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ABSTRACT

Objective: **To determine the prevalence of *Wuchereria bancrofti* infection in an area designated for filariasis control trial.**
Design: **A cross-sectional survey.**
Setting: **Three villages in Kinango location, Kwale district, Coast Province, Kenya.**
Subjects/participants: **Oral informed consent to participate was obtained from adults and parents or guardians of children below fifteen years of age.**
Main outcome measures: **Microfilaraemia prevalences, microfilarial densities and clinical manifestations.**
Results: **The overall prevalence of microfilaraemia in the population was 16.4%. The prevalence of microfilaraemia was age-dependent and the overall microfilarial density (MFD) was 69.4 mf/ml (geometric mean) and significantly higher in males (95.8 mf/ml) than in females (48.6 mf/ml) ($p < 0.05$). The prevalence of clinical signs of infection was also age-dependent with elephantiasis being significantly higher in females (2.3%) than in males (0.9%) ($p < 0.05$). Among the males, the major clinical manifestation was hydrocele (10.4%).**
Conclusion: **These findings show high prevalence of bancroftian filariasis in Kwale district and warrant similar studies followed by implementation of intervention measures to reduce transmission in all areas of endemicity in the Coast Province.**

INTRODUCTION

Lymphatic filariasis is a major social and economic burden in tropical and sub-tropical areas where the disease is well established. Bancroftian filariasis caused by *Wuchereria bancrofti* is the most common form of human lymphatic filariasis and an important cause of morbidity, deformity and disability in the developing world with over 100 million people affected in more than 70 countries(1). The disease affects people of all ages and sexes, particularly the poor and vulnerable. The prevalence of infection may be on the increase mainly due to mushrooming of shanty towns without adequate sanitation leading to favourable conditions for breeding of vector mosquitoes(2). Little attention has been paid to this disease in many countries because data on the magnitude of the problem do not exist(3). In Kenya, the disease is endemic in the coastal regions where microfilaraemia rates of about 20% have previously been documented(4). The intensity and severity of the disease varies from place to place(5), but the endemicity of the infection in many areas has not been determined and where it has been, an update is required. Studies in neighbouring Tanzania show that hydrocele is an important public health problem(5,6). In general, the most important clinical signs of disease in males of East African coast are hydrocele, funiculitis, and elephantiasis(6-9).

Like in many other vector-borne helminth infections, the level of parasite reservoir in the human population and the density and activity of the vectors are important factors influencing the intensity of transmission. The major man-biting mosquito species involved in transmission at the Kenyan coast are *Culex quinquefasciatus, Anopheles gambiae,* and *An. funestus*(10,11).

In 1990, a collaborative Filariasis Research Project between the Kenya Medical Research Institute (KEMRI) and Japan International Co-operation Agency (JICA) was started with an objective of instituting a suitable control programme against bancroftian filariasis in Kwale district, Coast Province, Kenya. The study reported herein focuses on the prevalence of microfilaraemia and clinical manifestations and provides part of the baseline data required for community-based intervention trials instituted in the study area(12).

MATERIALS AND METHODS

Study area and census: The study was conducted in three contiguous villages, namely, Gandini, Dzivani and Lutsangani in Kinango Location, Kwale district, Coast Province, Kenya. The area is situated about 30 km northeast of Kinango town and is adjacent to the Indian Ocean. There are two main rainy seasons, namely, the long rains between April and June and the short rains between October and November. The vegetation consists mainly of low bush and grassland in the unutilised land and coconut trees planted mainly in the valleys.

The purpose and nature of the study was explained to the villagers through public meetings locally known as *barazas* organised by the local leaders. Complete census, mapping and demographic data were obtained by a house-to-house survey prior to onset of the study.

Parasitological examinations: Venous blood samples (1 ml) for microfilaria (mf) examination were collected at night between 2100 h and 2400 h, when microfilaraemia level in the peripheral circulation peaks in the endemic area(13). The night blood samples were transported in heparinised tubes to Kwale sub-district hospital laboratory the following morning, and microfilaraemia quantified by filtration of the blood samples through 5 µm polycarbonate membranes (Nuclepore Corporation, Pleasanton, CA). The number of mf was counted under a binocular microscope and expressed as mf/ml. Low density microfilaraemia (LDM) was defined quantitatively as a count of 15 mf/ml of venous blood or less.

