gyapong M, and Asamoah EG (1996a). Rapid community diagnosis of lymphatic filariasis. *Acta Tropica*, **61:** 65-74.

Gyapong JO, Adjei S, and Sackey SO (1996b). Descriptive epidemiology of lymphatic filariasis in Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **90:** 26-30.

Gyapong JO, Gyapong M, and Adjei S (1996c). Epidemiology of acute adenolymphangitis (ADL) due to lymphatic filariasis in northern Ghana. *American Journal of Tropical Medicine and Hygiene*, **54:** 591-595.

Gyapong JO, Gyapong M, Evans DB, Aikins MK, and Adjei S (1996d). The economic burden of lymphatic filariasis in northern Ghana. *Annals of Tropical Medicine and Parasitology*, **90:** 39-48.

Gyapong JO, Pani SP, Premji Z, Belizario V, Radhamani MP and Premkumar M (1997). Clinical epidemiology of lymphatic filariasis I: comparison of prevalence and spectrum of chronic disease in six different geographical sites. *Acta Tropica* In press

Gyapong M, Gyapong JO, Adjei S, Vlassoff C, and Wiess M (1996a). Filariasis in northern Ghana: Some cultural beliefs and practices and their implications for disease control. *Social Science and Medicine*, **43:** 235-242.

Gyapong M, Gyapong JO, Amankwa J, Asedem J, and Sory E (1996b) Introducing insecticide impregnated bednets in an area of low bednet usage: An exploratory study in North East Ghana. *Journal of Tropical Medicine and International Health*, **1:** 328-333.

Hawking F (1977). The distribution of human filariasis throughout the world: part III Africa. *Tropical disease bulletin*, **74:** 649-679.

Henderson RH and Sundaresan T (1982). Cluster sampling to assess immunization coverage: a review of experience with a simplified sampling method. *Bulletin of the World Health Organization,* **60:** 253-260.

Hiscock J (1995). Looking a gift horse in the mouth: the shifting power balance between the Ministry of Health and donors in Ghana. *Health Policy and Planning*, **10:** S28-39.

Kar SK, Mania J, and Kar PK (1993). Humoral immunity response during filarial fever in bancroftian filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **87:** 230-233.

King CL and Nutman TB (1991). Regulation of the immune response in lymphatic filariasis and onchocerciasis. *Immunoparasitology Today*, **12:** A54-A57.

Kirkwood BR (1988). Essentials of Medical Statistics. Blackwell Scientific Publication.

Kroeger A (1985). Response error and other problem of health surveys in developing countries. *World Health Statistics Quarterly,* **38:** 15-37.

Lammie PJ, Addis DG, Leonard G, Hightower AW, and Eberhard ML (1993). Heterogeneity in filarial-specific immune responsiveness among patients with lymphatic obstruction. *Journal of Infectious Diseases*, **167:** 1178-1183.

Lemeshow S, Hosmer DW, Klar J, and Lwanga SK (1990). Adequacy of sample size in health studies. John Wiley and Sons, Chichester, England. A world Health Organization Publication.

Lengeler C, de Savigny D, Mshinda H, Mayombana C, Tayari S, Hatz C, Degremont A, and Tanner M (1991a). Community-based questionnaires and health statistics as tools for cost-efficient identification of communities at risk of urinary schistosomiasis. *International Journal of Epidemiology*, **20:** 796-807.

Lengeler C, Kilima P, Mshinda H, Morona A, Hatz C, and Tanner M (1991b). Rapid, low-cost, two-step method to screen urinary schistosomiasis at the district level: the Kilosa experience. *Bulletin of the World Health Organization*, **69:** 179-189.

Lengeler C, Sala-Diakanda D, and Tanner M (1992). Using questionnaires through an administrative system: a new approach to health interview surveys. *Health Policy and Planning,* **7:** 10-21.

Lim PKC (1993). Recent advances in diagnostic techniques in filariasis. *Tropical Medicine and Parasitology,* **24 (Suppl 2):** 45-50.

Magnussen P, Makunde W, Simonsen PE, Meyrowitsch D, and Jakubowski K (1995). Chronic pulmonary disorders, including tropical pulmonary eosinophilia, in villages with endemic lymphatic filariasis in Tanga region and Tanga town, Tanzania. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89:** 406-409.

Manderson L and Aaby P (1992a). An epidemic in the field? Rapid assessment procedures and health research? *Social Science and Medicine*, **35:** 839-850.

Manderson L and Aaby P (1992b). Can rapid anthropological procedures be applied to tropical research?. *Health Policy and Planning*, **7:** 46-55.

Materia E, Imoko J, Berhe G, Dawuda C, Omar MA, Pinto A, and Guerra R (1995). Rapid surveys in support of district health information systems: an experience from Uganda. *East African Medical Journal,* **72:** 15-18.

McMahon JE, Marshall TF, Vaughan JP, and Abaru DE (1979). Bancroftian filariasis: a comparison of microfilariae counting techniques using counting chamber, standard slide and membrane (nuclepore) filtration. *Annals of Tropical Medicine and Parasitology*, **73:** 457-464.

McMahon JE, Magayuka SA, and Kolstrup N (1981a). Studies on the transmission and prevalence of Bancroftian filariasis in four coastal villages of Tanzania. *Annals of Tropical Medicine and Parasitology*, **75:** 415-431

McMahon JE, Magayauka SA, Kolstrup N, Mosha FW, Bushrod FM, Abaru DE, and Bryan JH (1981b). Studies on the transmission and prevalence of Bancroftian filariasis in four coastal villages of *Tanzania. Annals of Tropical Medicine and Parasitology*, **75:** 415-431

Michael E, Grenfell BT and Bundy DA (1994). The association between microfilaraemia and disease in lymphatic filariasis. *Proceedings of the Royal Society of London; Series B: Biological Sciences*, **256:** 33-40.

Michael E, Bundy DA and Grenfell BT (1996). Re-assessing the global prevalence and distribution of lymphatic filariasis. *Parasitology*, **112:** 409-428.

Mirza NM, Macharia WM, Wafula EM, Agwanda RO, and Onyango FE (1990). Verbal autopsy: a tool for determining cause of death in a community. *East African Medical Journal*, **67:** 693-698.

More SJ and Copeman DB (1990). A highly specific and sensitive monoclonal antibody-based ELISA for the detection of circulating antigen in bancroftian filariasis. *Tropical Medicine and Parasitology*, **41:** 403-406.

Muhondwa EPY (1983). Community participation in filariasis control: the Tanzania experiment. TDR/SER/SWG(4)/WP83.13

Muirhead-Thomson RC (1954). Factors determining true reservoir of infection of *Plasmodium falciparum* and *Wuchereria bancrofti* in a west African village. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **48:** 208-225.

Nitcher M (1984). Project community diagnosis: participatory research as a first step toward community involvement in Primary Health Care. *Social Science and Medicine*, **19:** 237-252.

Ngoumou P, and Walsh JF (1993). *A manual for rapid epidemiological mapping of onchocerciasis*. Document TDR/TDE/ONCHO/93.4, World Health Organization.

Nguyen NL, Moulia-Pelat JP, Glaziou P, Martin PM, and Cartel JL (1994). Advantages of ivermectin at a single dose of 400 micrograms/kg compared with 100 micrograms/kg for community treatment of lymphatic filariasis in Polynesia. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88:** 461-464

Ogunniyi TAB, Simaren JO, and Amusan GO (1992). Prevalence of dracunculiasis among Nigerian school children as an index of prevalence in their communities of origin. *Annals of Tropical Medicine and Parasitology*, **86:** 407-412.

Ottesen EA (1980). Immunopathology of lymphatic filariasis in man. *Springer Seminars in Immunopathology*, **2:** 373-385.

Ottesen EA (1984). Immunological aspects of lymphatic filariasis and onchocerciasis in man. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **78:** S9-S18

Ottesen EA (1989). Filariasis now. *American Journal of Tropical Medicine and Hygiene*, **41:** 9-17.

Ottesen EA (1992). Infection and disease in lymphatic filariasis: an immunological perspective. *Parasitology*, **104:** S71-S79.

Ottesen EA (1994). The human lymphatic filariasis: new understandings, new therapeutic strategies. *Current Opinions in Infectious Diseases*, **7:** 550-558.

Ottesen EA and Ramachandran CP (1995). Lymphatic filariasis infection and disease: control strategies. *Parasitology Today*, **11:** 129-131.

Pani SP, Balakrishnan N, Srividya A, Bundy DA and Grenfell BT (1991). Clinical epidemiology of bancroftian filariasis: effect of age and gender. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **85:** 260-264.

Pani SP, Yuvaraj J, Vanamil P, Dhanda V, Grenfell BT, and Bundy DAP (1995). Episodic adenolymphangitis and lympoedema in patients with bancroftian filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89:** 72-74.

Pani SP, Gyapong JO, Premji Z, Radhamani MP, Belizario V and Premkumar M (1997). Clinical epidemiology of lymphatic filariasis II: comparison of acute episodic adenolymphangitis (ADL) in six different sites. *Acta Tropica*, In press.

Partono F (1987). The spectrum of disease in lymphatic filariasis. *Ciba Foundation Symposium*, **127:** 15-31.

Partono F, Cross JH, Purnomo, and Demijati S (1973). Evaluation of thick smear, Knott and membrane filtration methods for demonstrating microfilarae in blood. *Tropical and Geographical Medicine,* **25:** 286-289.

Pfister R (1954). Results of Survey on carriers of microfilariae in French west Africa. *Bulletin de la Societe de Pathologie Exotique et de ses Filiales,* **47:** 408-411.

Prescott NM (1987). The economics of schistosomiasis chemotherapy. *Parasitology Today,* **3:** 21-25.

Rajagopalan K (1990). Filariasis in India. *National Medical Journal of India,* **3**: 1-4.

Ramaiah KD, Das PK and Dhanda V (1994). Estimation of permissible levels of transmission of bancroftian filariasis based on some entomological and parasitological results of a 5-year vector control programme. *Acta Tropica,* **56:** 89-96.

Ramaiah KD, Kumar KNV and Ramu K (1996a). Knowledge and beliefs about transmission, prevention and control of lymphatic filariasis in rural areas of South India. *Journal of Tropical Medicine and International Health,* **1:** 433-438.

Ramaiah KD, Ramu K, Kumar KNV and Guyatt H (1996b). Epidemiology of acute filarial episodes caused by Wuchereria bancrofti infection in two rural villages in Tamil Nadu, south India. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* **90:** 639-643.

Ramu K, Ramaiah KD, Guyatt H and Evans D (1996). Impact of lymphatic filariasis on the productivity of male weavers in a south Indian village. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* **90:** 669-670.

Ramzy RM, Gad AM, Faris R and Weil GJ (1991). Evaluation of a monoclonal-antibody based antigen assay for diagnosis of *Wuchereria bancrofti* infection in Egypt. *American Journal of Tropical Medicine and Hygiene,* **44:** 691-695.

Rauyajin O, Kamthornwachara B and Yablo P (1995). Socio-cultural and behavioural aspects of mosquito-borne lymphatic filariasis in Thailand: a qualitative analysis. *Social Science and Medicine,* **41:** 1705-1713.

Regional Director of Health Services, Western Region (1993). Elephantiasis in Ahanta West District. A Project Report.

Rothenberg RB, Labanov A, Singh KB, and Stroh G (1985). Observations on the application of EPI cluster survey methods for estimating disease incidence. *Bulletin of the World Health Organization,* **63:** 93-99.

Santhanam S, Kumar H, Sethumadhavan KV, Chandrasekharan A, Jain DC, Malhotra A, Ghosh TK and Weil GJ (1989). Detection of Wuchereria bancrofti antigen in serum and finger prick blood samples by enzyme immunoassay: field evaluation. *Tropical Medicine and Parasitology,* **40:** 440-4

Selwyn BJ, Frerich RR, Smith GS, and Olson J (1989). Rapid epidemiological assessment: the evolution of a new discipline- an introduction. *International Journal of Epidemiology,* **18:** S1.

Shenoy RK, Sandhya K, Suma TK, and Kumaraswami V (1995). A preliminary study of filariasis related acute adenolymphangitis with special reference to precipitating factors and treatment modalities. *Southeast Asian Journal of Public Health,* **26:** 301-305.

Simonsen PE, Meyrowitsch DW, Makunde WH and Magnussen P (1995). Bancroftian filariasis: the pattern of microfilaraemia and clinical manifestations in three endemic communities in North-eastern Tanzania. *Acta Tropica,* **60:**179-187.

Smith GS (1989). Development of Rapid epidemiological assessment methods to evaluate health status and delivery of health services. *International Journal of Epidemiology,* **18:** S2-S15.

Snow RW, Armstrong JR, Forster D, Winstanley MT, Marsh VM, Newton CR, Waruiru C, Mwangi I, Winstanley PA, and Marsh K (1992). Childhood deaths in Africa: uses and limitations of verbal autopsies. *The Lancet,* **340:** 351-355.

Sommer A (1982). A field guide to the detection and control of xerophthalmia, 2nd edition. World Health Organization, Geneva.

Southgate BA (1974). A quantitative approach to parasitological techniques in bancroftian filariasis and its effect on epidemiological understanding. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* **68:** 177-185.

