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LYMPHATIC FILARIASIS AMONG THE EZZA PEOPLE OF EBONYI STATE, EASTERN NIGERIA

Jude C. Anosike[1], Bertram E. Nwoke[1], Ezekiel G. Ajayi[4], Celestine O. Onwuliri[2], Onuabuchi U. Okoro[1], Ene E. Oku[3], Joe E. Asor[3], Oliver U. Amajuoyi[1], Chidinma A. Ikpeama[1], Fidelia I. Ogbusu[1], Chidozie O. Meribe[1]

[1]Department of Animal & Environmental Biology, Imo State University, Owerri Nigeria
[2]Department of Zoology, University of Jos, Nigeria
[3]Department of Zoology, University of Calabar, Nigeria
[4]Global 2000 Guinea worm Eradication programme Ebonyi State, Nigeria

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Abstract: A total of 1,243 Ezza people living in 10 communities of Ebonyi State, eastern Nigeria were examined between July 2002–January 2003 for lymphatic filariasis. This is the first time a filariasis survey due to *Wuchereria bancrofti* has been carried out in this state. Of the 1,243 persons examined, 210 (16.9%) had *W. bancrofti* microfilariae. Infection varied significantly among communities and ages ($p<0.05$) but not sex-related ($p>0.05$). The Ezza people are predominantly farmers and professional hired labourers. There was a close association between microfilaria rate and microfilaria -density in various age groups ($r = 0.812$; $p<0.01$). Microfilaria density is an important measure in the epidemiology, treatment and control of human filarisis in this endemic foci. Clinical signs and symptoms of the disease include elephantiasis, hydrocoele, dermatitis and periodic fever. Clinical symptoms without microfilaraemia and microfilaraemia without clinical symptoms were also observed. Of 1,603 mosquitoes dissected, *Anopheles gambiae*, *An. funestus* and *Culex quinquefasciatus* showed infectivity rates of 6.3%, 5.1% and 6.0% respectively. The affected persons and other key informants are unaware of the cause of the disease and attributed it to witchcraft, violation of taboo, bad water and food. Intervention strategies to be integrated into the on-going Community-Directed Treatment with Ivermectin (CDTI) project are discussed.

Address for correspondence: Jude C. Anosike, Ph.D., Filariasis Research Project, Department of Animal and Environmental Biology, Imo State University, Owerri. P.M.B. 2000 Owerri, Nigeria. E-mail: jc_anosike@yahoo.com

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INTRODUCTION

Lymphatic filariasis is a tropical disease caused by the parasitic filarid nematode worms *Wuchereria bancrofti*, *Brugia malayi* and *B. timori*. The disease is a problem in many parts of Asia, Africa, the western Pacific and the Americas. Of the 73 countries where lymphatic filariasis is known to occur, 38 are in Africa and in this region infections are exclusively caused by *W. bancrofti* [20]. Lymphatic filariasis is a major public health problem and strikes vulnerable people of all ages and both sexes. It inflicts a considerable social and economic burden on

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many tropical and subtropical countries. About 120 million people in 73 countries are infected globally with an estimated 1.1. billion at risk of infection [31]. At least 40 million people are infected in Africa [3]. The disease is usually seen among the poorest of the poor, and for many years has had a very low public health rating in the priorities of most countries where it is prevalent.

The visible manifestations of the disease are severe and disfiguring. It has been reported that lymphoedema and elephantiasis of the limbs or genitalia, hydrocoele and scrotal pathology in man, recurrent infections associated with damaged lymphatics, lung disease, chyluria or abnormalities of the renal function occur in an estimated 44 million people [32].

Available literature on this disease from both the north and central parts of Nigeria and the report of a postal survey by the Nigerian Lymphatic Filariasis Elimination Programme (NLFEP) have shown that lymphatic filariasis is prevalent and widespread [3, 4, 5, 29, 30]. Nigeria is thought to have more cases of Lymphatic filariasis than any other country worldwide, except India, and about 24 million Nigerians are believed to be at risk of the disease [4]. Consequently, epidemiological information is needed on the distribution, clinical signs and intensity in many parts of Nigeria because many areas in the country remain unidentified and unstudied. This situation no doubt has continued to affect the planning and implementation of any elimination measures against the disease.

