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Lymphatic filariasis and associated morbidities in rural communities of Ogun State, Southwestern Nigeria

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Summary Lymphatic filariasis caused by *Wuchereria bancrofti* is a serious public health problem in rural communities of Nigeria. The study assessed the prevalence of lymphatic filariasis and associated clinical morbidities in Ado-Odo Ota Local Government Area of Ogun State. Microscopic examination of thick blood smears of 500 participants of both sexes and age ranging from 1 to 79 years was conducted. Visual observations of clinical manifestations of chronic infection were also conducted. The overall prevalence and intensity of infection were 21% and 21.4 mf/mL of blood respectively. Microfilaraemic prevalence was significantly higher in males (27.1%) than in females (16%) ($P < 0.001$). However, intensity of infection was not gender and age dependent ($P > 0.05$). The overall prevalence of all clinical manifestations of infection due to *W. bancrofti* is 15% with hydrocele, limb and breast elephantiasis constituting 16.9%, 4.6% and 5.1% of the total population respectively. Prevalence of hydrocele and limb elephantiasis was significantly higher in the older age groups ($P < 0.05$). Occurrence of elephantiasis of the breast in women however was not associated with age ($P > 0.05$). Integrated approach through chemotherapy and vector control is therefore advocated to reduce morbidity due to infection in this study area.

Introduction

Lymphatic filariasis is a major cause of acute and chronic morbidity in humans living in the tropics.[1] The disease is caused by infection with the parasitic worm *Wuchereria bancrofti* in Africa (*Brugia malayi* and *Brugia timori* in Asia-Pacific) and is transmitted by *Anopheles*, *Culex*, *Aedes* and *Mansoni* mosquitoes.[2,3] Over 120 million people in at least

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80 countries of the world are infected with lymphatic filariasis and it is estimated that 1.2 billion (20% of the world population) are at risk of acquiring the infection.[4,5]

In the last decade, Nigeria was rated the second most endemic country worldwide and also with the largest population at risk of infection in the African continent for lymphatic filariasis worldwide.[6] Filarial infections have been reported in the coastal and rain-forest zones of Nigeria.[7–9] Many of the studies carried out in Nigeria have reported infection rates which are far above the WHO recommended 1% threshold necessary for initiation of mass treatment.[10,11]

Lymphatic filariasis is characterized by a wide range of clinical presentations including acute and chronic manifestations[12] with about 40 million incapacitated and disfigured by morbid grotesque manifestations of the disease known as lymphedema and hydrocele.[13] Studies on rapid assessment of chronic manifestations of lymphatic filariasis in Kano[14] and Taraba state in Nigeria[15] indicated that hydrocele and lymphedema of the lower limbs were the most common morbid manifestations. A similar study conducted in Ogun state revealed similar results,[16] however, the study and others in Nigeria did not closely consider the risk factors of the disease. The disease although rarely fatal, it causes permanent long-term disability, gross disfigurement and untold suffering for millions. Unfortunately despite these indicators of filariasis in the country, and the existence of a National Lymphatic Filariasis Program, very little work has been done and documented on lymphatic filariasis in Nigeria. This study therefore aims to give a systematic and detailed assessment of the extent and impact of the disease on the subject population in order to provide baseline information for control program.

Methods

Study areas

The study was carried out in Ado-Odo Ota Local Government Area of Ogun State. The local government is located within the tropical zone, lying between 6°47′N of the equator and 2°53′E and 3°18′E of the Greenwich Meridian covering a land area of 1263 km^2. It has a terrain of 1010.4 km^2 plane land and about 252.6 km^2 bad terrains comprising of 10% riverine and 4% hilly regions. The 2006 Nigerian National Census showed that the population size was about 526,565.

Census and mapping

Prior to commencement of the study, meetings were held in the study areas and selected sections of the towns to explain the purpose and procedures of the study. Three communities (Ado I, Ado II and Eri) out of the total of seven in the Local Government Area were randomly selected for the study. The three communities comprised those randomly selected out of paper wraps containing the names of the seven localities in the Local Government Area. The towns are well demarcated into sections by a network of streets. Participants were drawn from every 5th house systematically selected from each section. All household members of the selected houses were included in the study. All the selected subjects from the three communities were recruited at the local government health center through the help of the communities' health workers. The subjects constituted the usual residents i.e. indigenes and non-indigenes who have resided in the area for at least one year. All individuals aged one year or more were eligible to participate in the clinical and parasitological surveys.

Sample size determination and parasitological survey

No previous study on lymphatic filariasis has been conducted in the study areas. A prevalence of 17% was assumed based on previous report in Ogun state, Nigeria.[16] The precision 5% (0.05) is most suitable for such prevalence[17] and a minimum sample size of 217 subjects was calculated using the method described by Naing et al.[17] A total of 500 participants in all were recruited for the exercise.

Blood sampling for parasitological examination took place in the night between 21:00 and 02:00. A thick blood film was prepared from finger prick blood drawn into a heparinized capillary tube (60 μL) and then stained with Giemsa. Microscopic examination of slides was done. Microfilariae were identified based on the specific morphological features described by Cheesbrough.[18] The prevalence of microfilaraemia was determined and the intensity of infection was expressed as mf/mL.