Clinical examinations: Clinical data were collected by physical examination for signs and symptoms of bancroftian filariasis. Adenolymphangitis was defined as fever associated with lymphadenitis and lymphangitis without any concomitant wound on the corresponding limb. A lymph gland abscess and/ or scar around the inguinal region was taken to be a sign of a previous attack of lymphadenitis. For males, orchitis, epididymitis and funiculitis were recorded as genital lesions due to filariasis.

Elephantiasis was defined as swelling of the limb without any concomitant injury to the affected limb resulting in increase in size with loss of contour and the term was used to include lymphoedema. Hydrocele was defined as enlargement of the scrotum due to fluid accumulation. The examinations were carried out through house-to-house visits during the day. During the visits, the villagers were reminded to avail themselves for night blood collection.

Data analysis: Data were entered into a personal computer using the Microsoft Excel program (Microsoft Corporation, One Microsoft Way Redmond, WA 98052 - 6399). The Chi-square test was used to compare microfilaraemia among the villages. The Student's two-tailed t-test was used to test for differences in the microfilarial density (MFD). Results were considered significant when $p < 0.05$.

RESULTS

Out of a total population of 4730 registered residents aged five years and above, 1839 persons (38.9%) were examined for clinical signs of disease and 1716 persons (36.3%) were examined for microfilaraemia.

Table 1 shows the prevalences of microfilaraemia in the individual villages. Microfilaraemia was most prevalent in Lutsangani (24.9%) and lowest in Gandini (12.1%). There was a significant difference in microfilaraemia prevalences between Lutsangani and the other villages ($p < 0.05$), but no statistical difference was observed between Dzivani and Gandini ($p > 0.05$). The overall prevalence of microfilaraemia in the population was 16.4%. In general, the prevalence of microfilaraemia increased with age peaking in the 45-54 age group (Figure 1). The overall prevalence of microfilaraemia was 18.1% and 14.8% in males and females, respectively, but the difference was not statistically significant ($p > 0.05$).

Table 1

Microfilarial prevalences among males and females from three villages in Kwale district, Kenya

	Males	Females	Both sexes
Village	No.pos/total (%)	No. pos/total (%)	No.pos/total (%)
Gandini	36/268 (12.6)	36/309 (11.7)	72/595 (12.1)
Dzivani	39/248 (15.7)	33 (322 (10.2)	72/570 (12.6)
Lutsangani	68/255 (26.7)	69/296 (23.3)	137/551 (24.9)
Total	143/789 (18.1)	138/927 (14.8)	281/1716 (16.4)

Figure 1

Microfilarial prevalence related by sex and age among inhabitants from three villages in Kwale District, Kenya.

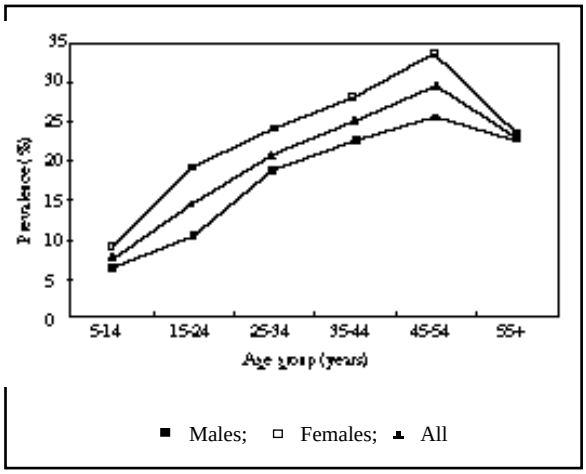


Table 2 shows data on the microfilarial densities/ intensities (MFD) and proportion of low-density microfilaraemia (LDM) carriers among mf positive persons. The MFDs among the individual villages were significantly different ($p < 0.05$). The overall MFD was 69.4 mf/ml (geometric mean) with 25.3% of the mf positive persons being LDM carriers. In all the villages, the MFDs were significantly higher in males than in females ($p < 0.05$).

To further analyse microfilarial prevalence and intensity by relation to gender, age was categorised into three age groups, namely, children (5-14 years), child bearing (15-45 years) and post-child bearing (45 years and above) age groups. Although there was no significant statistical difference between males and females in the children and the post-child bearing age groups, there was a significant difference in the child bearing age group in both the microfilarial prevalence and MFD ($p < 0.05$).