As it is, NLFEP of the Federal Ministry of Health, with the assistance of the Carter Centre, has set 2015 as the year to eliminate the disease in Nigeria. To achieve this goal, Nigeria and all the supporting agencies/ organizations require comprehensive nation-wide epidemiological data to delineate the main Lymphatic filariasis endemic foci that require priority mass community-directed treatment with ivermectin and albandazole, and also ensure adequate coverage of all high risk areas.

The present work is necessary to elucidate the endemicity, microfilaria rate, intensity, and clinical signs, as well as the local vectors of the disease amongst the Ezza people of eastern Nigeria. We report here the results of field studies conducted in selected villages in Ebonyi State during the period July 2002–January 2003.

MATERIALS AND METHODS

Study area and population. The study was carried out in the north-western part of Ebonyi State. Ebonyi State in situated between coordinates 7^0 30^1 and 8^0 3^1 N and between 5^0 40^1 and 6^0 45^1 E. The State is made up of mainly 4 ethnic groups, namely: Ezza, Izzi, Ikwo and Afikpo. The areas surveyed were mainly the Ezza people. They have boundaries with some parts of Enugu and Benue states. The Ezza people are mainly farmers who are easily recognized as hired labourers in swampy rice fields, maize and cassava farms, and in other out door activities such as crushing of rocks, digging of wells, cutting trees, etc. The local populations live in small farming settlements few kilometers from the rivers and ponds, while some live within only a few metres. Most of the communities were accessible by foot during the dry months (October–January), but otherwise they lived in marshy and impassable.

Announcement of the survey team's visit was usually made by the village head on the evening proceeding the visit. This includes the Global 2000 consultant, (JCA), 3 physicians, 3 Field Managers as well as 2 village based Health Workers. Members of the community aged 1 year and above were assembled at the headman's compound where the investigation was carried out between 10:00 pm and 2:00 am. Information on each individual was obtained for age, sex, duration within the community, and previous treatment with ivermectin and recorded on a standard individual form.

Physical and parasitological examinations. The methods adopted have been fully described [3]. The 3 physicians attached to the team examined subjects physically for clinical manifestations. Night blood specimens were collected due to the periodic pattern exhibited by *W. bancrofti* microfilariae in the peripheral blood of infected subjects. Adopting the finger pick method using disposable sterile blood lancets, the thick blood smear technique was used for studying the presence of blood microfilariae. Thick smears were made from about 20 mm^3 blood samples. The thick films were air-dried, fixed in methanol, stained with Giemsa and examined under a binocular compound microscope for the presence of sheathed microfilariae. The thick blood smear technique made it possible to examine a large number of persons, and could be tolerated more easily than the filteration method during filariasis survey [1, 3, 8]. Apart from its suitability for large field observations, it has been shown to be as sensitive as the venipuncture technique [13]. Microfilariae were identified based on specific morphological features and sizes. They were also counted and recorded in individual data sheets.

Also, subjects were interviewed on the clinical signs and symptoms as well as community knowledge, and beliefs of the disease following the methods of Braide *et al.* [7]. The spectrum of lymphatic filariasis ranges from periodic reoccurring attack of localized inflammation, tenderness and pain, often accompanied by fever, nausea as well as vomiting, known as acute adenolymphangitis (ADL), to chronic symptoms including lymphoedema, chyluria, hydrocoele and elephantiasis.

Entomological studies on transmission aspects using fixed Pyrethrum, Spray Collection (PSC) was carried out in 6 villages monthly during the period of the survey. Samples were collected from the rural areas in round grass-thatched mud - huts with mat-covered doors which do not serve as barriers to the entry of mosquito vectors into sleeping areas. These huts are typical of the Ezza people's residential areas. The PSC was made in the morning between 5:30 am and 6:30 am (GMT+1).

Collections were immediately separated by sex and the females were identified into species according to the keys adopted from Gillet [12]. Only *Anopheles gambiae*, *An. funestus* and *C. quinquefasciatus*, the established vectors of *W. bancrofti*, were dissected as suggested by WHO [31] and Hati *et al.* [14]. Mosquitoes infected with *W. bancrofti* larvae were recorded.