Southgate BA (1992a). The significance of low density microfilaraemia in the transmission of lymphatic filarial parasites. *Journal of Tropical Medicine and Hygiene,* **95:** 78-86.

Southgate BA (1992b). Intensity of transmission and development of microfilaraemia and disease: their relationship to lymphatic filariasis. *Journal of Tropical Medicine and Hygiene,* **95:** 1-12.

Srividya A, Pani SP, Rajagopalan, Bundy DAP, and Grenfell (1991). The dynamics of infection and disease in bancroftian filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **85:** 255-259.

Statistical Service Department (1984). Ghana Demographic Survey.

Stone L and Campbell JG (1984). The use and misuse of surveys in international development. An experiment from Nepal. *Human Organization*, **43:** 27-37.

Sundaresan TK (1992). Issues involved in the rapid assessment of the Leprosy problem. *Leprosy Review*, **63:** 11S-20S.

Taylor RH, Duke BOL, and Monoz B (1992). The selection of communities for treatment of onchocerciasis with ivermectin. *Tropical Medicine and Parasitology*, **43:** 267-270.

Tesch R (1989). TextBase Alpha Users Manual.

Turner P, Copeman B, Gerisi D and Speare R (1993). A comparison of the Og4C3 antigen capture ELISA, the Knott test, an IgG4 assay and clinical signs, in the diagnosis of bancroftian filariasis. *Tropical Medicine and Parasitology*, **44:** 45-48.

Turner AG, Magnani RJ and Shuaib M (1996). A not quite as quick but much cleaner alternative to the Expanded Programme on Immunization (EPI) Cluster Survey Design. *International Journal of Epidemiology,* **25:** 198-203.

Vlassoff C (1979). Fertility control without mordenization: evidence from a rural Indian community. *Journal of Biosocial Science*, **11:** 325-339.

Vlassoff C and Tanner M (1992). The relevance of rapid assessment to health research and interventions. *Health Policy and Planning*, **7:** 1-9.

Vlassoff C and Vlassoff M (1978). Misreporting of rural fertility data: an analysis of husband-wife disagreement. *Journal of Biosocial Science*, **10:** 437-444.

Wamae CN (1994). Advances in the diagnosis of human lymphatic filariases: a review. *East African Medical Journal,* **71:** 171-182.

Webber RH (1979). Eradication of Wuchereria bancrofti infection through vector control. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **73:** 722-724.

Webber RH (1991). Can anopheline-transmitted filariasis be eradicated?. *Journal of Tropical Medicine and Hygiene*, **94:** 241-244.

Webber RH and Southgate BA (1981). The maximum density of anopheline mosquitoes that can be permitted in the absence of continuing transmission of filariasis. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **75:** 499-506.

Wegesa P, McMahon JE, Abaru DE, Hamilton PJ, Marshall TF, and Vaughan JP (1979). Tanzania filariasis project. Survey, methodology and clinical manifestations of bancroftian filariasis. *Acta Tropica*, **36:** 367-377.

Weil GJ, Kumar H, Santhanam S, Sethumadhavan KV and Jain-DC (1986). Detection of circulating parasite antigen in bancroftian filariasis by counterimmunoelectrophoresis. *American Journal of Tropical Medicine and Hygiene*, **35:** 565-70

Weil GJ, Jain DC, Santhanam S, Malhotra A, Kumar H, Sethumadhavan KVP, Liftis F and Ghosh TK (1987). A monoclonal antibody-based enzyme immunoassay for detecting parasite antigenaemia in bancroftian filariasis. *Journal of Infectious Diseases*, **156:** 350-355.

Weil GJ, Ramzy RMR, Chandrasherkar R, Gad AM, Lowrie RC and Faris R (1996). Parasite antigenemia without microfilaraemia in bancroftian filariasis. *American Journal of Tropical Medicine and Hygiene*, **35:** 565-70.

Weller PF, Ottesen EA, Heck L, Tere T, and Neva FA (1982). Endemic filariasis on a Pacific island. I. Clinical, epidemiologic, and parasitologic aspects. *American Journal of Tropical Medicine and Hygiene*, **31:** 942-952.

Wijers DJB and Kinyanjui H (1977). Bancroftian filariasis in Kenya II. Clinical and parasitological investigations in Mambrui, a small coastal town and Jaribuni, a rural area more inland (Coast Province). *Annals of Tropical Medicine and Parasitology*, **71:** 333-345

World Bank (1993). World Development Report. Investing in health (World development indicators). Oxford University Press, New York, pp 1-329.

World Health Organization (1984). Lymphatic filariasis. Fourth report of the WHO expert committee on lymphatic filariasis. *WHO technical report series*, **702.**

World Health Organization (1987). Control of lymphatic filariasis. A manual for health personnel. WHO Geneva, Switzerland.

World Health Organization (1992). Lymphatic filariasis: The disease and its control. Fifth report of WHO expert committee on lymphatic filariasis. *WHO technical report series*, **821**.

World Health Organization Expert Committee on Filariasis (1993). Lymphatic filariasis: Diagnosis and pathogenesis. *Bulletin of the World Health Organization*, **71:** 135-141.

World Health Organization (1994). Lymphatic filariasis Infection and Disease: Control Strategies. Report of a WHO Consultative Meeting held at the Universiti Sains Malaysia, Penang, Malaysia.

World Health Organization (1996a) Community directed treatment with ivermectin: Report of a multi-country study. TDR/AFR/RP/96.1

World Health Organization (1996b). Lymphatic Filariasis Fact Sheet No. 102. Division of Control of Tropical Diseases, Geneva, Switzerland.

Zhang S, Zhang Q, Chen F, Wang L, and Pen G (1991). Threshold for the transmission of *Brugia malayi* by *Anopheles sinensis*. *Journal of Tropical Medicine and Hygiene*, **94:** 245-250.

Appendices

Appendix I: Guidelines for Focus Group Discussions.

- How do people recognise and perceive filariasis?
    - What disease states are recognized
    - Is there one word for filariasis
    - Explore local terminologies

- Knowledge on the cause and transmission of filariasis.
    - Explore local beliefs
    - ? Mosquito
    - ? Hereditary

- The relative importance of filariasis to other disease in the community.
    - ?Malaria
    - Schistosomiasis, etc.

- The community's attitude to people with filariasis, especially evident chronic disease.

- The family and community role in the management of filariasis patients.

- The treatment seeking practice at the various stages of the disease.
    - Traditional methods
    - Modern health care

- The effect of filariasis on agricultural, economic and social activities.
    - Productivity
    - Leadership roles

Appendix II: District Assembly Questionnaire used in the Pilot Study

(District Assembly) FORM NO.....

Health Research Unit, Ministry of Health Ghana
Rapid Assessment of Burden and Distribution of Disease
Self Administered Questionnaire for Elected District Assembly Members

1. Basic Data

1.1 Individual name..... Name

1.2 Sex..... Sex

1.3 Age..... Age

1.4 Electoral area..... EA

1.5 Date of interview..... Date

2. General Information on Community

2.1 How many villages do you represent..... Vill

2.2 What is the estimated population..... Pop
of your electoral area

2.3 How many JSS are in your electoral area..... ..... JSS

3. Information on Health

3.1 List in order, the commonest childhood diseases in your electoral area.

1_____ 4_____

2_____ 5_____

3_____ 6_____

3.2 List in order, the common diseases of adults in your electoral area?

1_____ 4_____

2_____ 5_____

3_____ 6_____

3.3 Do you have a Health Centre/Post in your electoral area?

1. Yes	2. No	9. NK	Hcen

3.4 Do you have a community clinic/dispensary in your electoral area?

1. Yes	2. No	9. NK	Clin

3.5 Do you have a "drug shop" in your electoral area?

1. Yes	2. No	9. NK	Drug

4. Specific Disease Information

4.1 Do you know of people in your electoral area with Goitre?

1. Yes	2. No	9. NK	Goit

4.2 List number you know of per village

1		5	
2		6	
3		7	
4		8	

4.3 Do you know of people in your electoral area with elephantiasis of the leg?

1. Yes	2. No	9. NK	Elep

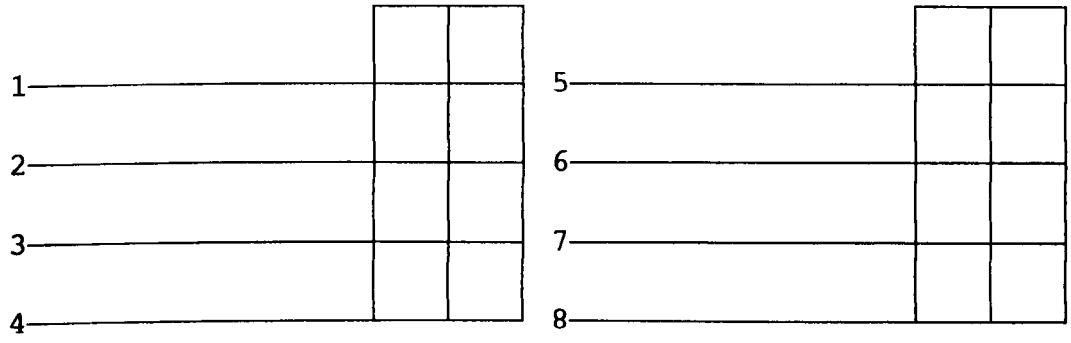
4.4 List the number you know per village

1		5	
2		6	
3		7	
4		8	

4.5 Do you know of people in your electoral area with hydrocele?

1. Yes	2. No	9. NK	Hydr

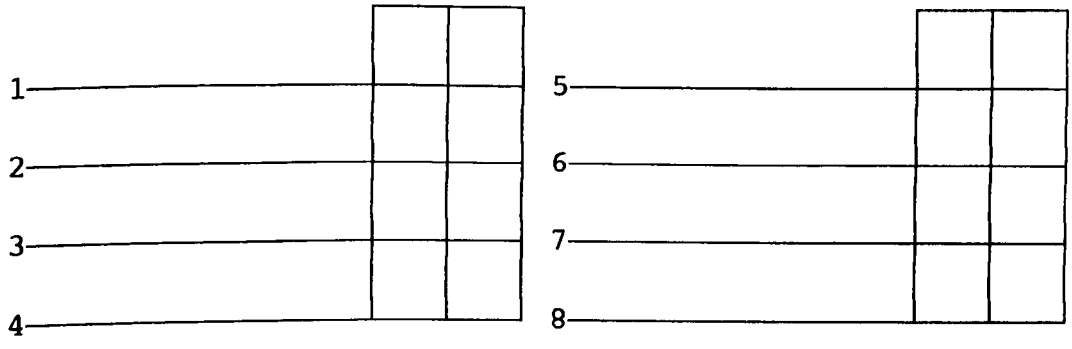
4.6 List the number you know per village



4.7 Do you know of people in your electoral area with guinea worm?

1. Yes	2. No	9. NK	Gwor

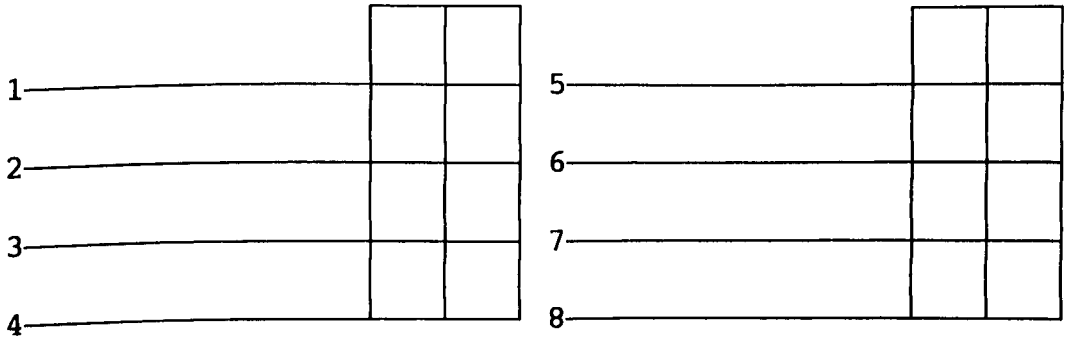
4.8 List the number you know per village



4.9 Do you know of people in your electoral area with leprosy?

1. Yes	2. No	9. NK	Lepr

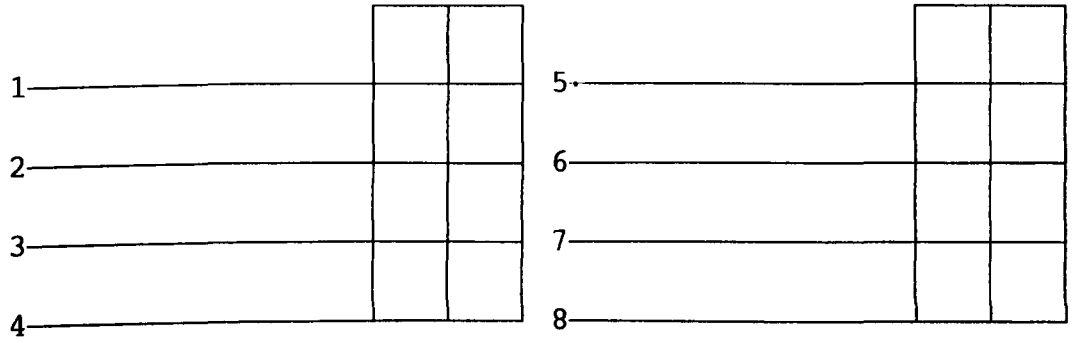
4.10 List the number you know per village



4.11 Do you know of people in your electoral area with Yaws?

1. Yes	2. No	9. NK	Yaws

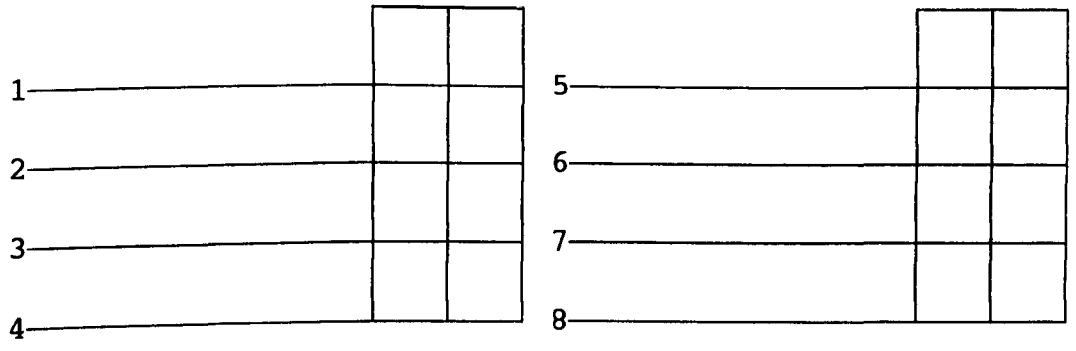
4.12 List the number you know per village



4.13 Do you know of people in your electoral area with burili ulcer?

1. Yes	2. No	9. NK	Buri

4.14 List the number you know per village



4.15 Please provide any other health information which you consider very important, but has not been raised in the questionnaire.

