Prevalence of hydrocele as a rapid diagnostic index for lymphatic filariasis

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Abstract

The real burden of lymphatic filariasis in most endemic areas remains unknown even though it is a major public health problem in many tropical countries, particularly in sub-saharan Africa. The nocturnal periodicity of the parasite requires parasitological examinations to be done at night. The aim of this study was to develop and validate rapid epidemiological assessment tools for the community diagnosis of lymphatic filariasis, that may be used in the future to determine the distribution of the disease and identify high risk communities in Ghana. Twenty communities with varying endemicity of filariasis were sampled from 3 endemic districts. Community members were selected for the study using a modified Expanded Programme for Immunization (EPI) cluster sampling technique. The prevalence of hydrocele was high (range 4·5–40·75%, mean = 17·78%) and the community prevalence of microfilaraemia correlated well with that of hydrocele ($r = 0·84$). The findings suggest that it is possible to obtain reliable and valid estimates of the community burden of lymphatic filariasis using the prevalence of hydrocele as a diagnostic index.

Keywords: filariasis, Wuchereria bancrofti, hydrocele, prevalence, diagnostic index, Ghana

Introduction

Lymphatic filariasis is a major public health problem in many tropical countries. A minimum of 120 million people in 73 endemic countries world-wide are estimated to be infected (WHO, 1994; MICHAEL et al., 1996). 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 there are some 4·6 million prevalent cases of lymphoedema and over 10 million cases of hydrocele in Africa. These figures represent approximately 40% of the global burden of the disease and, although they give an indication of the overall scale of the problem, there is little information that is useful in the control of the infection (EVANS et al., 1993; WHO, 1994).

In most parts of Africa, real data on the distribution of the disease are not widely available, primarily because the standard procedures for assessing communities at risk of the disease are cumbersome, time-consuming, expensive and very intrusive (WHO, 1992). In most endemic areas the parasite exhibits nocturnal periodicity and thus parasitological examinations need to be done at night. This becomes logistically cumbersome to organize and communities often refuse to co-operate. As a result very few studies have been done on filariasis in Africa until recently. Most of these studies were from a few East African communities (HAWKING, 1977; WIJERS & KINYANJUI, 1977; MCMAHON et al., 1981).

As a result of this and the generally low funding for departments of health in Africa, filariasis has not received the required attention from health care managers (EVANS et al., 1992; GYAPONG, J. O. et al., 1996c). In an earlier preliminary investigation using a combination of routine data and rapid surveys, the community prevalence of hydrocele was found to correlate quite well with the community prevalence of infection (GYAPONG, J. O. et al., 1996a). Based on these preliminary findings, this study was designed to determine the correlation between the prevalence of disease states associated with lymphatic filariasis such as acute adenolymphangitis (ADL), elephantiasis and hydrocele, and the microfilaraemia prevalence at the community level. The ultimate objective was to evaluate the practicality of using one of these disease measures as a simpler and more rapid measure of the community burden of filariasis, in order to identify high risk communities more easily.

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Methods

The study was conducted between June 1995 and August 1996. Based on findings from a national filariasis survey in Ghana (GYAPONG, J. O. et al., 1996b), 3 districts found to have substantial prevalence of the disease were selected, one each from 3 biogeographically different zones of the country (the southern coastal savannah, the coastal forest and the northern savannah). The corresponding districts were the Winneba, Ahanta West, and Bawku Districts. Twenty communities with an average population of about 400 people each were randomly selected for the study, 7 each from the first 2 districts and 6 from the last. A census of all the villages was conducted.