Statistical analysis. The community prevalence of infection was calculated using percentages. Independence and relationship of age, sex and microfliaria rate and density were stratified using chi-square analysis. Regression analysis was also used in assessing the mf-rate and mf-density in various age groups.

RESULTS

1,243 persons from 10 communities situated amongst the Ezza people of Ebonyi State, Eastern Nigeria were examined for lymphatic filariasis due to *W. bancrofti*. Generally, 210 (16.9%) out of the 1,243 persons examined were infected. Infection rates of lymphatic filariasis ranged from 7.4% in Ndeagwegu to 38.6% in Okaleru Umuoghara community (Tab. 1). Distribution of the disease between communities showed a significant variation (chi-square test, $p<0.05$).

The age-differential in distribution of the disease is evident in Table 2. There was a gradual increase of the disease prevalence with increase in age, reaching a peak in the 40–49 year old age group before a gradual decline in prevalence. Chi-square test shows that age and infection are dependent ($p<0.05$). As shown in Table 3, of the 1,243 persons sampled, 592 and 651 were males and females, respectively. 98 (16.6%) and 112 (17.2%) males and females were infected, respectively. Although more females were infected than males, it was not statistically significant (chi-square test, $p>0.05$). In both sexes, prevalence seems to increase with age. Table 4 depicts the distribution of clinical symptoms/signs in amicrofilaremic individuals. Of the 290 persons observed with several clinical signs, 210 (72.4%) and 80 (27.6%) were micro-filaraemia and amicrofilaremic, respectively. 28.6%, 27.3% and 27.3% cases of elephantiasis, dermatitis (skin eruption) and hydrocoele respectively were amicrofilaremic.

The microfilarial density showed that a high proportion of the infected persons (69.8%) had counts below 14 microfilariae per 20 mm^3 of blood, while 30.2% of microfilaraemic individuals had counts above 14 mcirofilariae per 20 mm^3 of night peripheral blood. We also gathered that annual mass treatment of inhabitants in the area with mectizan is on its fourth round. Frequency distribution of clinical filariasis as regards mf-rate and intensity of microfilaria is given in Table 5. While periodic fever, dermatitis and a crawling sensation appeared much earlier in life, tenderness of limbs, elephantiasis as well as hydrocoele showed up from the fifth decade of life. Both mf-rate and mean microfilarial density increased with advancing age until 49 years, with a slight decline between 50 years and above. A close association was observed between mf-rate and mf-density in various age groups ($r = 0.812$; $p<0.01$).

Table 1. Community prevalence of lymphatic filariasis in the study area.

Communities	Total number examined	Number (%) with microfilariae
Okaleru Umuohera	145	56 (38.6%)
Ogudali	126	16 (12.7%)
Oharugo	110	11 (10.0%)
Ohainyi	199	23 (11.6%)
Ndeagwegu	95	7 (7.4%)
Amaeta	102	25 (24.5%)
Igweledeoha	79	7 (8.7%)
Ekwetekwe	222	41 (18.5%)
Azunramura	97	9 (9.3%)
Enyagharigwe	68	15 (22.1%)
Total	1243	210 (16.9%)

Table 2. Prevalence of lymphatic filariasis in relation to age amongst the Ezza people.

Age (in years)	Number examined	Number (%) positive for microfilaria rate
0–9	164	5 (3.0)
10–19	203	20 (9.9)
20–29	309	44 (14.2)
30–39	217	31 (14.3)
40–49	134	56 (41.8)
50–59	110	35 (31.8)
60–69	64	13 (20.3)
70+	42	6 (14.3)
Total	1243	210 (16.9)

Table 4. Distribution of clinical symptoms/signs without microfilaraemia.

Clinical symptoms/signs	No. of cases observed	No. of cases (%) with micro-filariae in blood	No. of cases (%) without micro-filariae in blood
Dermatitis/ skin eruption	66	48 (72.7)	18 (27.3)
Hydrocoele	22	16 (72.7)	6 (27.3)
Elephantiasis/ swollen limbs	28	20 (71.4)	8 (28.6)
Crawling sensation	57	40 (70.2)	17 (29.8)
Tenderness of limbs	34	22 (64.7)	12 (35.3)
Periodic fever	83	64 (77.1)	19 (22.9)
Total	290	210 (72.4)	80 (27.6)

Entomological studies on the natural infection of mosquitoes revealed that *An. gambiae* (6.3%), *An. funestus* (5.1%) and *C. quinquefasciatus* (6.0%) are the vectors of *W. bancrofti* in the area.