Table 2

Microfilarial densities (MFD) and proportion of low-density microfilaraemia (LDM) carriers among microfilaria positive males and females from three villages in Kwale district, Kenya

	Males		Females		Both sexes	
Village	MFD	% LDM	MFD	% LDM	MFD	% LDM
Gandini	103.9	19.4	55.3	30.6	75.1	25.0
Dzivani	49.1	28.2	18.7	54.5	30.7	40.3
Lutsangani	140.7	20.6	78.2	14.5	108.6	17.5
All	95.8	22.4	48.6	28.3	69.4	25.3

MFD was expressed as geometric mean of individual mf counts. LDM was expressed as proportion of mf positive individuals with 15 mf/ml or less.

Table 3

Prevalence of signs of acute disease among inhabitants from three villages in Kwale district, Kenya

	Gandini	Dzivani	Lutsangani	All villages
Sign	No.pos/total (%)	No.pos/total (%)	No.pos/total (%)	No.pos/total (%)
Adenolymphangitis	56/783 (7.2)	11/589 (1.9)	15/467 (3.2)	82/1839 (4.5)
Filarial scar	22/783 (2.8)	15/589 (2.5)	13/467 (1.8)	50/1839 (2.7)
*Genital lesion	21/401 (5.2)	7/237 (3.0)	6/294 (2.0)	34/932 (3.6

*Funiculitis, orchitis and/or epididymitis in males only

Figure 2

Prevalence of hydrocele in males by age group

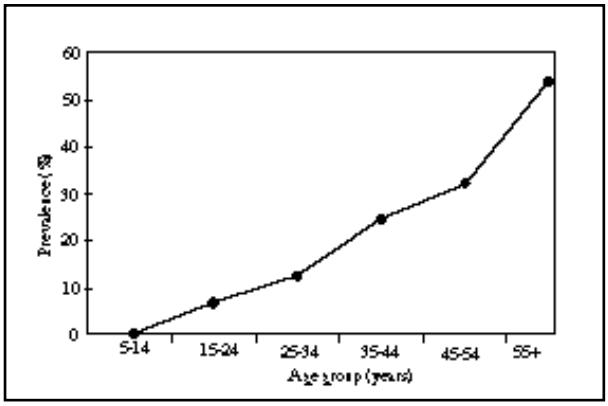
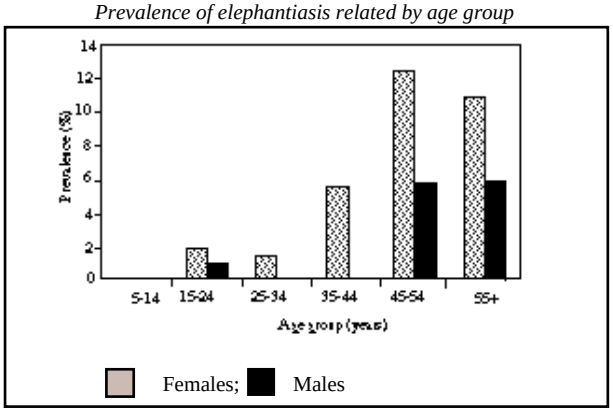


Figure 3

Prevalence of elephantiasis related by age group



The prevalence of signs of acute disease in the population was generally low (Table 3). However, Gandini village had a significantly higher prevalence of acute disease compared to the other villages ($p < 0.05$); 5.0%, 2.3% and 2.8% for Gandini, Dzivani and Lutsangani, respectively.

Figures 2 and 3 show the comparative age related prevalences of hydrocele (range: 0.5% - 53.7%) and elephantiasis (range: females, 0.0% -12.5%; males, 0.0% - 5.9%), respectively. The prevalence of the two conditions was clearly age-dependent, with hydrocele rates rising sharply in older age groups. The most prevalent sign of chronic disease in males was hydrocele (10.4%). Leg elephantiasis was more common in females (2.3%) than in males (0.9%) and elephantiasis of the arm was seen in only one female.

Out of twenty persons with elephantiasis whose blood was examined for mf, only three (15.0%) were found to have microfilaremia. Similarly, for persons with hydrocele only five out of 59 (15.3%) were found to have microfilaraemia.

DISCUSSION

The endemicity of filariasis can be assessed using clinical, parasitological, immunological and entomological methods. Parasitological assessment is made on the basis of microfilarial density (MFD) and microfilaraemia prevalence. The observed overall MFD (geometric mean)

and microfilaraemia prevalence of 69.4 mf/ml and 16.4%, respectively show that the endemicity of bancroftian filariasis in the study area is relatively high. A similar study(8) undertaken in the same district and at almost the same time has reported an overall microfilaraemia prevalence of 13.7%. However, in neighbouring Tanzania microfilaraemia prevalence and MFD were higher ranging from 22.2 to 37.6% and 546 to 735 mf/ml, respectively(14).