Approximately 100 people of all ages were examined in each village to achieve the required sample size of 2000 people. Depending on the average household size estimated from the census, between 30 and 50 households were randomly selected for examination, using a modified Expanded Programme for Immunization (EPI) cluster survey technique (HENDERSON & SUNDARESAN, 1982; BENNETT et al., 1991). All individuals were clinically examined and had a blood sample taken for detection of microfilariae. Both clinical and laboratory examinations were done concurrently at night (between 22:00 and 02:00) because of the nocturnal periodicity of the parasite. Clinical examination of all individuals was carried out by the same physician (J.O.G.), and included examination of lymphoedema/elephantiasis of the limbs, hydrocele (in males), and breast lymphoedema/elephantiasis (in females). A history of an episode of ADL in the preceding month was taken using local terminology (GYAPONG, M. et al., 1996). A finger-prick thick blood film was prepared using 20 µL of blood and stained with Giemsa's stain at pH 8·2. The entire film was examined and all microfilariae counted and recorded. As a quality control measure, 10% of all slides were randomly selected and re-examined 'blindly' by the technician and the principal investigator (J.O.G.). The agreement between the different examinations was assessed using the kappa statistic (κ). The κ score between the 2 readings of the technician was 0·92, and that between the principal investigator and the first reading of the technician was 0·89. The few films for which the readings were different had very low density microfilaraemia. All members of each community were treated using the current World Health Organization (WHO) recommended treatment regimen of ivermectin (400 µg/kg) because most parts of the study area were known to be endemic for onchocerciasis. Pregnant women and children under 5 years were ex-

cluded for safety reasons (WHO, 1996).

Statistical analysis was carried out using Epi-Info and SPSS-PC™. The community prevalences of clinical filariasis and of microfilaraemia were standardized by age and sex using the total population of the 20 communities from the census data as the standard population (KIRKWOOD, 1988). In addition, the geometric mean intensity of microfilaraemia in the community was calculated as antilog [Σlog $(x+1)/n$], where x is the number of microfilariae per millilitre of blood in microfilaraemic individuals, and n is the number of people examined. The Pearson correlation coefficient was used to assess the closeness of association between the prevalence of disease and the prevalence and intensity of infection. The findings from the study were further validated using published data from other endemic communities in East and West Africa.

est correlation was between prevalence of hydrocele and prevalence of infection (r=0·84, r^2=0·71, P<0·001). Thus microfilaraemia prevalence was associated with as much as 71% of the variation in community prevalence of hydrocele (Fig. 1). Similarly, the intensity of infection at the community level was closely associated with the prevalence of hydrocele (r=0·64, r^2=0·41, P=0·002). Thus 41% of the variation in community prevalence of hydrocele was associated with the variation in the community intensity of infection.

The association between the community prevalence of infection and hydrocele was further examined using published data from Ghana. DUNYO *et al.* (1996) carried out detailed studies on lymphatic filariasis in 9 communities along the coast of Ghana, where they documented the prevalence of infection using the counting chamber technique. They also assessed the

Table 1. Age and sex standardized prevalence of disease and infection, and intensity of infection

District and community	Total	No. examined Females[a]	No. examined Males[a]	Acute adenolymph-angitis	Percentage of subjects with Elephantiasis	Percentage of subjects with Hydrocele	Percentage of subjects with Total chronic disease[b]	Percentage of subjects with Microfilaraemia	Microfilariae (per mL)[c]
Ahanta West									
G	92	56(60·9)	36(39·1)	13·0	6·2	30·5	20·7	28·5	457
H	106	56(52·8)	50(47·2)	10·5	12·5	35·6	20·4	39·7	792
J	117	65(55·6)	52(44·4)	5·5	4·3	38·7	22·0	28·0	782
K	106	63(59·4)	43(40·6)	6·6	1·5	36·4	18·7	25·8	841
L	100	68(68·0)	32(32·0)	5·2	9·7	40·8	26·9	30·6	1807
M	85	52(61·2)	33(38·8)	1·4	1·4	10·5	6·4	1·9	629
N	157	96(61·1)	61(38·9)	8·0	5·9	30·0	17·9	15·7	448
Total	763	404(56·3)	314(43·7)	7·0	5·8	33·3	20·3	24·3	803
Winneba									
A	109	67(61·5)	42(38·5)	6·8	5·4	17·2	13·5	9·7	925
B	131	73(55·7)	58(44·3)	0·8	1·7	7·2	5·1	15·1	348
C	123	63(51·2)	60(48·8)	3·3	0·8	5·4	3·4	9·9	551
D	101	53(52·5)	48(47·5)	1·0	1·7	7·6	5·3	9·6	470
P	80	57(71·3)	23(28·8)	3·0	4·4	4·5	6·5	5·8	500
Q	120	68(56·7)	52(43·3)	3·1	0·7	8·8	4·9	8·8	500
R	54	23(42·6)	31(57·4)	2·2	4·1	18·7	7·2	15·8	718
Total	718	456(59·8)	307(40·2)	2·8	2·5	9·7	6·9	11·3	506
Bawku									
S	74	36(48·6)	38(37·3)	1·8	2·0	17·6	10·3	17·2	568
T	102	64(62·7)	38(37·3)	0·7	0	6·8	3·2	4·9	251
U	86	40(46·5)	46(53·5)	0	0	20·1	9·5	28·8	226
V	74	35(47·3)	39(52·7)	0	0	8·3	4·0	12·4	429
W	90	51(56·7)	39(43·3)	0	0	7·8	3·7	4·4	629
X	65	33(50·8)	32(49·2)	1·0	3·0	21·2	13·1	11·5	646
Total	491	259(52·9)	231(47·1)	0·8	1·1	12·9	7·2	14·2	344
Total (all zones)	1972	1119(56·7)	853(43·3)	3·7	3·0	17·8	11·1	16·0	570