On community knowledge and beliefs of lymphatic filariasis in the study area, the affected persons and other key informants interviewed did not know the cause of the

Table 3. The age and sex distribution of positive cases (carriers of *Wuchereria bancrofti* microfilaria) in the study area.

Age (years)	Male			Female			Total		
	No. examined	No. positive	% positive	No. examined	No. positive	% positive	No. examined	No. positive	% positive
0–9	77	2	2.6	87	3	3.4	164	5	3.0
10–19	103	11	10.7	100	9	4.0	203	20	9.9
20–29	143	19	13.3	166	25	15.1	309	44	14.2
30–39	92	17	18.5	12.5	14	11.2	217	31	14.3
40–49	69	22	31.9	65	34	52.3	134	56	41.8
50–59	50	17	34.0	60	18	30.0	110	35	31.8
60–69	38	7	18.4	26	6	23.0	64	13	20.3
70+	20	3	15.0	2.2	3	13.6	42	6	14.3
Total	592	98	16.6%	651	112	17.2	1243	210	16.9

Table 5. Age-related distribution of clinical signs in relation to microfilaria density.

Age (years)	Number of sub examined	Number (%) microfilaria positive cases	Mean microfilaria density	Frequency distribution of clinical signs/symptoms (% of persons examined in each age group)*					
				Crawling sensation	Periodic fever/chill	Tenderness of limbs	Elephantiasis	Dermatitis	Hydrocoele
1–9	164	5 (3.0)	3.3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (3.0)	0 (0.0)
10–19	203	20 (9.9)	8.1	8 (3.9)	2 (0.9)	0 (0.0)	0 (0.0)	2 (1.0)	0 (0.0)
20–29	309	44 (14.2)	10.5	16 (5.32)	8 (2.6)	0 (0.0)	0 (0.0)	4 (1.3)	0 (0.0)
30–39	217	31 (14.3)	10.6	8 (3.7)	24 (11.0)	0 (0.0)	0 (0.0)	7 (3.2)	0 (0.0)
40–49	134	56 (41.8)	19.4	7 (5.2)	13 (9.7)	8 (6.0)	4 (3.0)	9 (6.7)	9 (6.7)
50–59	110	35 (31. 8)	16.6	5 (4.5)	11 (10.0)	6 (5.5)	3 (2.7)	10 (9.0)	4 (3.6)
60–69	64	13 (20.3)	9.7	6 (9.4)	12 (18.8)	8 (12.5)	8 (12.5)	11 (17.2)	3 (4.7)
70+	42	6 (14.3)	5.2	7 (16.7)	13 (40.0)	12 (28.6)	13 (31.0)	18 (42.9)	6 (14.3)
Total	1243	210 (16.9)	10.4	57 (4.6)	83 (6.7)	34 (2.7)	28 (2.3)	66 (4.3)	22 (1.8)

*An infected person may have several clinical signs.

disease and attributed it to witchcraft, violation of taboo, bad water and bad food.

DISCUSSION

This study on lymphatic filariasis in Ebonyi State is an added advantage considering the current effort by Global 2000 Nigeria towards the elimination of lymphatic filariasis in Nigeria. The present observations show that the disease is endemic amongst the Ezza people of Ebonyi State, Nigeria. With an overall prevalence of at least 16.9% and a highest prevalences of 7.4% and 38.6% in Ndeagwuegu and Okaleru Umuoghara villages respectively, lymphatic filariasis due to *W. bancrofti* infections is indeed a public health problem. This prevalence rate is higher than that of earlier observations in parts of Nigeria by Anosike [3, 4] in Bauchi State; in Western Nigeria [22]; in Cross River [7]; in the Niger Delta [28]; in the Kano area [9] as well as in Mutum-Biyu district of Gongola State [1]. However, when this record is compared with the reports of Wijeyaratne *et al.* [30] in the Malumfashi district of Northern Nigeria (22.6%), Akogun *et al.* [2] in Taraba State (33.3%), and Mba & Njoku [19] in Anambra State (18.8%), it is relatively low. Even within the sampled communities, there were significant variations. This could be due to several factors, especially the local environmental condition, which supports the breeding of *An. gambiae* and *An. funestus* in the clean and highly-oxygenated water pools prevailing in the cassava farms and rice fields. *C. quinquefasciatus* were also caught in the huts. These mosquitoes showed infectivity for *W. bancrofti* larval stages. Therefore, various activities of the local population such as rice farming and other outdoor related activities tend to increase man-fly contact rates in different communities.