.....
.....
.....
.....
.....
.....
.....
.....

Appendix III: School Teachers Questionnaire Used in the Pilot Study

(School Teachers) FORM NO.....

Health Research Unit, Ministry of Health Ghana
Rapid Assessment of Burden and Distribution of Disease
Self Administered Questionnaire for School Teachers

1. Basic Data

1.1 Individual name..... Name

1.2 Sex..... Sex

1.3 Age..... Age

1.4 School..... School

1.5 Date of interview..... Date

2. General Information on Community

2.1 How many villages does your school serve. Vill

2.2 What is the population of the school..... Spop

2.3 How many pupils are in your class..... Cpop

2 Information on Health

3.1 List in order, the common diseases among pupils in this school.

1_____ 5_____

2_____ 6_____

3_____ 7_____

4_____ 8_____

3.2 List in order, the common diseases among adults in your community.

1_____ 5_____

2_____ 6_____

3_____ 7_____

4_____ 8_____

3.3 Do you have a Health Centre/Post in your community?

1. Yes	2. No	9. NK	Hcen

3.4 Do you have a school clinic/dispensary?

1. Yes	2. No	9. NK	Scli

3.5 Do you have a "drug shop" in your community?

1. Yes	2. No	9. NK	Drug

4. Specific Disease Information

4.1 Do you know of people in your community with Goitre?

1. Yes	2. No	9. NK	Goit

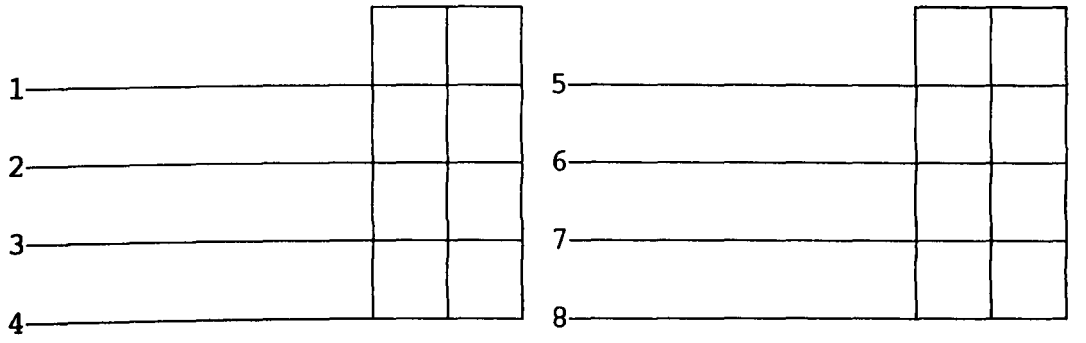
4.2 List number you know of per village

1			5		
2			6		
3			7		
4			8		

4.3 Do you know of people in community with elephantiasis of the leg?

1. Yes	2. No	9. NK	Elep

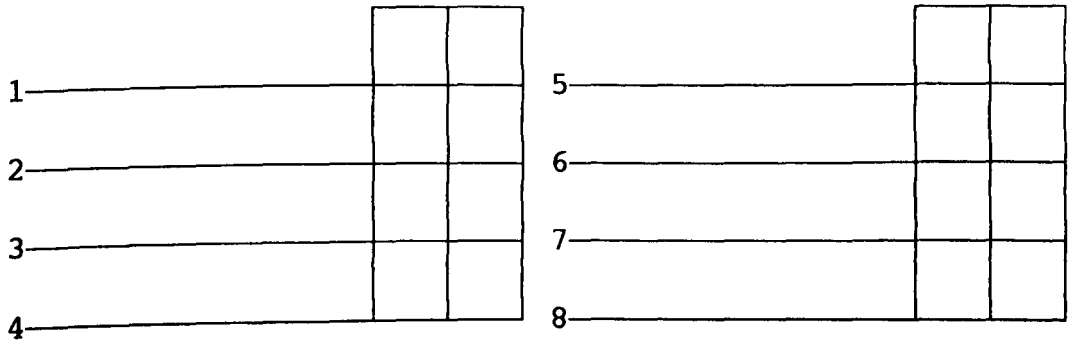
4.4 List the number you know per village



4.5 Do you know of people in your community with hydrocele?

1. Yes	2. No	9. NK	Hydr

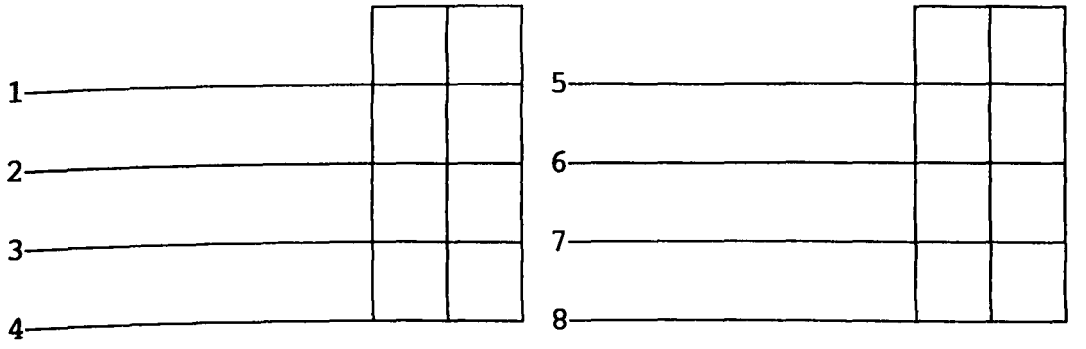
4.6 List the number you know per village



4.7 Do you know of people in your community with guinea worm?

1. Yes	2. No	9. NK	Gwor

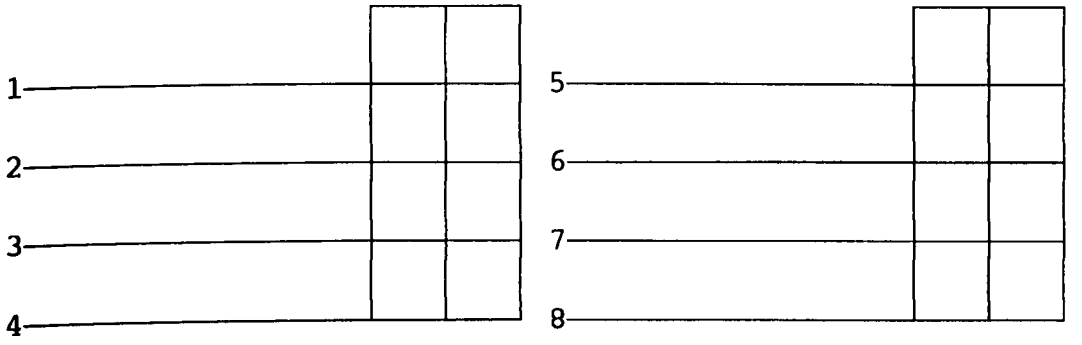
4.8 List the number you know per village



4.9 Do you know of people in your community with leprosy?

1. Yes	2. No	9. NK	Lepr

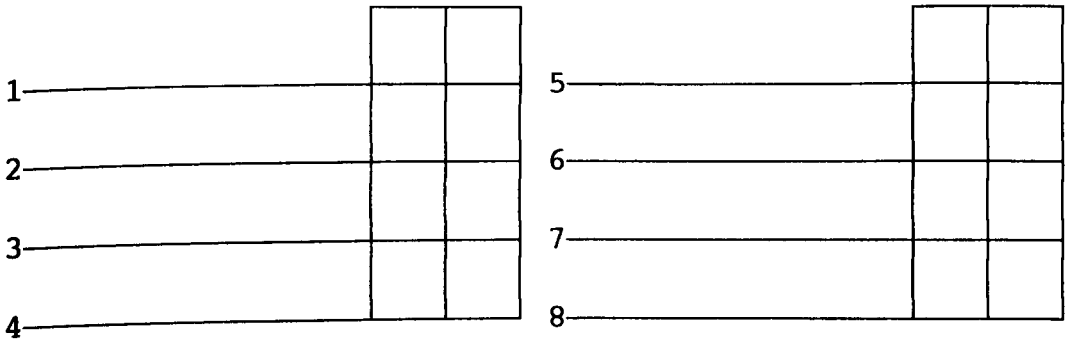
4.10 List the number you know per village



4.11 Do you know of people in your community with Yaws?

1. Yes	2. No	9. NK	Yaws

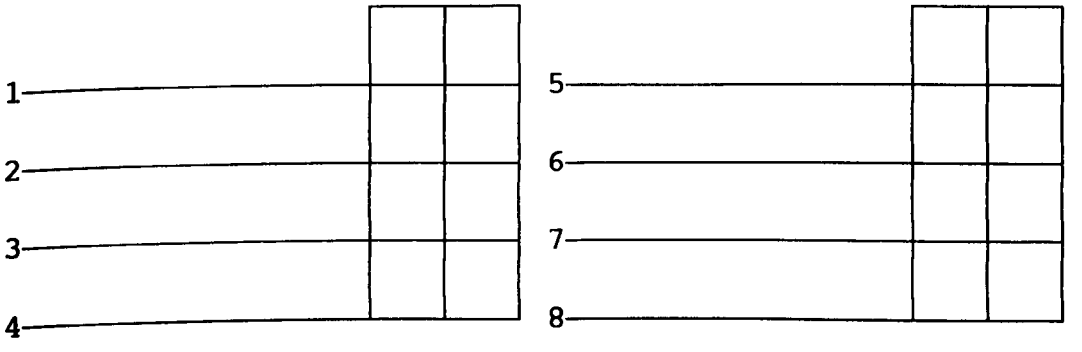
4.12 List the number you know per village



4.13 Do you know of people in your community with burili ulcer?

1. Yes	2. No	9. NK	Buru

4.14 List the number you know per village



5 School children

5.1 Did any of the children in your class experience a combination of at least two of the following symptoms in the last month?
a) fever b)painful leg/arm c)swollen leg/arm d)painful swelling of armpit/groin

1. Yes	2. No	9. NK	ADL

5.2 How many? If the answer in 5.1 is "No" or "NK", then enter "88"

		ADLN

5.3 Is there anyone in your class with a permanently swollen leg/arm?

1. Yes	2. No	9. NK	Swel

5.4 How many? If the answer in 5.3 is "No" or "NK", then enter "88"

		Snum

Appendix IV: Health Facility Questionnaire Used in the Pilot Study.

(Health Personnel) FORM NO.....

Health Research Unit, Ministry of Health Ghana
Rapid Assessment of the Burden of Lymphatic Filariasis
Group Interview of Selected Health Personnel

1. Basic Data

1.1 Name of Institution..... INST

1.3 District..... DIST

1.4 Region..... REG

1.5 Date of Interview..... DATE

2. Outpatient Records

2.1 How many patients were seen at the OPD in the last 12 months? OPDN

2.2 How many were diagnosed as lymphangitis or lymphadenitis? OPDA

2.3 How many were diagnosed as lymphoedema or elephantiasis? OPDE

2.4 How many were diagnosed as hydrocele? OPDH

3. Inpatient Records

3.1 How many patients were admitted at the health facility in the last 12 months?

							INPN

3.2 How many were diagnosed as lymphangitis or lymphadenitis?

					INPA

2.3 How many were diagnosed as lymphoedema or elephantiasis?

					INPE

2.4 How many were diagnosed as hydrocele?

					INPH

4. Surgical or Operative Procedures

4.1 How many surgical/operative procedures were done in the last 12 months?

							SURN

4.2 What was the indication for the surgery?

Obstetric and Gynaecological.						OBG
Hernias						HER
Hydroceles						SURH
Other						OTHER

5. Laboratory Investigations

5.1 How many blood specimens were examined for filariasis in the last 12 months?

					LABN

5.2 How many were found to be positive for microfilaria?

					LABF

5.3 How many hydrocele fluid specimens were examined for filariasis in the last 12 months?

					LABH

5.4 How many were found to be positive?

					HFIL

Appendix V: The Census Form and Coding Sheet

Census Form

Village..... House Number.....