[a]Percentage in parentheses.
[b]Hydrocele plus all elephantiasis (limbs, breast, genitalia).
[c]Geometric means.

Table 2. Correlation between infection and disease at the community level

Disease	Prevalence of infection r[a]	Prevalence of infection P	Intensity of infection r[a]	Intensity of infection P
Acute adenolymphangitis	0·61	0·005	0·75	0·001
Elephantiasis	0·64	0·002	0·64	0·002
Hydrocele	0·84	<0·001	0·64	0·002
Total chronic disease[b]	0·79	<0·001	0·70	0·001

[a]Correlation coefficient.
[b]Hydrocele plus all elephantiasis (limbs, breast, genitalia).

Results

The age and sex standardized prevalence of clinical filariasis and microfilaraemia was high in most of the communities (Table 1). In general, there was more disease in Ahanta West district than in Bawku and Winneba districts. The level of association between the community prevalence of clinical filariasis and the community prevalence and intensity of infection was high for all the conditions examined (Table 2), and the high-
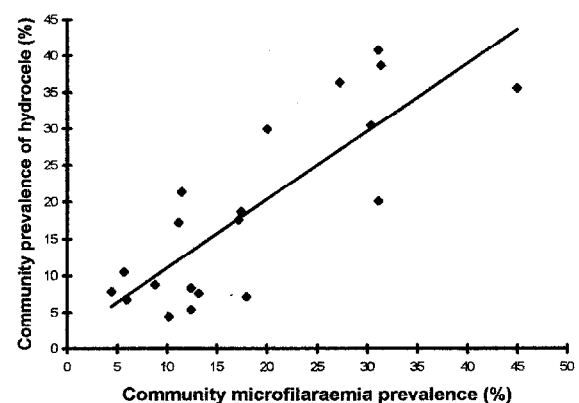

Fig. 1. The correlation between community prevalence of microfilaraemia and hydrocele found in the present study.

community prevalence of hydrocele and elephantiasis using standard assessment criteria. The correlation between infection and disease was assessed in these 9 communities. As much as 81% of the variation in the
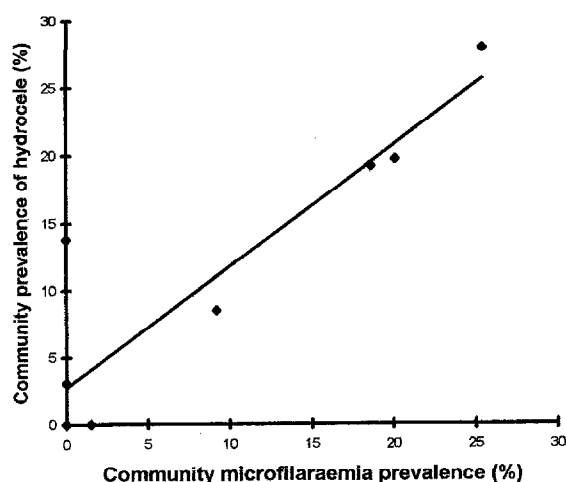
Fig. 2. The correlation between community prevalence of microfilaraemia and hydrocele in coastal Ghana (data from DUNYO *et al.*, 1996).
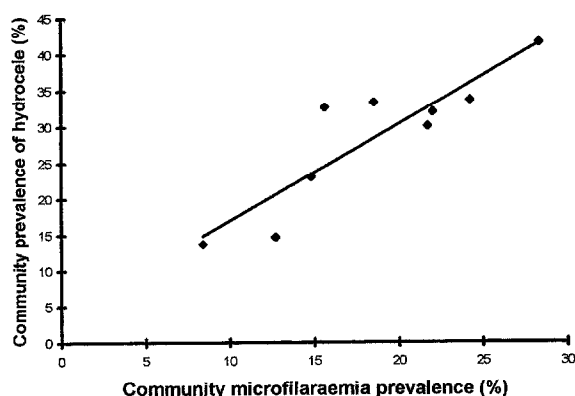