Age-related infection rates agree with previous findings [1, 4, 28, 31], which showed that prevalence rises with age. Duration exposure to the vector in middle age and the farming age groups may be the major reason for differences. The high prevalence between the age of 29–59, which incidentally are the most productive ages of life, should be of tremendous concern to the Ezza people.

The similarity in prevalence between the sexes is expected. Both men and women equally work on the farms. It is interesting to note that the high prevalence of lymphatic filariasis observed amongst the Ezza people could be mainly due to their occupational dispositions, living conditions, frequency of exposure to infectious bites from mosquitoes, and proximity to various breeding sites of the vectors.

Both the microfilarial rate (mf-rate) and the microfilarial density (mfd) in positive cases offer valuable information in evaluating data obtained in mass surveys of human populations in different endemic areas, as well as data collected before and after the application of various control measures. This means that microfilarial density is an important measure in the epidemiology, treatment and control of human filariasis in endemic foci. The present work presents an interesting picture. The intensity of *W. bancrofti* infection had relatively low microfilarial counts, almost 70% of all infected persons harbouring counts less than 8 mf per 20 mm^3 of night peripheral blood. On the whole, a low mfd of 10.4 was recorded.

Infections with *W. bancrofti* were associated with dermatitis, elephantiasis and hydrocoele. Dermatitis is a symptom that is associated with many filarial parasite species while hydrocoele has been recognized as the major symptom of bancroftian filariasis [31]. Hydrocoele and elephantiasis were observed in ages above 40 years, as found in endemic areas in Africa [1, 24] and India [10]. Generally the hydrocoeles were mild in degree and asymptomatic in 3 cases, similar to the findings in east Africa and India [15, 10]. No enlargements were found in women because, for ethnocultural reasons, the genitals of the Ezza women could not be examined. Hydrocoele was unilateral in most cases.

It is also noteworthy that while even with positive microfilaraeamia, some people showed no symptoms; even with characteristic symptoms, a few others did not show any microfilaria in their peripheral blood. The suggestion that a low grade microfilaremia may escape detection by the thick smear technique [13] seems a reasonable explanation for the high rate of amicrofilaremic individuals with clinical symptoms amongst the Ezza people, or could be related to the already mass treatment of subjects with mectizan in the area by Global 2000 Carter Centre. The complex interactions of vector, parasite and host are still not well understood, but filarial infection without microfilaraemia is well recognized [6, 10, 18, 21, 24, 25].

Although the immune mechanism may also be involved in the pathogenesis of elephantiasis, Partono [25] noted that persons with elephantiasis are less likely to have microfilaraemia than persons who have been equally exposed but do not have elephantiasis; the present finding conforms with the observations of Dupont *et al.* [11], Ufomadu *et al.* [29] and Anosike *et al.* [3] who reported common occurrence of amicrofilaremic filariasis in parts of Africa. To date the exact, course of disease development in bancroftian filariasis is not fully understood.

Hii *et al.* [16] found high (27.3%) prevalence rate of *W. bancrofti* but a comparatively low level of clinical signs; an indication of possible well adapted host-parasite relationship. Consequently, it is not known whether clinical manifestations are always preceded by an asymptomatic microfilariaemic stage. Immunological studies are needed in this respect.

Results of mosquito dissections revealed that *An. gambiae*, *An. funestus* and *C. quinquefasciatus* are the vectors of *W. bancrofti* in Ebonyi State, just as in other parts of West Africa [30]. The involvement of the triads of these mosquito species in the transmission of lymphatic filariasis is epidemiologically important. Apart from *An. gambiae* and *An. funestus* recorded in this study, the presence of *C. quinquefasciatus* in Ebonyi State is not uncommon. This mosquito species has been known to breed naturally in open drains, flooded latrine pits, store water drains [23], as well as polluted pots and drums used for cassava fermentation in some parts of Eastern Nigeria [17].