Interviewer Date...

Status.....

Head of Household.....

IDN	NAME	YOB	SEX	MAR	EDU	REL	OCC
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Census Coding Sheet

Use BLOCK LETTERS through out.

1. INTERVIEWER: Write your two letter code given you during the training

2. DATE: DD/MM/YY

3. STATUS: Occupied=O Unoccupied=U

4. IDN- This is already provided on the census sheet. In the rare occasion where you find more than 20 people in a household, use the additional sheets provided.

5. NAME- Write two names per person, preferably the names by which they can easily be identified.

6. YOB- Record the Year of Birth (NOT AGE). The appropriate use of local events calendar is essential.

7. SEX- M=Male; F=Female

8. MAR- Marital Status
   - MR=Married
   - DI=Divorced
   - WI=Widowed
   - SI=Single
   - SP=Separated
   - NA=Not Applicable (Below 18yrs and not married)
   - NK=Not Known

9. EDU- Educational Status
   - 0=No formal education
   - 1=Primary education (Class 1-6)
   - 2=Secondary education (JSS, SSS, technical, commercial schools etc)
   - 3=Tertiary education (university, post sec. training colleges etc)

10. REL- Religion
    - C=Christian M=Muslim T=Traditional O=Other

11. OCC- Occupation
    - FM=Farmer
    - FS=Fisherman
    - TR=Trader
    - AT=Artisan (eg tailors, carpenters etc)
    - GE=Govt. Employee
    - UN=Unemployed (above 18yrs and not working)
    - NA=Not applicable (children and those in school)

Appendix VI: Key Informants Questionnaire Used in the Main Study

Key Informants Form No.....

Indirect/direct Interview of Key Informants
Rapid Assessment of Community Burden of Disease

1. Name_____ Age_____ Sex____ Occupation_____

2a. What is the estimated population of this village/ community_____

2b. How many schools are in this village_____

3a. What are the commonest childhood diseases in this village.

a._____b._____c._____

d._____e._____f._____

3b. If there was enough money to help prevent only THREE of these childhood diseases, list in order of preference, the ones you would choose.

a._____b._____c._____

4a. What are the commonest diseases of school going children in this village.

a._____b._____c._____

d._____e._____f._____

4b. If there was enough money to help prevent only THREE of these diseases of school going children, list in order of preference, the ones you would choose.

a._____b._____c._____

5a. What are the commonest diseases of adults in this village.

a._____b._____c._____

d._____e._____f._____

5b. If there was enough money to help prevent only THREE of these diseases of adults, list in order of preference, the ones you would choose.

a._____b._____c._____

6. Do you have a community clinic/dispensary in your village? Yes____ No____

7. Specific Disease Information

7.1 Do you know of people in this village with Goitre? Yes____ No____

How many people in the village have goitre _____

7.2 Do you know of people in this village with elephantiasis of the leg?
Yes___ No__

How many people in the village have elephantiasis _____

7.3 Do you know of people in this village with hydrocele? Yes____ No____

How many people in the village have hydrocele _____

7.4 Do you know of people in this village with guinea worm? Yes____ No____

How many people in the village have guinea worm _____

7.5 Do you know of people in this village with leprosy? Yes____ No____

How many people in the village have leprosy _____

7.6 Do you know of people in this village with Tuberculosis? Yes____ No____

How many people in the village have tuberculosis _____

8. Please provide any other health information which you consider very important, but has not been raised in the questionnaire.

.....

.....

.....

.....

.....

Appendix VII: Clinical Examination Form Used by Health Workers.

Form No.....

Simplified Clinical Examination by Health Worker

Village_____ **Staff Code**___

PERMID	Name	Age	Sex	ADL in the last month	Elephantiasis in family member	Examination for limb elephantiasis	Examination for hydrocele	Examination for breast lymphoedema

ADL: 0=No history of ADL in the last month, 1=Had ADL in the last month
Elephantiasis of limbs in family member: 0=No; 1=Yes
Elephantiasis of limbs in respondent: 0=No; 1=Yes
Hydrocele in respondent: 0=No; 1=Yes, smaller than tennis ball; 2=Yes, bigger than tennis ball
Lymphoedema of breast: 0=No; 1=Yes

Appendix VIII: Form for Validation of Health Worker's Clinical Examination.

Form No.....

Physician Clinical Examination (Validation) Form

Village_____ **Physician Code**___

PERMID	Name	Age	Sex	ADL in the last month	Elephantiasis in family member	Examination for limb elephantiasis	Examination for hydrocele	Examination for breast lymphoedema

ADL: 0=No history of ADL in the last month, 1=Had ADL in the last month
Elephantiasis of limbs in family member: 0=No; 1=Yes
Elephantiasis of limbs in respondent: 0=No; 1=Yes
Hydrocele in respondent: 0=No; 1=Yes, smaller than tennis ball; 2=Yes, bigger than tennis ball
Lymphoedema of breast: 0=No; 1=Yes

Appendix IX: Photographs from the the Fieldwork

Page 198.
Top: Medical anthropologist have a focus group discussion with elders of Nsuakyir, one of the study communities in the Winneba district.

Bottom: Mr. Joseph Newton, a peripheral health worker in the Ahanta West District conducting a key informant interview.

Page 199.
Top: Numbering of houses as part of the census.

Bottom: Typical mosquito breeding site in the villages.

Page 200.
Top: Preparation for field work: members of the team loading the vehicle with some of the things needed for the work such as a generator to provide lighting and screens to provide privacy during the clinical examination.

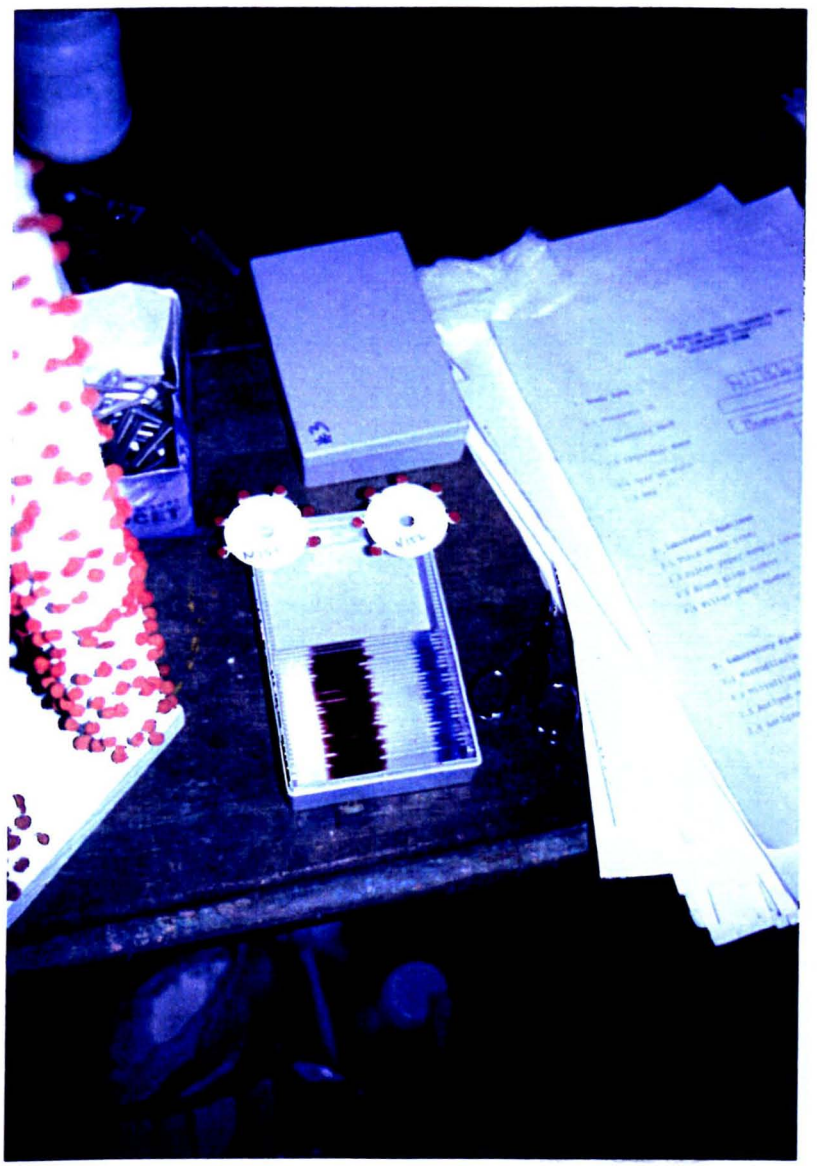
Bottom: Laboratory technician doing a finger prick to collect blood samples.

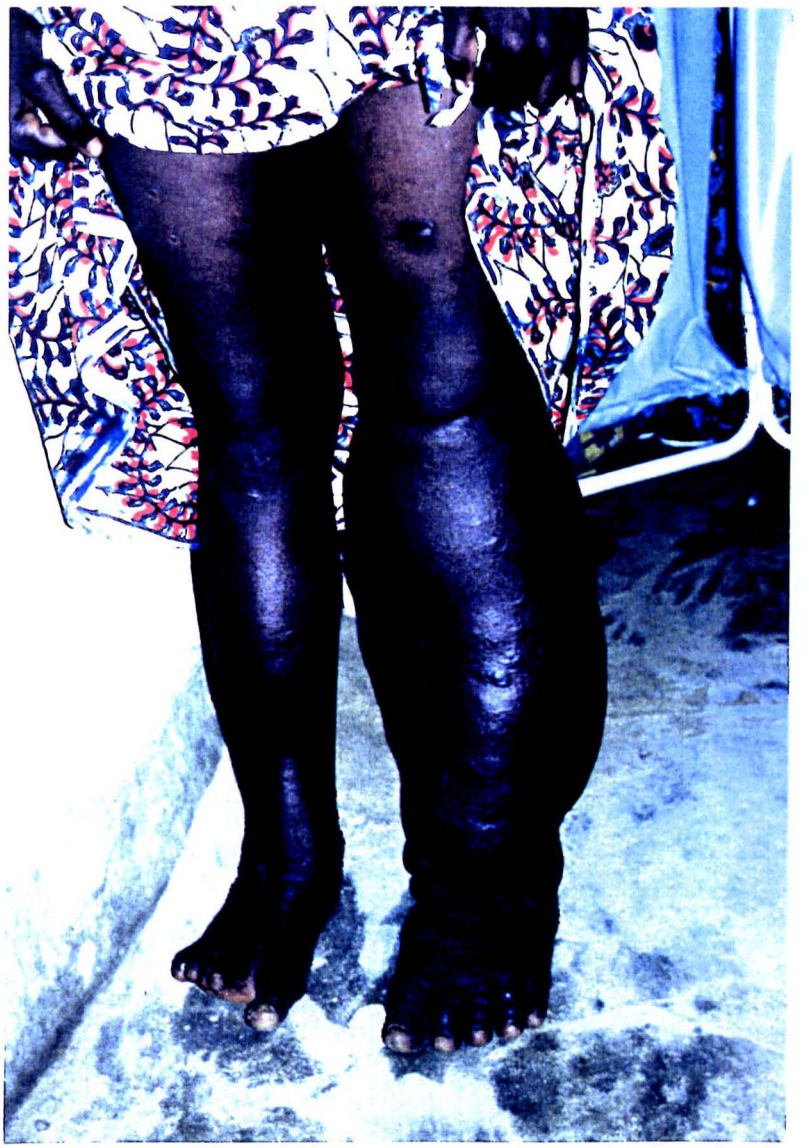
Page 201.
Blood samples collected onto filter papers and blood slides.

Page 202.
A 31 year old woman with elephantiasis of the leg.

Page 203.
A 29 year old man with a hydrocele and an inguinal hernia.


4WD





Appendix X: Notes on the Og4C3 Filarial Surface Antigen Assay

ELISA KIT FOR DETECTING AND QUANTIFYING *Wuchereria bancrofti* ANTIGEN

Filter paper compatible

03-010-05

Manufactured by JCU Tropical Biotechnology Pty Ltd
James Cook University of North Queensland
Townsville, Queensland, Australia 4811
A.C.N. 051 617 424

This kit contains sufficient reagents for 400 tests.