Fig. 3. The correlation between community prevalence of microfilaraemia and hydrocele in East African communities (data from SOUTHGATE, 1992).

community prevalence of hydrocele was associated with the variation in microfilaraemia prevalence ($r=0.90$, $r^2=0.81$, $P<0.001$) (Fig. 2). The association between the prevalence of microfilaraemia and elephantiasis in that study 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 8 communities from East Africa (Tanzania and Kenya) which were summarized in a publication by SOUTHGATE (1992) on the subject of intensity and efficiency of transmission and the development of microfilaraemia and disease. The positive and highly significant association between infection and hydrocele was again confirmed at the community level ($r=0.89$, $r^2=0.80$, $P<0.001$) (Fig. 3)

Discussion

This study documented for the first time a positive and significant association between filarial disease prevalence and infection prevalence and intensity 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 lymphatic filariasis has always been that patent infection is negatively related with chronic disease (BUNDY *et al.*, 1991; SRIVIDYA *et al.*, 1991; GRENFELL & MICHAEL, 1992; OTTESEN, 1992; WHO, 1992; MICHAEL *et al.*, 1994) and, as a result, reationships between infection and disease at the community level have not been investigated. Even the 2 studies from Africa cited earlier (SOUTHGATE, 1992; DUNYO *et al.*, 1996)

did not report on this relationship. This is probably because most reported studies involved too few communities to allow for the investigation of such an association. Secondly, since different clinical and parasitological examination procedures were used by different research teams, it has not been easy to pool data even from the same geographical area for such an analysis.

The most likely interpretation of 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 such as mass chemotheraphy 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).

Our findings imply that, at least in Ghana and some East African communities, disease prevalence at the community level could be used to predict the prevalence and intensity of infection. This is particularly so with hydrocele because as much as 71% of the community prevalence of hydrocele is associated with the variation in microfilaraemia prevalence. Secondly, since men are culturally more amenable to physical examination than women in these communities, it will be much easier to examine them at the community level. Thirdly, there are usually more cases of hydrocele than elephantiasis in most endemic communities and, therefore, sampling errors are likely to be smaller. Finally, as this correlation was achieved with an average of 40 males per community, a smaller number of people will need to be examined if the prevalence of hydrocele were used as the predictor of prevalence of infection. There is therefore a strong case for the use of hydrocele prevalence in predicting infection prevalence or identifying communities at risk. We recommend the examination of a random sample of 40–50 males aged 10 years and over for hydrocele as a proxy measure of the prevalence and intensity of infection in communities with a population of up to 500 people. This could be readily linked with rapid epidemiological assessment for onchocerciasis, in which adult males are examined for nodules (NGOUMOU & WALSH, 1993). Since 62% of total chronic disease (all elephantiasis and hydrocele) is also associated with the variation in microfilaraemia in the community (Table 2), it is possible to use both men and women in identifying the communities at risk, should there be any gender-related problem in the choice of males only.

These conclusions are of great importance to the control of lymphatic filariasis. The current WHO recommended control strategy is mass treatment of the population and, when possible, the use of vector control as an adjunct to chemotherapy (WHO, 1996). Using this strategy, it is important to identify communities at risk by estimating the community prevalence of infection, but it is not very important to identify which individuals are infected. Given that the prevalence of disease (especially hydrocele) correlates very well with the prevalence of infection, an estimation of community prevalence of hydrocele could be reliably used to identify the communities at risk and in need of control measures. It must, however, be emphasized that this method of identifying communities at risk of infection would not be very useful for monitoring a control programme, since the reduction in prevalence and intensity of infection is not likely to be reflected in an immediate reduction in disease prevalence. There will therefore be a need to identify sentinel populations and to monitor their parasitological and entomological indices to assess the effectiveness of the control programme.

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