Although transmission of lymphatic filariasis is predominantly rural in areas where the Anopheline mosquitos are vectors, there is a growing concern about the involvement of *C. quinquefasciatus* on the disease transmission in several rural areas of Ebonyi State. This observation is similar to the report on the East African coast [15] where culicine - and anopheline - transmitted filariasis co-exist in the same population. *C. quinquefasciatus* was shown to have a vector potential as great as that of both *An. gambiae* and *An. funestus*, an unexpected result in view of previous studies of *Culex* – transmitted filariasis in Northern Nigeria [4, 26, 27]. This finding is potentially very worrying for many areas of West Africa where *W. bancrofti* is endemic and *C. quinquefasciatus* is rapidly becoming more abundant, but where local compatibility between the parasite and the mosquito has not yet appeared.

On the community's knowledge and beliefs of lymphatic filariasis in the area, less than 15% knew about the disease which they had specific local name for. Conversely, because of the marked clinical manifestation of the disease, most of the villagers recognized and had local names that reflect the physical conditions of their afflictions. Only 2.3% of the respondents knew that the disease could be transmitted by an insect vector-mosquito, which makes it difficult to put in place appropriate management and preventive measures.

To this effect, awareness of the cause of the disease, the relationship between infection and clinical signs/ symptoms and goal of treatment must be increased through community-based Health Education campaigns. This would enhance the possibility of acceptance and support of control/elimination programmes. We therefore recommend intensive intervention (Chemotherapy and morbidity control) to be integrated into the on-going Community-Directed Treatment with Ivermectin (CDTI) project.