CONTENTS

1. **Microtitre Plates** Five U-bottom polystyrene microtitre plates pre-coated with Og4C3 monoclonal antibody.
2. **Sample diluent** One 100 mL bottle of diluent (Clear solution) at working strength for mixing with samples prior to boiling.
3. **Antibody and conjugate diluent** One 100 mL bottle (Blue solution).
4. **Hydrogen Peroxide** One 2 mL bottle of H_2O_2 concentrate (amber with a green cap).
5. **Standard antigens (1-7)** Seven dilutions of *Onchocerca gibsoni* antigen. Each vial contains 600 μL of standard (Orange cap).
6. **Rabbit anti-onchocerca antibody** One 300 μL bottle (Yellow cap).
7. **Conjugate** One 300 μL bottle of anti-rabbit horseradish peroxidase conjugate (Purple cap).
8. **Chromogen** One 60 mL bottle of single component ABTS ready to use..
9. **Washing buffer** (x20) concentrate.
10. **Wash bottle** (optional)

METHOD

All steps carried out at room temperature.

Ensure that all reagents and the microtitre plates are at room temperature before use.

Quantities indicated below refer to those required for the use of **ONE** plate.

To prepare washing buffer, dispense one measure from the x20 dispensing bottle into 500 mL of distilled water.

1. **Preparation of filter paper samples.**

   Cut three protrusions from the disk and add them to a suitable tube. If the racked tubes supplied in the kit (005-001-08) are used the protrusions should first be cut in half to allow the disks to reach the bottom of the tubes.

   Add 200 μL of sample diluent to each tube and place the racked tubes into a 100°C water bath for five minutes.

   After boiling, centrifuge the samples at 2,000 *g* for 15 minutes. The supernatant fluid contains the heat stable antigen.

   Add 50 μL aliquots of supernatant fluid to a test well. Up to 80 samples can be tested per plate (see the plate layout diagram).

2. Add the **standard antigens** and **conjugate control** to rows 11 and 12 (following the plate diagram shown below).

Add the standards (1-7) (Orange caps) at 50 μL per well in duplicate. **Do not dilute or boil.**

For conjugate control (CC), add 50 μL of sample diluent (100 mL bottle, clear solution) to wells A11 and A12.

3. Place the plate(s) in a humid container and incubate for at least 1.5 hours at room temperature. Plates may be incubated overnight to increase sensitivity.

4. Wash the plate three times with wash buffer, invert and tap gently to remove residual droplets.

5. Prepare the blocking solution by adding 200 μL of H_2O_2 concentrate to 6 mL of diluted wash buffer.

   Add 50 μL of blocking solution to all wells and incubate for 10 minutes.

6. Wash the plate three times as before.

7. Dilute rabbit anti-*Onchocerca* antibody by adding 50 μL of rabbit anti-*Onchocerca* antibody (Yellow cap) to 6 mL of antibody diluent.

   Add 50 μL of diluted rabbit antibody to all wells and incubate for one hour.

8. Wash the plate three times as before.

9. Dilute conjugate by adding 50 μL of anti-rabbit conjugate (Purple cap) to 6 mL of antibody diluent. Add 50 μL of diluted conjugate to all wells and incubate for one hour.

10. Wash the plate three times as before.

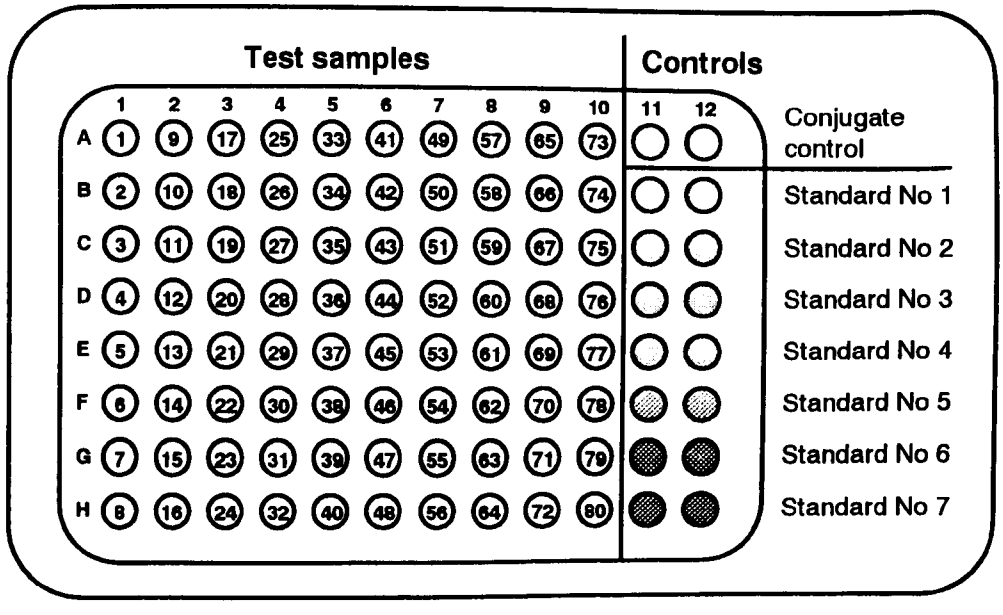
11. Add 100 μL of chromogen (ABTS) (**do not dilute**) to each well and incubate for one hour.

12. Plates can be read with a spectrophotometer at a single wavelength of 414 nm or dual wavelengths of 414 and 492 nm.

    Blank the plate reader on wells containing conjugate control or a row of wells containing substrate in a separate blanking plate.

    This kit is to be used for *in vitro* testing purposes only. All components must be disposed of by autoclaving at the completion of the testing.

Standard ELISA plate layout



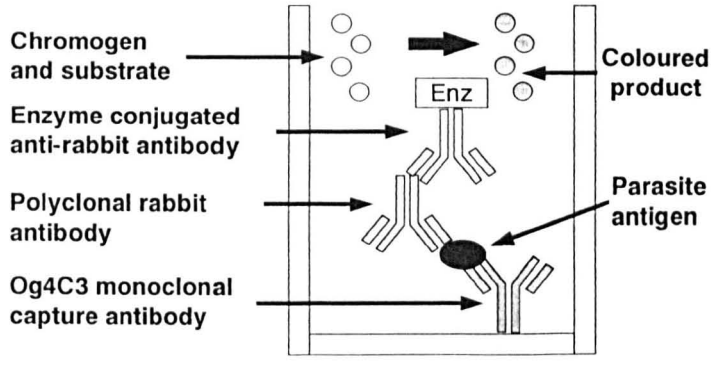
Notes on the assay

This kit has been designed to be used in conjunction with the filter paper collection kits (05-001-08 and 05-001-07). Boiling of the filter papers is likely to leach endogenous peroxidase from the erythrocytes in the filter paper. The assay incorporates an additional blocking step to remove this problem and prevent high non-specific background reactions from occurring.

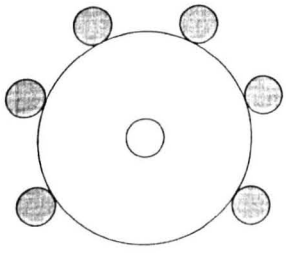
The 96 well microtitre plates supplied are coated with a monoclonal antibody(Og4C3) which has been shown to specifically recognise only *Wuchereria bancrofti* antigen in human sera. Og4C3 will not cross react with human sera infected with *Onchocerca volvulus*, *Brugia malayi*, *Brugia timori*, *Loa loa*, *Mansonella perstans*, *Strongyloides stercoralis*, *Dracunculus medinensis* or *Ascaris lumbricoides*. The cattle parasite *Onchocerca gibsoni* is recognised by this monoclonal antibody and is used to standardise the ELISA.

The indicator antibody is produced by vaccinating rabbits with purified *Onchocerca gibsoni* antigen. Finally the rabbit globulin is detected by goat anti-rabbit globulin conjugated to horseradish peroxidase. The substrates solution which contains the chromogen ABTS produces a green colour which has maximum absorption at 414 nm.

ELISA configuration (antigen detection) for *W. bancrofti*



Collection of blood on TropBio filter paper disks



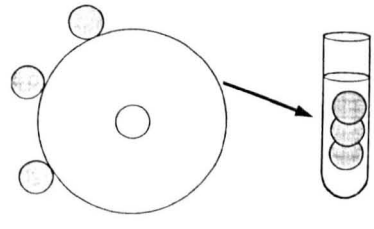
Sample collection protrusions are saturated with blood, dried and transported to the laboratory

Samples for this assay are collected on filter paper disks. One disk is collected per patient. A number can be recorded on the body of the disk prior to collection. Patient details are linked to the record number. A data sheet is supplied as part of the collection kit.

All six protrusions are saturated with blood and the filter paper is thoroughly dried on the rack provided. Each protrusion contains the equivalent of 5 µL of serum. The filter paper collection kit contains small plastic bags punched to allow air movement. These bags are then placed in groups of eighty and placed in a larger press seal bag into which is placed a silica gel sachet to further dry the samples.

The samples are transported to the laboratory. Eight samples will be placed in one column of the plate. The collection kit encourages the arrangement of the samples in blocks of eight which are then arranged in groups of 80 which is sufficient for one test plate. Five test plates containing 400 samples can be assayed in one kit.

Elution of parasite antigen from TropBio filter paper disks



Parasite antigen is eluted by boiling in the EDTA diluent

Three protrusions can be cut from the filter paper disk and placed in the elution tubes. To allow the disks to reach the bottom of the tubes provided in the kit (005-001-08) they should first be cut in half. Diluent containing EDTA is added to the tubes. Three disks will contain antigen equal to 15 µL of serum and this is eluted in 200 µL of diluent. This is equivalent to a 1:13 dilution of a serum sample.

In the kit which uses serum as a sample the dilution is 1:4. The filter paper results are therefore lower than the corresponding serum results. However, as most infected patients have relatively high antigen titres the clinical sensitivity remains high.

INTERPRETATION OF RESULTS

If the optical density for the high titre control is less than 1.1 or the optical density for the negative control (Standard No 1) is more than 0.3 the test results should be regarded as unreliable and the test should be repeated.

Please note that there can be quite large differences between plate readers. The result will also be influenced by the choice of filter (a 414 nm filter will produce the highest results). The absorbance indicated by the plate reader may also change as the filters deteriorate with age.

Seven control samples are used in duplicate on all plates. These samples are produced using parasite antigen extracted from *Onchocerca gibsoni* nodules. Control sample No 1 contains no parasite antigen. Control samples No 2 to No 7 all contain parasite antigen.

Sample No 2 is at the limit of the sensitivity of the assay. However, it will consistently produce an absorbance higher than the control sample No 1. Very few serum samples will react with a higher absorbance than control sample No 7.

Using these seven control samples it is possible to allocate the test samples into eight titre groups according to the following table. The titre groups are very useful for population studies. Moore and Copeman (1990) allocated antigen units to the seven controls.

Allocation of samples to titre groups			
Titre group	**Absorbance**	**Standard No**	**Antigen units**
1	< Control sample No 1	1	<10
2	≤ Control sample No 2	2	32
3	≤ Control sample No 3	3	128
4	≤ Control sample No 4	4	512
5	≤ Control sample No 5	5	2,048
6	≤ Control sample No 6	6	8,192
7	≤ Control sample No 7	7	32,000
8	> Control sample No 7		

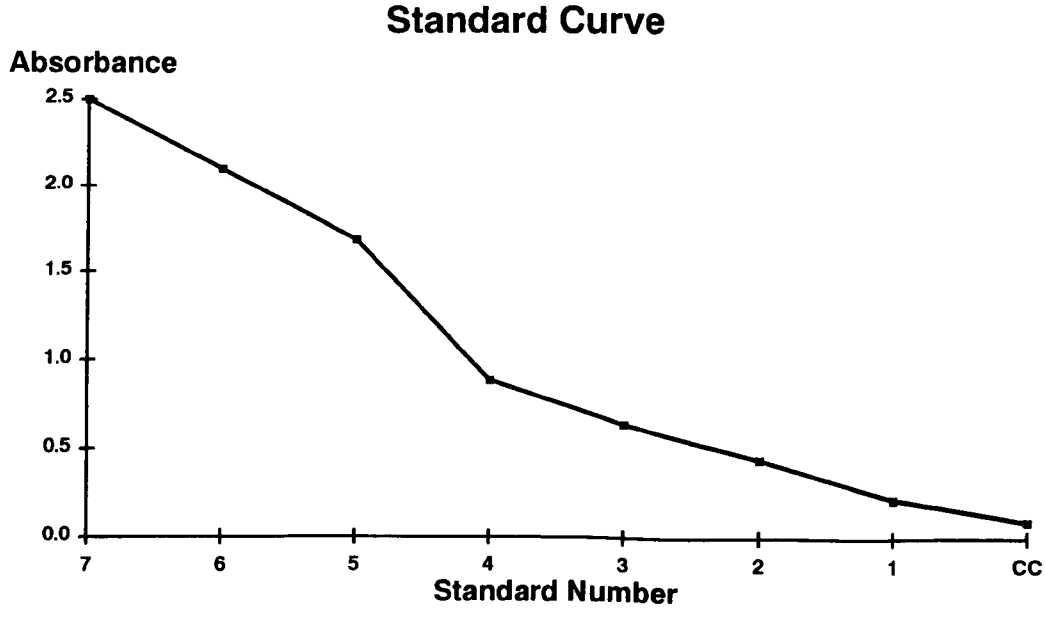
A total of 100 filter paper samples from uninfected patients from the Townsville region reacted with the following distribution. Mean OD = 0.149. Standard deviation = 0.045.