Low density microfilaraemia is a density of circulating mf which is often difficult to detect by most parasitological techniques used for field surveys, for example, the conventional thick blood smear using 60 µl of blood. In the present study, 25.3% of the mf positive persons were found to be LDM carriers. In a review of the significance of LDM in the transmission of lymphatic filariasis(15), LDM was reported to be an important cause of underestimation of filariasis in epidemiological surveys. To avoid underestimation of bancroftian filariasis, parasitological methods should be complemented with the currently available very sensitive and specific immunological methods for circulating filarial antigen detection, for example, the ICT card test (ICT Diagnostics, 3/14 Roseberry St, Balgowlah, Sydney, Australia).

Lymphatic filariasis has a wide spectrum of clinical manifestation including acute and chronic manifestations, with the former recognised as the first apparent clinical indication of the disease(16). There are no satisfactory definitions of acute and chronic forms of the disease. Manifestations of acute filarial disease, variously described as acute attacks, filarial fevers, adenolymphangitis or ADL(3), are characterised by episodic attacks of malaise, fever and chills and the appearance of enlarged painful lymph nodes draining the affected part. The affected part in most cases is usually the lower limb, followed by an acute, warm and tender swelling(16). Signs of acute filarial disease were rare in the three villages, however, although Gandini village had the lowest microfilaraemia prevalence, it had a significantly higher prevalence of signs of acute disease compared to the other villages. This observation may suggest that the prevalence of acute clinical manifestations in a community is independent of the microfilaraemia prevalence.

The importance of both age and gender of a bancroftian filariasis survey sample has been stressed(17). The results of this study shows that the overall MFDs and microfilaraemia prevalence rates were higher in males than in females. Further, elephantiasis was more common in females than in males and in general hydrocele the most common manifestation of disease. The findings suggest that results obtained when only one sex is used in the survey sample would be unrepresentative of the population. In addition, the present study shows that there is a positive association between microfilaraemia prevalence rates and the age of the persons infected. A similar observation has been made in previous studies in the East African coast(4,10). This observation suggests that repeated infective mosquito bites may be necessary for microfilaraemia to develop. However, the microfilaraemia prevalence rates decrease above the age of about 50 years, a time at which the chronic disease rates peaks.

The results of the present study show that females in the reproductive age group have statistically significant lower microfilarial prevalence and MFD than males in the corresponding age group. It has previously been suggested that females may have increased resistance to infection and that this resistance is heightened in the reproductive years, implying the involvement of pregnancy-related mechanisms or other gender-dependent variations in hormone levels(18). An epidemiological survey in the district found that there was a significant gender dependent difference in microfilarial prevalence although there was no significant difference in MFD(19).

Although the three villages in the study area were adjacent to one another, the MFDs and microfilaraemia and disease prevalences were different. This confirms previous observation that the intensity and severity of filariasis varies widely even in the same ecological zones(5,9). An entomological survey carried out in the three villages during the study period revealed that Lutsangani village, unlike the others, had the highest density of vector mosquitoes(11). More important was the finding that in Lutsangani all the three major filaria vectors, namely, Cx. q*uinquefasciatus, An. gambiae* and *An. funestus* were found to be infective. However, only *An. gambiae* and *An. funestus*; *Cx quinquefasciatus* and *An. gambiae* were found infective in Gandini and Dzivani, respectively. In addition, *An. funestus* were caught throughout the year in Lutsangani unlike in the other villages where they appeared mostly during the long rains. The findings suggest that there are more attractive ecological niches that favour breeding of filaria vectors in Lutsangani village than in the other two villages.

There was no relationship between the manifestation of disease and microfilaraemia. This result is consistent with the observation that manifestations of chronic disease are not always associated with microfilaremia(7). In addition, signs of overt disease were seemingly absent among the five to 14-year age group and suggest that pathology develops progressively with age and its onset may not be readily evident in children.

This study revealed the extent and importance of bancroftian filariasis in an area designated for intervention trials. Similar studies in other parts of the Coast Province should be conducted and appropriate control strategies designed and implemented.