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REFERENCES

1. Akogun OB: Filariasis in Gongola State Nigeria. I: Clinical and parasitological studies in Mutum-Biyu District. *Angew Parasitol* 1992, **33(3)**, 125-131.
2. Akogun OB, Chessed G, Akafyi DE: Prevalence of Bancroftian filariasis in two communities in Zing Local Government Area of Taraba State Nigeria. **In:** *Nig. Soc. Parasitol. 25th Annual Conference Abstr.* No. 10. 2001.
3. Anosike JCN: The status of human filariasis in north-western zone of Bauchi State, Nigeria. *Appl Parasitol* 1994, **35**, 133-140.
4. Anosike JC: *Studies on filariasis in some local government Areas of Bauchi State Nigeria*. PhD thesis. University of Jos, Nigeria 1996.
5. Anosike JC, Azoro VA, Nwoke BEB, Keke RI, Okere AN, Oku EE, Ogbulie JN, Tony-Njoku RF, Okoro OU, Nwosu DC: Dracunculiasis in the north-eastern border of Ebonyi State, south-eastern Nigeria. *Int J Hyg Environ Health* 2003, **206(1)**, 45-51.
6. Badaki JA, Akogun OB: Acute lymphatic filariasis morbidity in central Nigeria. **In:** *Nig. Soc. Parasitol. 24th Annual Conference Abstr.* No. 3, 2000.
7. Beaver PC: Filariasis without microfilaraemia. *Am J Trop Med Hyg* 1970, **19**, 181-189.
8. Braide EI, Ikpeme B, Edet E, Atting I, Ekpo UF, Esu B, Kale OO: Preliminary observations on the occurrence of lymphatic filariasis in Cross River State, Nigeria. *Nig J Parasitol* 2003, **24**, 9-16.
9. Chlebowsky HO, Zielke E: Membrane filtration technique for the diagnosis of microfilaruria. *Trans R Soc Trop Med Hyg* 1977, **71(2)**, 181-182.
10. Courtney BJ: The association of certain common complains as seen in native hospital patients with the presence of microfilariae in their blood. *J Trop Med Hyp* 1923, **26**, 87-90.
11. Dondero TJ Jr, Bhattacharya NC, Black HR, Chowdhury AB, Gubler DJ, Inui TS, Mukerjee M: Clinical manifestations of Bancroftian filariasis in a suburb of Calcutta, India. *Am J Trop Med Hyg* 1976, **25(1)**, 64-73.
12. Dupont A, Zue-N'dong J, Pinder M: Common occurrence of amicrofilaraemic Loa loa filariasis within the endemic region. *Trans R Soc Trop Med Hyg* 1988, **82(5)**, 730.
13. Gillet JD: *Common African Mosquitoes and their medical importance*. William Heinemann Medical Books. Ltd. London. 1972.
14. Gubler DJ, Inui TS, Black HR, Bhattacharya NC: Comparisons of microfilaria density in blood sampled by finger-prick, venipuncture, and ingestion by mosquitoes. *Am J Trop Med Hyg* 1973, **22**, 174-178.
15. Hati AK, Chandra G, Bhattacharya A, Biswas D, Chatterjee KK, Dwibedi HN: Annual transmission potential of bancroftian filariasis in an urban and a rural area of West Bengal, India. *Am J Trop Med Hyg* 1989, **40(4)**, 365-367.
16. Hawking F: Distribution of filariasis in Tanganyika Territory, east Africa. *Ann Trop Med Parasitol* 1940, **34**, 107-199.
17. Hii J, Kan S, Pereira M, Parmar SS, Campos RL, Chan MK: Bancroftian filariasis and malaria in island and hinterland populations in Sabah, Malaysia. *Trop Geogr Med* 1985, **37(2)**, 93-101.
18. Iwuala MO: Cassava fermentation pools as major breeding foci for culicine mosquitoes in Nsukka Nigeria. *Niger Med J* 1979, **9(3)**, 327-335.
19. Kazura JW, Forsgth K: Relationship of microfilariaemic status to lymphatic diseases in Papua New Guinea. **In:** TDR/FIL-SWG. (12) 85.3 Annex II. 28-29.
20. Mbah DC, Njoku OO: Prevalence of lymphatic filariasis in Oraeri, Aguata Local Government Area of Anambra State, Nigeria. *Nig J Parasitol* 2000, **21**, 95-102.
21. Michael E, Bundy DA: Global mapping of lymphatic filariasis. *Parasitol Today* 1997, **13(12)**, 472-476.
22. Napier LE: Filariasis due to *Wuchereria bancrofti*. *Medicine* 1944, **23**, 149-179.
23. Ngu VA, Konstam PG: Chronic lymphoedema in western Nigeria. *Br J Surg* 1964, **51**, 101-110.
24. Nwoke BEB, Ebo J: Human activities in south-eastern Nigeria and their potential danger to the breeding of mosquito vectors of human diseases. Unpublished.
25. Partono F: Elephantiasis and its relation to filarial immunity. Southeast *Asian J Trop Med Public Health* 1982, **13(2)**, 275-279.
26. Service MW: The ecology of the mosquitoes of the northern Guinea Savanna of Nigeria. *Bull Entomol Res* 1963, **54**, 601-632.
27. Taylor AW: The domestic mosquitoes of Gadau Northern Nigeria, and their relation to malaria and filariasis. *Ann Trop Med Parasitol* 1930, **24**, 425-435.
28. Udonsi JK: Filariasis in the Igwun River Basin, Nigeria: an epidemiological and clinical study with a note on the vectors. *Ann Trop Med Parasitol* 1988, **82**, 75-82.
29. Ufomadu GO, Nwoke BE, Akoh JI, Sato Y, Ekejindu GO, Uchida A, Shiwaku K, Tumbau M, Ugomo KK: The occurrence of loiasis, mansonellosis and wuchereriasis in the Jarawa River Valley, central Nigeria. *Acta Trop* 1990, **48(2)**, 137-147.
30. Wijeyaratne PM, Verma OP, Singha P, Osuhor PC, Motha B, Saha AL, Slotboom AB, DeLeon A, Bandipo AB: Epidemiology of filariasis in Malumfashi district of northern Nigeria. *Indian J Med Res* 1982, **76**, 534-544.
31. World Health Organization: *Lymphatic filariasis: Fourth report of the WHO Expert Committee on filariasis.* WHO Tech Rep Ser 1984, 702, 1-112.
32. World Health Organization: *Lymphatic filariasis: reasons for hope*. World Health Organization, Geneva 1997.