100 Australian samples	
Titre group	**Number of samples**
1	83
2	17
3 or more	0

The test samples allocated to titre groups 1 and 2 can be considered to be non-reactors (negative). Samples allocated to titre groups 4 to 8 can be considered to be reactors (positive).

Samples allocated to titre group 3 can be considered to be equivocal or suspect reactors. In a recent study in New Guinea, Ghana, the Philippines and India this group represented up to 10% of the test samples. None of the Australian samples from an uninfected population were allocated to group 3. It is very likely that samples allocated to group 3 are reacting in the assay. Further data will be collected on this group to determine their status.

A typical standard curve for the seven standard antigens is shown below. These values are used to allocate the test samples into one of eight titre groups according to the table shown above.



Published Papers

Related Published Papers

TRANSACTIONS OF THE ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (1995) 89, 616–618

Lay reporting of elephantiasis of the leg in northern Ghana

John O. Gyapong[1,3], **Nicola Dollimore**[2,3], **Fred N. Binka**[1,3] and **David A. Ross**[2,3] [1]*Navrongo Health Research Centre, Ministry of Health, Navrongo, Ghana;* [2]*Department of Epidemiology and Population Sciences, London School of Hygiene and Tropical Medicine, London, UK;* [3]*Ghana Vitamin A Supplementation Trials, Navrongo, Ghana*

Abstract

Within a large scale community trial in northern Ghana lay interviewers were trained to enquire about and identify elephantiasis of the leg by the use of local terms and simple examination of respondents. This was repeated a year later after moving the interviewers to different geographical areas. The proportions of extended family compounds reported to have at least one member with elephantiasis of the leg were 12·2% and 12·1% respectively in the first and second surveys (κ=0·60). 'Blind' re-examination of a sub-sample by a physician showed a high level of agreement with the lay interviewer's findings in the first and second surveys (κ=0·67 and 0·82 respectively). This study has shown that lay people, even with minimal training, can obtain repeatable and valid estimates of the prevalence of elephantiasis of the leg, at least within an area where local terms for the condition are available. This method could potentially be used for other diseases with visible manifestations.

Keywords: elephantiasis, lay reporting, Ghana

Introduction

Chronic obstructive lymphopathy due to lymphatic filariasis remains a disease which severely affects people of low socioeconomic status in some parts of tropical Africa and Asia, usually manifesting as elephantiasis of the leg and hydrocele (WHO, 1992). Little attention has been paid to this disease in many countries because data on the magnitude of the problem do not exist (WHO, 1992). The cost of conducting population-based studies of the prevalence of important illnesses has been a deterrent, especially when there are insufficient funds to act on the findings. There is, however, the need to assess priorities of diseases in order to direct the meagre resources available in the most cost-effective way, and to plan research into more effective and less costly interventions (VLASSOFF & TANNER, 1992). In this paper, we report how lay interviewers were trained to identify and record elephantiasis of the leg in a community-based survey, and on the repeatability and validity of their findings.

Methods

The study was carried out in the Kassena-Nankana District of the Upper East Region of Ghana, at the request of the Regional Ministry of Health. The study area has been described in detail elsewhere (GHANA VAST STUDY TEAM, 1993; GYAPONG *et al.*, 1994). The study used cross-sectional surveys plus the routine data collection of the child survival study component of the Ghana Vitamin A Supplementation Trials (VAST) (GHANA VAST STUDY TEAM, 1993). As part of the vitamin A study, trained lay interviewers visited over 6000 compounds in the rural areas of the district every 4 months to interview the mothers or guardians of all resident young children born during or after 1984. There were 7 data collection rounds during the 2 years of follow-up from September–December 1989 to September–December 1991. There were between 23 and 26 interviewers, each of whom was responsible for a specific geographical area (subzone) with a total population of 3000–4000 people. The interviewers were all local people who had had at least 10 years of formal education and spoke at least one of the 2 main languages in the study area, Kassim and Nankani.

During the second data collection round, from January to April 1990, the interviewers were given special training to identify elephantiasis of the leg. This is well known in the district, with recognized local names throughout the study area—*napimpim* in Kassim and *nantintim* in Nankani. The training was very simple and involved a discussion of the local names for elephantiasis of the leg and a physician showing the interviewers several cases, both in photographs and among patients attending the district hospital. No measurement was taken in making the diagnosis, which was based purely on questions and observations. A diagnosis of elephantiasis was made if the leg was enlarged to at least twice the normal size. No distinction was made between lymphoedema and elephantiasis. The interviewers enquired whether there was anyone living in the compound with elephantiasis of the leg, using the appropriate local name. They then examined the respondent for the presence or absence of the condition.

The result of the first survey showed considerable variation in the prevalence between the study subzones. The survey was therefore repeated during the fifth data collection round from January to April 1991, to establish whether the differences were stable or due to inter-observer variation. As one of the measures to maintain a high quality of data collected in the vitamin A study, interviewers were moved to a different subzone after each dosing round. Thus, in the second (1991) survey, each of the geographical areas was visited by a different interviewer from the one who had visited that area in the first (1990) survey.

An additional validation exercise was undertaken in the 5 subzones where the proportions of compounds with elephantiasis cases reported in the 2 surveys differed by more than 4%. The sensitivity, specificity, and predictive values of the lay interviewers' findings were not calculated because they could be misleading, since the validation study was not performed on a representative sample of all individuals in the main study. Respondents from these 5 areas who were interviewed in both surveys were identified and grouped into those in whom the 2 interviewers agreed that elephantiasis was present, those in whom they agreed it was absent and those in whom there was disagreement between the 2 interviewers. The research physician (J. O. G.) attempted to visit all those about whom the interviewers had disagreed, and a random sample of those for whom they had agreed. Altogether, 106 individuals were re-interviewed and re-examined by the physician, who was not aware of the interviewers' findings.

All data forms were double-entered into microcomputers by 2 clerks in the field office in Navrongo using D-Base III+®, and were checked for range and internal consistency. Analysis was conducted using Epi-Info and SPSS PC+® software. The repeatability of the interviewers' findings was assessed by calculating κ scores. By convention, we took κ<0 to indicate discordance between the interviewers, 0–0·39 to represent poor agreement, 0·40–0·74 as good agreement, and >0·75 as excellent agreement (FLEISS, 1981).

Results

A high prevalence of elephantiasis of the leg was found

Address for correspondence: Dr John O. Gyapong, Health Research Unit, Ministry of Health, P.O. Box 184, Accra, Ghana.

in both surveys, but with considerable variation between the different study subzones. In the first (1990) survey, data were collected from 5846 compounds, of which 12·2% had at least one resident reported as having elephantiasis of the leg (range 2·1–22·1), compared to 12·1% of the 6050 compounds visited in the same geographical area during the second (1991) survey (range 4·4–19·0). The agreement between the 2 sets of observers was good (κ=0·60; range 0·26–0·82) (Table 1).

There was a high level of agreement between the findings of the lay interviewers and the physician concerning the 106 individuals re-examined in the validation study (Table 2). This was especially so in the second survey, when they had received more training. In survey 1, κ=0·67; in survey 2, κ=0·82. Of the 18 individuals about whom there was disagreement between the interviewers, 16 were cases of grade 1 elephantiasis, with irreversible lymphoedema and mild thickening of the skin, but increase in the size of the leg was not immediately obvious on examination. The other 2 had recurrent leg ulcers associated with some oedema.

In the second survey, 13 426 guardians of children were interviewed and examined, of whom the great majority (12 893; 96%) were women aged 15–59 years; 379 men and 8 women aged less than 15 years, 137 women over 59 years old, and 9 individuals whose age or sex was not recorded, were excluded from the analysis. Of the remaining respondents, 14 had elephantiasis information coded as 'not known' or 'missing'. The prevalence of elephantiasis of the leg was 2·0% among the remaining 12 879 women. The prevalence of elephantiasis of the leg increased with age from nil in the 15–19 years age group to over 3% in all age groups >40 years (χ^2 for trend=91, $P<0·001$).

Table 1. Proportion of village compounds in Ghana with at least one case of elephantiasis of the leg reported by 23 different interviewers

Subzone	First survey: No. of compounds	First survey: Percentage with one or more cases of elephantiasis	Second survey: No. of compounds	Second survey: Percentage with one or more cases of elephantiasis	Difference (%)[a]	κ
EA	217	8·8	232	15·1	−6·3	0·35
EB	245	15·1	240	15·0	0·1	0·70
EC	250	11·6	256	10·2	1·4	0·60
ED	278	12·9	287	8·4	4·5	0·63
EE	211	13·3	233	16·3	−3·0	0·66
EF	289	22·1	299	14·0	8·1	0·53
EG	252	15·5	245	15·9	−0·4	0·69
NA	256	8·6	254	9·8	−1·2	0·47
NB	276	17·8	274	19·0	−1·2	0·70
NC	284	12·0	277	12·6	−0·6	0·76
ND	252	21·0	261	15·3	5·7	0·60
NE	262	19·8	254	7·5	12·3	0·39
NF	255	17·6	275	18·2	−0·6	0·64
SA	282	10·6	284	12·3	−1·7	0·65
SB	269	10·0	267	10·9	−0·9	0·57
SC	285	10·9	294	12·6	−1·7	0·53
SD	291	8·6	288	10·8	−2·2	0·51
SE	306	10·8	312	12·2	−1·4	0·61
SF	289	10·7	281	10·7	0	0·64
WA	190	2·1	210	5·5	−3·4	0·26
WB	196	4·1	203	4·1	0	0·82
WC	198	10·1	217	12·4	−2·3	0·51
WD	213	8·9	307	8·8	0·1	0·64
Total	5846	12·2	6050	12·1	0·1	0·60

[a](Survey 1)−(Survey 2).

Table 2. Comparison of the findings of the lay interviewers and the physician reporting elephantiasis of the leg

Interviewers	No. of subjects	Elephantiasis cases diagnosed by physician
Both agreed elephantiasis absent	68	0
Both agreed elephantiasis present	20	19
Disagreed		
Present in survey 1, absent in survey 2	8	6
Absent in survey 1, present in survey 2	10	10

Discussion

The use of lay interviewers to collect information on the prevalence of elephantiasis of the leg was found to be both feasible and reliable in this community-based research setting in northern Ghana. Two surveys one year apart with different interviewers yielded very similar results and a validation study of a subsample by a physician showed high levels of agreement with the lay interviewers' findings. Most of the disagreements between the lay interviewers were about individuals who had only the mildest form of elephantiasis of the leg (grade 1).

A prevalence of elephantiasis of the leg of 2% among women aged 15–59 years represents a high disease burden of substantial public health significance (WHO, 1987). As a follow-up to this study, 2 community-based filariasis prevalence surveys have been conducted in the district to ascertain the most likely cause of the elephantiasis. The results of the first showed a microfilaria prevalence rate of 41·1%. The only species identified was *Wuchereria bancrofti*. Elephantiasis of the leg was found in 3·6% of those examined and hydroceles were found in 30·8% of males (GYAPONG *et al.*, 1993). The second survey revealed similar findings, with a microfilaria prevalence rate of 32·4% and a geometric mean density of 794 microfilariae/mL in infected persons; elephantiasis occurred in 4·6% of the study population and 32·2% of males had hydroceles (GYAPONG *et al.*, 1994). These studies have confirmed that bancroftian lymphatic filariasis is the most likely cause of the high prevalence of elephantiasis of the leg seen in the Kassena-Nankana district. Studies are now under way to look at the relationship between the prevalence of chronic disease associated with filariasis, including elephantiasis of the leg and hydrocele, and microfilaria prevalence in several communities in the country as a means of developing rapid

epidemiological diagnostic tools for lymphatic filariasis.

The prevalence of several other chronic diseases can also be assessed by lay interviewers, provided they have obvious manifestations. Lay interviewers have been shown to provide valid estimates of urinary schistosomiasis in surveys enquiring about haematuria (LENGELER *et al.*, 1991), dracunculiasis (OGUNNIYI *et al.*, 1992), onchocerciasis by screening for 'leopard skin' (EDUNGBOLA *et al.*, 1987) or nodules (TAYLOR *et al.*, 1992; NGOUMOU & WALSH, 1993), and vitamin A deficiency using xerophthalmia as indicator (SOMMER, 1982; GHANA VAST STUDY TEAM, 1993). However, such methods have not received the attention they deserve, and hve been neither developed nor employed to their full potential. In developing such methods, the local community's perception of the disease, including sociocultural beliefs and the freedom with which the condition is discussed in the community, will be of crucial importance and must be investigated.

Acknowledgements

This study was part of the Ghana Vitamin A Supplementation Trial (VAST) Survival Study, a collaborative research project of the University of Science and Technology, Kumasi, Ghana and the London School of Hygiene and Tropical Medicine, and was funded by the Health and Population Division of the UK Overseas Development Administration.

We acknowledge the considerable efforts of the field and computing staff of VAST, especially Mr Martin Adjuik, Mr Azumah Amidini, Mr Seth Owusu-Agyei, and Mr Peter Wontuo. This study could not have been done without the support and co-operation of the people of the Kassena-Nankana district and their leaders.