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REFERENCES

1. Ottesen, E.A. and Ramachandran, C.P. Lymphatic filariasis infection and disease: control strategies. *Parasit. Today* 1995; **11**:129-131.
2. Curtis, C.F. and Feachem, R.G. Sanitation and *Culex pipiens* mosquitoes: a brief review. *J. trop. Med. Hyg.* 1981; **84**:17-25.
3. WHO. *Lymphatic filariasis: The Disease and its Control. Fifth Report of the WHO Expert Committee on Filariasis.* 1992; World Health Organization, Technical Report Series No. 821.
4. Wijers, D.J.B. and Kinyanjui, H. Bancroftian filariasis in Kenya. II. Clinical and parasitological investigations in Mambrui, a small coastal town, and Jaribuni, a rural area more inland (Coast Province). *Ann. trop. Med. Parasit.* 1977; **71**:333-345.
5. Abaru, D.E., McMahon, J.E., Marshall, T.F. de C., Hamilton, P.J.S., Vaughan, J.P. and Wegesa, P. Tanzania Filariasis Project: studies on microfilaraemia and selected clinical manifestations of bancroftian filariasis. *Acta trop.* 1980; **37**:63-71.
6. Wegesa, P., McMahon, J.E., Abaru, D.E., Hamilton, P.J.S., Marshall, T.F. de C. and Vaughan, J.P. Tanzania Filariasis Project: survey methodology and clinical manifestations of bancroftian filariasis. *Acta trop.* 1979; **36**:369-377.
7. Wijers, D.J.B. and McMahon, J.E. Early signs and symptoms of bancroftian filariasis in males at the East African coast. *East Afr. Med. J.* 1976; **53**:57-63.
8. Estambale, B.B., Simonsen, P.E, Knight, R. and Bwayo, J.J. Bancroftian filariasis in Kwale District of Kenya. I. Clinical and parasitological survey in an endemic community. *Ann. trop. Med. Parasit.* 1994; **88**:145-151.
9. Wamae, C.N., Gatika, S.M., Roberts, J.M. and Lammie, P.J. *Wuchereria bancrofti* in Kwale District, Coastal Kenya: patterns of focal distribution of infection, clinical manifestations and anti-filarial IgG responsiveness. *Parasit.* 1998; **116**:173-182.
10. McMahon, J.E., Magayuka, S.A. and Kolstrup, N. Studies on the transmission and prevalence of bancroftian filariasis in four coastal villages of Tanzania. *Ann. trop. Med. Parasit.* 1981; **75**:415-431.
11. Mwandawiro, C.S., Fujimaki, Y., Mitsui, Y. and Katsivo, M. Mosquito vectors of bancroftian filariasis in Kwale District, Kenya. *East Afr. Med. J.* 1997; **74**:288-293.
12. Njenga, S., Mitsui, Y., Muita, M., Fujimaki, Y., Mbugua, J., Kirigi, G., Gachihi, G., Wasunna, M. and Aoki, Y. The effect of sodium bicarbonate on a single dose of diethylcarbamazine therapy in patients with bancroftian filariasis in Kenya. *Parasit. Int.* 1997; **46**:171-179.
13. Gatika, S.M., Fujimaki, Y., Njuguna, M.N., Gachihi, G.S. and Mbugua, J.M. The microfilaria periodic pattern of *Wuchereria bancrofti* in Kenya. *J. trop. Med. Hyg.* 1994; **97**:60-64.
14. Simonsen, P.E., Meyrowitsch, D.W., Makunde, W.H. and Magnussen, P. Bancroftian filariasis: The pattern of microfilaremia and clinical manifestations in three endemic communities of Northeastern Tanzania. *Acta trop.* 1995; **60**:179-187.
15. Southgate, B.A. The significance of low density microfilaremia in the transmission of lymphatic filarial parasites. *J. trop. Med. Hyg.* 1992; **95**:79-86.
16. Dunyo, S.K., Nkrumah, F.K., Ahorlu, C.K. and Simonsen, P.E. Exfoliative skin manifestations in acute Iymphatic filariasis. *Tran. roy. Soc. trop. Med. Hyg.* 1998; **92**:539-540.
17. Pani, S.P., Balakrishnan, N., Srividya, A., Bundy, D.A.P. and Grenfell, B.T. Clinical epidemiology of bancroftian filariasis: effect of age and gender. *Trans. roy. Soc. trop. Med. Hyg.* 1991; **85**:260-264.
18. Brabin, L. Sex differentials in susceptibility to lymphatic filariasis and its implications for maternal child immunity. *Epi. Infections.* 1990; **105**:335.
19. Wamae, C.N. An epidemiological study of *Wuchereria bancrofti* in Muhaka, Kwale District, South Coastal Kenya; PhD Thesis, Tulane University, USA, 1995.