References

Edungbola, L. D., Alabi, T. O., Oni, G. A., Asaolu, S. O., Ogunbanjo, B. O. & Parakoyi, B. D. (1987). 'Lepoard skin' as a rapid diagnostic index for estimating the endemicity of African onchocerciasis. *International Journal of Epidemiology*, **16**, 590–594.

Fleiss, J. L. (1981). *Statistical Methods for Rates and Proportions*. New York: John Wiley.

Ghana VAST Study Team (1993). Vitamin A supplementation in northern Ghana: effects on clinic attendances, hospital admissions, and child mortality. *Lancet*, **342**, 7–12.

Gyapong, J. O., Badu, J. K., Binka, F. N. & Adjei, S. (1993). Bancroftian filariasis in the Kassena Nankana District of the Upper East Region of Ghana: a preliminary study. *Journal of Tropical Medicine and Hygiene*, **96**, 317–322.

Gyapong, J. O., Magnussen, P. & Binka, F. N. (1994). Parasitological and clinical aspects of bancroftian filariasis in Kassena-Nankana District, Upper East Region, Ghana. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88**, 555–557.

Lengeler, C., de Savigny, D., Mshinda, H., Mayombana, C., Tayari, S., Hatz, C., Degremont, A. & Tanner, M. (1991). Community-based questionnaires and health statistics as tools for cost-efficient identification of communities at risk of urinary schistosomiasis. *International Journal of Epidemiology*, **20**, 1–12.

Ngoumou, P. & Walsh, J. F. (1993). *A manual for rapid epidemiological mapping of onchocerciasis*. Geneva: World Health Organization, mimeographed document TDR/TDE/ONCHO/93.4.

Ogunniyi, T. A. B., Simaren, J. O. & Amusan, G. O. (1992). Prevalence of dracunculiasis among Nigerian school children as an index of prevalence in their communities of origin. *Annals of Tropical Medicine and Parasitology*, **86**, 407–412.

Sommer, A. (1982). *A Field Guide to the Detection and Control of Xerophthalmia*, 2nd edition. Geneva: World Health Organization.

Taylor, R. H., Duke, B. O. L. & Monoz, B. (1992). The selection of communities for treatment of onchocerciasis with ivermectin. *Tropical Medicine and Parasitology*, **43**, 267–270.

Vlassoff, C. & Tanner, M. (1992). The relevance of rapid assessment to health research and interventions. *Health Policy and Planning*, **7**, 1–9.

WHO (1987). *Control of Lymphatic Filariasis. A Manual for Health Personnel*. Geneva: World Health Organization.

WHO (1992). *Lymphatic filariasis. Fifth Report of the WHO Expert Committee on Filariasis*. Geneva: World Health Organization, Technical Report Series, no. 821.

Received 24 January 1995; revised 24 April 1995; accepted for publication 25 April 1995

Announcement

African Index Medicus (AIM) Project
An international index to African health literature and information sources

In order to give access to information published in or related to Africa and to encourage local publishing, the Association for Health Information and Libraries in Africa (AHILA), with the technical support of the World Health Organization, has initiated a project to create an international index to African health literature and information sources–the *African Index Medicus*.

The creation of the regional index is a collaborative, participatory process. Firstly, national databases are being built, using a common methodology, in African countries. From them, local information services and products will be provided for national health professionals. National production should ensure self-sufficiency and sustainability at country level and the tailoring of services according to local needs.

The various national databases are then merged into a regional data base to which are added bibliographic records relating to health in Africa from other international existing sources such as WHO's WHOLIS, MEDLINE, POPLINE etc. to produce the *African Index Medicus* in printed or electronic form, eventually CD-ROM. It is distributed to African countries and as part of an affiliated membership to AHILA for institutions outside the region.

At this stage, AHILA, with support from WHO, is looking for further sponsoring partners at bilateral level with African countries not yet participating in the Project. Sponsorship comprises equipment and training of staff and could be part of an information component of a health-related project in the country, which may also include use of communications and CD-ROM.

Further information can be obtained from Dr Deborah Avriel, World Health Organization, Library, 1211 Geneva 27, Switzerland; fax +41 22 791 0746.

Acta Tropica, 61(1996)65–74

ACTROP 00524

Rapid community diagnosis of lymphatic filariasis

John Owusu Gyapong [a,*], Sam Adjei [a], Margaret Gyapong [a], Godfried Asamoah [b]

[a] *Health Research Unit, Ministry of Health, P.O. Box 184, Accra, Ghana* [b] *District Medical Officer of Health, Ahanta West District, Western Region, Ghana*

Received 15 May 1995; revised 7 November 1995; accepted 8 November 1995

We conducted a pilot study to test rapid assessment procedures for the community diagnosis of lymphatic filariasis in some rural communities in Ghana. The assessment criteria included direct key informant interviews, focus group discussions, routine reporting from health facilities, self-administered questionnaires, and a random examination of adult males for hydroceles. All the data collection methods were easy, convenient, non-invasive to use and acceptable to the community. The study provided reliable estimates of the burden of lymphatic filariasis in the community when compared with data from standard epidemiological surveys. The direct key informant interviews and focus group discussions gave a broad perspective of the burden of diseases in the community in general, and lymphatic filariasis in particular. The use of self-administered questionnaires provided data comparable with data on elephantiasis in the community from a case search. Examination of a random 30–40 adult males for hydroceles provided a good correlation with the community microfilaria prevalence, with a correlation coefficient of linear regression $r=0.79$. These individual rapid assessment procedures of the burden of lymphatic filariasis, if further developed and tested could, be widely used in combination for the mapping of the distribution of lymphatic filariasis in Ghana and possibly, the African sub-region.

Key words: Lymphatic filariasis; Epidemiological survey; Hydrocele; Microfilaria

1. Introduction

Lymphatic filariasis continues to be a major disease in many tropical countries. The disease imposes very high socio-economic costs on endemic populations especially those from low income families (Evans et al., 1993). The prevalence and distribution of the disease is not well documented in most of these countries, and as a result, has not received much priority from national Ministries of Health and the international health agencies. The World Health Organization reported recently that no information was available from countries in the African region although both urban and rural bancroftian filariasis are known to be highly endemic in Zanzibar and along the coastal areas of Kenya, Madagascar and United Republic of Tanzania. Scattered foci are also known from past studies in many areas of Central and West Africa in the broad transmission Zone (WHO, 1992). It has suggested, therefore, that as an urgent research priority, efforts should be made to collect more information

* *Corresponding author: Tel/fax 233–21–226739, Telex: 2340 MNJ.*

SSDI 0001-706X(95)00141-7

on the prevalence and distribution of the disease and the vectors, especially from the African region.

Diagnosis of the disease is usually based on the presence of the parasite in the peripheral blood and of clinical manifestations associated with the disease, such as elephantiasis and hydrocele. In most parts of Africa where microfilariae of the *Wuchereria bancrofti* parasite, the causative organism of lymphatic filariasis in the sub-region, exhibit a nocturnal periodicity, conventional epidemiological surveys include night blood surveys or the diethyl carbamazine (DEC) provocation test combined with clinical examinations. The latter is not commonly used because of the unpleasant side effects associated with the use of DEC. Most immuno-diagnostic techniques are still in the development and testing phase, and even if they were widely available, they would not be affordable in most developing countries where disease is endemic.

In Ghana, even though the disease is now known to be a problem in some parts of the country (Gyapong et al., 1993, 1994), the prevalence and distribution has not been fully documented. This is because it has not been logistically feasible to survey all areas of the country in order to have a sound epidemiological basis for a control programme, and as a result the, disease has had low priority on the national health agenda. Furthermore, many of the established health information systems are cumbersome for health personnel and as a result they are hardly utilized. Traditional methods of obtaining epidemiological, sociological and anthropological data are often beyond the resources of most ministries of health. This highlights the potential role of rapid assessment methods in improving the community effectiveness and sustainability of health interventions (Vlassoff and Tanner, 1992).

This paper reports on the findings of a pilot study on the field testing of rapid assessment procedures for lymphatic filariasis in a coastal district in Ghana which has become a focus of research in lymphatic filariasis in Ghana for the past year following press reports of the high prevalence of elephantiasis. The aim of this study was to test the effectiveness of different rapid assessment procedures for lymphatic filariasis developed at a workshop of experts in filariasis in Ghana.

2. Methods

The study was conducted in the Ahanta West district of the Western Region of Ghana from November 1994 to February 1995. The main hypothesis that was tested in this study was that, there would be a reasonably high correlation between the rapid assessment procedures described below and the standard epidemiological diagnostic procedures for lymphatic filariasis at the community level. Based on the initial work done in the Kassena Nankana district, Navrongo, Ghana (Gyapong, 1994), various instruments were developed to identify populations at risk. The main issues looked at were morbidity indicators of lymphatic filariasis in health facilities, community key informant reporting, the use of self-administered questionnaires through existing administrative systems and an examination of a random number of adult males for hydroceles. A series of consultations and workshops were organised to improve upon these initial instruments. Participants included, physicians, epidemiologists, entomologists, biologists, social scientists, public health nurses, health educators, and health policy makers.

3. Sources of data

Data were collected from the following sources using discussion guides and questionnaires. The four main sources of data were:

3.1. Key informant interviews and focus group discussions

Informal discussions were held with community leaders, traditional health providers and key informants. Issues addressed included common diseases of childhood and adulthood, the importance of filariasis is to the community as compared to other diseases, terms used to describe filarial disease, knowledge of the cause and transmission of filariasis, health seeking practice regarding the disease, and perceptions of the burden of the disease in terms of distribution, numbers and severity. Information gathered from these semi-structured interviews were used as a basis for drawing up guidelines for focus group discussions involving women's groups, men's groups and people with chronic disease. All interviews, which were conducted in the local language by trained personnel, were recorded onto audio cassettes and transcribed into English. The transcripts were typed onto a word processor and analysed with Text Base Alpha, a software programme for analysing qualitative data. The programme, among other things, collates all open-ended responses by thematic code, making it possible to compare data from different interviews and data collection methods (Tesch, 1989).

3.2. Routine reporting at health facilities

Out-patient departments (OPD) records, admission records, laboratory records and surgical operative procedure records from health facilities in the district were reviewed. This included all health facility records of the preceding 12 months. Key people in the hospital or health centre were interviewed to supplement this information, guided by a check list.

3.3. Self-administered questionnaires

A self-administered questionnaire designed to look at the community burden of various diseases was administered to two groups of people; district assembly representatives and school teachers. It among other things enquired about the presence of diseases with obvious chronic manifestations such as leprosy, yaws, elephantiasis, goitre, guinea worm and hydrocele in the community. Where present, an estimated number of people affected was asked. This was to avoid bias reporting which was likely to arise from enquiring about chronic filarial disease only. District assemblies have been established country-wide. They are comprised of representatives of populations of between 2000 and 5000 people. These representatives usually live in the community and are well known by the entire population and form the basis of local government. Assembly meetings are organized quarterly for about four days during which matters concerning the entire district are discussed. One such meeting was used to rapidly assess the prevalence of clinical conditions of the diseases in the communities they represent using the self-administered questionnaire. The questionnaire was introduced and explained to the assembly by the District Medical Officer

of Health (DMOH), who is a coopted member of the assembly. All school teachers in the selected communities were also served with a questionnaire similar to what was given to the district assembly members. The questionnaires were sent to the district education office for distribution and were return when they had been completed. For the school teachers, there were additional questions regarding the occurrence of episodes of acute adenolymphangitis among their pupils in the preceding 2 weeks.

3.4. Examination of adult males for hydroceles

A random sample of 30–40 adult males above the age of 20 years per community were examined for hydroceles using the EPI cluster sampling technique (Henderson and Sundaresan, 1982). All the examinations were done by the first author.

4. Validation of instrument

Parasitological data on filariasis was available from work done by the District Health Management Team (DHMT) 6 months prior to doing this study. The technique used was thick smears of night blood stained with geimsa (Western Regional Director of Health Services, 1993). The DHMT had also conducted a case search of elephantiasis of the leg in 17 communities with the help of chiefs and community leaders. The findings from the RAP methods were therefore compared with the findings of the DHMT to assess the reliability of these methods.

5. Results

5.1. Key informant interviews and focus group discussions

The most common illnesses reported among young children were 'fever', measles, diarrhoea and malnutrition. Among children of school-going age, however, 'blood in the urine' and 'fever' were the commonest. The ranking of the relative importance of these conditions, however, varied from one community to another. Among adults, the commonest illnesses were 'fever', scrotal swellings, rheumatic pain, asthma and elephantiasis. The ranking of these conditions also varied from one community to another. One contributor said, "We did not know elephantiasis was such an *important disease* until a lot of noise was made about it in the radio. We have had it for decades and neither our traditional healers nor the western medicine has been helpful. The more you treat it, the worse it becomes. We have therefore accepted it as something from the gods even though it worries us very much".

Even though elephantiasis has been with them for a very long time, almost all of them did not know its cause. Participants of the focus group discussions and key informants said the only thing they knew about the condition was that, it starts like a 'fever' and painful swelling and after several episodes over the years, the leg does not reduce in size any more. They actually described vividly, the signs of acute adenolymphangitis (ADL). Only one elder mentioned that he has heard on the radio that it was caused by mosquitoes bites. Others thought it could be inherited since

there are a few households where elephantiasis is present in at least one member in every generation. Others also speculated that it could be caused by 'evil forces'. Treatment in general was hard to find. Apart from those caused by 'evil forces' which could be reversed by 'stronger evil forces', most of the traditional and orthodox treatment has not been very useful. Hydroceles were said to be caused by bad fluid in the body which descends and settles in the scrotum. It was common among people who drink palm wine and 'apketeshi' a locally distilled gin. The most reliable treatment they knew of for hydrocele is surgery. There was no known relationship between elephantiasis and hydrocele but were seen as entirely different conditions caused by different things.

5.2. Routine reporting at health facilities

There were only two health facilities within the catchment area of the study population. These were the District Hospital at Dixcove, and a Health Centre at Agona. In the district hospital, out of 8564 out-patient visits in the 12 months under review, there was no diagnosis as acute adenolymphangitis (ADL), there were 18 cases of lymphoedema or elephantiasis and 42 cases of hydrocele. Of the 3532 admission, none was as primarily due to elephantiasis nor hydrocele. There had been 27 surgical operations, all of which were done in the first 2 months of the 12-month review period, when there was a doctor who could perform these operations at post. The breakdown was as follows: hydrocele operations 10, hernia operations 7, concurrent hernia and hydrocele 4, Obstetric and Gynaecology 4, and other 2. No laboratory investigations were done for lymphatic filariasis for the 12-month period. At the Agona Health Centre, there were 7379 OPD attendance, out of which four were diagnosed as lymphoedema or elephantiasis, with no ADLs nor hydroceles. The centre which is run by a medical assistant (a senior nurse with special training) has no facilities for laboratory investigations, admission nor surgical operations.

5.3. Self-administered questionnaires

(A) District assemblies

There were eight assembly members who represented the 17 communities that were studied, one of whom was female. They were able to provide reasonably accurate information on their community, such as the population of their catchment area, the number of school and other facilities available. On the whole, they seemed to have reasonably good information on the population they represented. They also provided reasonable estimates of number of people with elephantiasis when their figures were compared with data available from the district health management team (DHMT). As expected, reports on hydroceles were grossly under-estimated. Only gross scrotal enlargements were reported (Table 1).

(B) School teachers

There were 49 school teachers who filled this questionnaire in the 17 communities with an average of about three per community. The information provided by the teachers from each community were very similar and comparable in most instances. Difference observed were minor and insignificant. The figures provided in Table 1 is the mean of the estimates per community. Their estimates of numbers of people

70

Table 1

Reported number of elephantiasis cases in various towns and villages by the District Health Management Team (DHMT), school teachers, and community representatives

Town/village	Population	DHMT report: case search	Teachers' estimate	Community Rep's estimate
Upper Dixcove	1972	7	7	8
Lower Dixcove	2322	8	7	too many
Busua	1488	17	20	too many
Achowa	501	6	6	8
Achinim	345	4	4	don't know
Butre	750	12	10	15
Old Akwidaa	1305	8	7	5
New Akwidaa	865	4	5	don't know
Cape Three Points	1289	5	5	5
Asemko	564	4	5	5
Adjoa	1810	2	1	0
Funkoe	1465	3	4	2
Aketechi	2926	9	10	many
Princess Town	2980	14	15	too many
Mpatano	509	4	5	2
Miamia	678	10	7	many
Agyambra	1838	3	2	5

affected by elephantiasis was closer to figures from the DHMT than those reported by the assembly representatives. Table 1 shows the comparison between reports of the number of cases of elephantiasis by school teachers, assembly representatives, and the results from a case search by the DHMT. The experience on reports on hydroceles was similar to that of the district assembly representatives. Fifteen out of the 49 school teachers reported a history of ADL among some of their class children within the preceding 2 weeks. Twenty-five of them responded 'not known' and nine responded 'no'.

5.4. Examination of adult males for hydroceles

The prevalence of hydroceles among adult males (aged 20 years and above) was quite high in most communities, ranging from between 4.1% to 19.8%. Over 50% of them were larger than the size of a tennis ball. The community microfilaria prevalence correlated very well with the prevalence of hydroceles amongst males, with a correlation coefficient of linear regression 0.79 (Fig. 1, Table 2).

6. Discussion

The findings of this study has shown that it is possible to obtain reliable and valid estimates of the burden of lymphatic filariasis at community level using a combination of cheap and non-invasive methods such as key person interviews, focus group discussions, self-administered questionnaires, and an examination of a random 30–40 adult males for hydrocele. In this study, the prevalence of hydroceles amongst males provided a very good correlation with the community microfilaria prevalence. Since

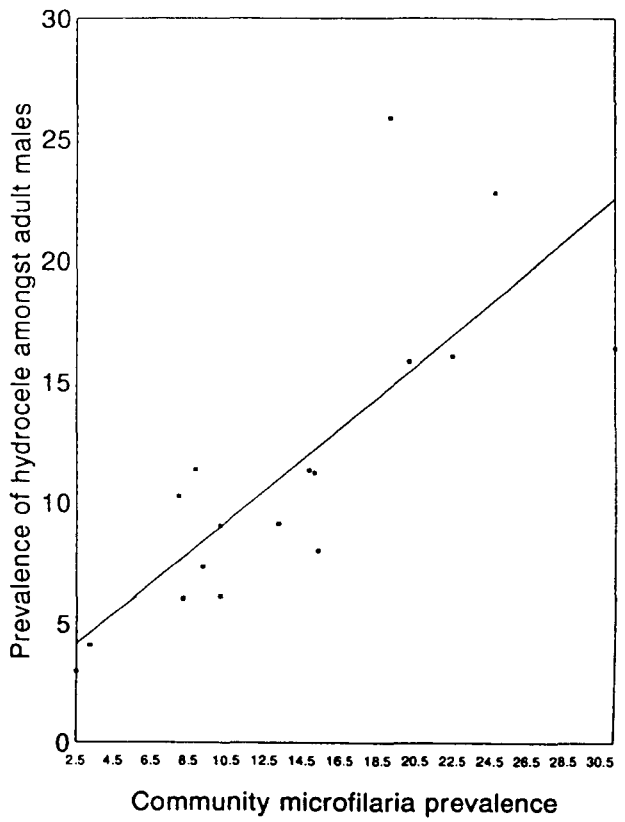


Fig. 1. Community microfilaria prevalence vs. prevalence of hyrocele in adult males.

there was no data on the intensity of infection (geometric mean density of microfilaraemia), it was not possible to compare with the rapid assessment methods. The experiences from this pilot study will be very useful in any further development and testing of rapid assessment procedures for lymphatic filariasis. Conclusions of this study has been drawn on the premise that there has been no substantial change in the epidemiology of the filariasis in the district. This is because there has been no specific intervention programme for the disease and there has not been any vector control programme to affect the intensity of transmission. Thus, even though people with chronic filarial disease must have had their infection two or more decades ago, it is reasonable to compare parasitaemia and chronic disease states of today.

In this study, routine reports from health institutions, even though useful, provided a gross under estimate of the burden of the disease in the community. This is because these reports are influenced by other factors such as accessibility, ability to pay for the services and socio-cultural believes associated with the disease. Secondly, record keeping at the institutions leave a lot to be desired. Thirdly, the use of these facilities is influenced by the availability of laboratory services and technical expertise, and in this study area this was inadequate. Any such reports should therefore be seen as the tip of the iceberg.

The use of the indirect interviewing approach for gathering this data was also

72

Table 2

Comparison between community microfilaria prevalence and the prevalence of hydroceles in males aged 20 years and above

Town/village	Community microfilaria prevalence	Prevalence of hydrocele amongst adult males
A. Upper Dixcove	13.2	9.2
B. Lower Dixcove	15.1	11.3
C. Busua	24.7	19.8
D. Achowa	19.1	25.9
E. Achinim	22.4	18.1
F. Butre	20.1	15.9
G. Old Akwidaa	8.8	11.4
H. New Akwidaa	7.9	10.3
I. Cape Three Points	10.1	9.1
J. Asemko	14.8	11.4
K. Adjoa	2.5	3.0
L. Funkoe	8.1	6.1
M. Aketechi	9.2	7.4
N. Princess Town	10.1	6.2
O. Mpatano	15.3	8.1
P. Miamia	31.2	16.4
Q. Agyambra	3.2	4.1

found to be very useful. The findings from this study suggest that school teachers could potentially be very useful in providing valid estimates of diseases with obvious manifestations at the community level. The use of the community representative was also found to be very useful but sometimes they were not able to provide exact figures on all the communities they represent. This is because they usually represent three communities, and are therefore able to provide accurate figures for their community of residence only, but not for the other communities they represent. There were problems with the understanding of some parts of the questionnaire. Not everybody understood some of the medical terminology such as burili ulcer used on the questionnaire. This approach could be developed further to take care of such deficiencies by further development of the questionnaire by providing a narrative description of the rare conditions which are not well known. The major advantage of using this approach was that it reduced the bias of respondents over-reporting on a specific disease since the caption was 'assessment of disease burden' rather than 'assessment of burden of filariasis'. Lengeler et al. (1991, 1992), earlier demonstrated using the 'indirect interview approach' that simple, self-administered questionnaires could be distributed through an existing administrative system, and that their diagnostic performance for identifying high risk communities was very good.

The concept of ADL needs further work since not all communities have well-known descriptive terminologies. Some of them did not appreciate the concept of ADL and will therefore need more piloting in order to explore its full potential in rapid community diagnosis of lymphatic filariasis. It is hoped that, based on the findings of this pilot study, these individual methods will be further developed and tested in other districts of the country to form the basis of further work on rapid community diagnosis of lymphatic filariasis. One approach will be the training of

peripheral level health personnel such as public health nurses to examine for hydroceles since most developing countries may not be able to afford to use physicians in gathering such information. If it were possible to replicate these findings in other districts, various combinations of these methods could be used to estimate the prevalence of the disease and map out its distribution in the entire country, and possibly in other parts of Africa. There is the need to look at other rapid assessment measures of infection which will be necessary for monitoring control programmes. A great potential in this area will be the field testing of antigen detection techniques in day blood samples within a control program.

In conclusion, these RAP methods have been useful in determining the distribution of the chronic diseases associated with lymphatic filariasis, identifying high risk communities, and providing relevant information for planning a control programme. It has also been convenient and quick to use, non-invasive, relatively inexpensive (cost–effective), and above all valid. There is therefore the need to strengthen the application of these methods which will give health managers timely and accurate information to reach decisions in launching, monitoring and evaluating disease control programmes, especially when rapid assessment procedures for determining the burden and distribution of disease are becoming increasingly important in view of the high cost and time involved in the use of conventional epidemiological survey techniques (Vlassoff and Tanner, 1992).

Acknowledgement

The authors acknowledge the immense input of all the scientists who helped in developing the instruments, especially the participants of the Navrongo workshop. We also thank the Regional Director of Health Services, Dr. E. Hansen and the District Health Management Team of Ahanta West for their support during the data collection phase. This preliminary study was carried out when the PI (JOG) was studying for a PhD degree at the Tropical Health Epidemiology Unit of the Department of Epidemiology and Population Sciences, London School of Hygiene and Tropical Medicine under the supervision of Dr. Roger Webber and Ms. Jo Morris. This investigation received financial support from the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases Project IDs: 940054 and 940672.

References

Evans, D.B., Gelband, H. and Vlassoff, C. (1993) Social and economic factors and the control of lymphatic filariasis: a review. Acta Trop. 53, 1–26.

Gyapong, J.O., Badu, J.K., Adjei, S. and Binka FN. (1993) Bancroftian filariasis in the Kassena-Nankana district of the upper east region of Ghana – a preliminary study. J. Trop. Med. Hyg. 96, 317–322.

Gyapong, J.O., Magnussen, P. and Binka, F.N. (1994) Parasitological and clinical aspects of bancroftian filariasis in Kassena Nankana district, Upper East Region, Ghana. Trans. R. Soc. Trop. Med. Hyg. 88, 555–557.

Gyapong, J.O. (1994) Developing and Testing Rapid Epidemiological Assessment Methods for Lymphatic filariasis. Report of a WHO Workshop held at the Navrongo Health Research Centre, Navrongo, Ghana.

Henderson and Sundaresan (1982) Cluster sampling to assess immunization coverage: a review of experience with a simplified sampling method. Bull. WHO 60, 253–260.

Lengeler, C., de Savigny, D., Mshinda, H., Mayombana, C., Tayari, S., Hatz, C., Degremont, A. and Tanner, M. (1991) Community-based questionnaires and health statistics as tools for cost–efficient identification of communities at risk of urinary schistosomiasis. Int. J. Epidemiol. 20, 1–12.

Lengeler, C., Sala-Diakanda, D. and Tanner, M. (1992) Using questionnaires through an administrative system: a new approach to health interview surveys. Health Policy and Planning 7, 10–21.

Regional Director of Health Services, Western Region (1993) Elephantiasis in Ahanta West District. A Project Report.

Tesch, R. (1989) TextBase Alpha Users Manual.

Vlassoff, C. and Tanner, M. (1992) The relevance of rapid assessment to health research and interventions. Health Policy and Planning 7, 1–9.

WHO (1992) Lymphatic filariasis. Fifth Report of the WHO Expert Committee on Filariasis. Geneva, (WHO Technical Report Series, No. 821).