Clinical examination

A clinic was set up at the communities' local government health center. The eligible individuals presented themselves to the clinic during daytime, and were examined for evidence of symptoms and signs of lymphatic filariasis. Chronic involvement of the genitalia in males and of the limbs in both sexes were examined.[19] In the case of male genital involvement, swelling of the spermatic cord was graded as hydrocele stage I, and true hydroceles were graded as stage II (6–10 cm in length), stage III (11–15 cm), or stage IV (>15 cm). Leg elephantiasis was graded as stage I (early pitting edema), stage II (non-pitting edema with thickened skin and loss of elasticity), or stage III (evident elephantiasis with skin folds and/or warty lesions) (Fig. 1).

Questionnaire administration

A pretested and structured questionnaire was administered to obtain information on the subjects' demographic data (age, sex, education, occupation e.t.c), history of fever and control of the disease.

Ethical clearance

The University of Ibadan/University College Hospital (UI/UCH) Ethical Review Board and Ado-Odo Ota Local Government Area health authorities gave approval for the study. Informed consent to participate was obtained from those aged ≥15 years and from the parents of children younger than 15 years.

Figure 1 a—e Clinical manifestations of *W. bancrofti*. a. Hydrocele in the early stage (Fuculitis) in a young boy. b. Hydrocele in its advanced stage in adult male. c. Elephantiasis of the breast in adult female. d. Elephantiasis of the leg (Stage II) in one of the participants. e. Elephantiasis of the leg in the advanced stage in adult male.

Data analysis

Data were entered into a Microsoft Excel database (Microsoft Corporation, Seattle, WA) subject to validation checks. The data was then analyzed using SPSS 17 for windows (2007 version). The geometric mean intensity (GMI) of microfilaraemic individuals was calculated as antilog [Σlog $(x+1)/n$], with x being the number of mf/mL of blood in microfilaraemic individuals and n the number of microfilaraemic individuals examined. GMI was used to determine microfilariae load in infected population in different age groups. When analyzing for the effect of age on microfilaraemia, individuals were divided into 7 groups: aged 0—9, l0—19, 20—29, 30—39, 40—49, 50—59 and 60+ years. Student's t-test was used to determine significant differences in the intensity of infection across age groups. Differences in proportions were tested by chi-square (χ^2) test. Contingency chi-square and multivariate logistic analyses were used to test for associations between infection and variables. P values <0.05 were considered statistically significant.

Results

The overall prevalence of *W. bancrofti* infection was 21% and infection in males (27.1%) was significantly higher than in females (16%) ($P < 0.001$) (Table 1). The prevalence of infection generally increased with age with individuals in age group 10—19 years in males and 50—59 years in females having the highest prevalence of the disease. Intensity of infection on the other hand showed an early rise in the younger groups, dropped in the middle age individuals and then picked up again in the older adults. The youngest

Table 1 Age and sex-related infection pattern of lymphatic filariasis in Ado-Odo Ota LGA, Ogun state.

Age (years)	Males			Females			Total		
	No examined	No infected (%)	GMI (mf/mL)	No examined	No infected (%)	GMI (mf/mL)	No examined	No infected (%)	GMI (mf/mL)
0–9	8	3(37.5)	26.5	12	1(8.3)	33.4	20	4(20.0)	25.0
10–19	12	9(75.0)	22.0	26	3(11.5)	26.5	38	12(31.6)	20.3
20–29	60	5(8.3)	24.7	78	9(11.5)	22.0	138	14(10.1)	19.8
30–39	48	9(18.8)	22.4	33	4(12.1)	24.9	81	13(16.1)	19.8
40–49	42	11(26.2)	20.9	27	5(18.5)	23.9	69	16(23.2)	19.9
50–59	13	5(38.4)	25.3	22	5(22.7)	23.9	35	10(28.6)	20.7
60+	42	19(45.2)	25.8	77	17(22.1)	19.9	119	36(30.3)	24.7
Total	**225**	**61(27.1)**	**23.9**	**275**	**44(16.0)**	**24.6**	**500**	**105(21.0)**	**21.4**

microfilaraemic positive boy and girl were 9 and 10 years old respectively. The overall geometric mean intensity of bancroftian filariasis in positive individuals was 21.4 mf/mL of blood. Intensity of infection due to *W. bancrofti* showed no significant variation in male (23.9 mf/mL) and females (24.6 mf/mL) subjects ($P > 0.05$). The highest and lowest intensity of infection were recorded in the stratified age group 0–9 and 20–29/30–39 years with 25.0 mf/mL and 19.8 mf/mL of blood respectively. Age related intensity varied insignificantly ($P > 0.05$).

Three chronic manifestations of Bancroftian filariasis: hydrocele, limb elephantiasis and breast elephantiasis were observed (Fig. 1). The overall prevalence of hydrocele was 16.9%. The different stages of hydrocele were observed. Stage I hydrocele which is the swelling of the spermatic cord was observed mostly in ≤19 years age group and was rarely found among the old men. The youngest individual with stage I hydrocele was 9 years old. True hydrocele appeared later in life. Expectedly, the prevalence of true hydrocele increased with age with the final stages only found in older men. A significant association therefore existed between the clinical manifestation 'hydrocele' and the age of the male subjects in the study population ($P < 0.001$).

Prevalence of limb elephantiasis was significantly higher in females (5.8%) than in males (3.1%) ($P < 0.001$) (Table 2). The early age groups (0–19 years) in both sexes showed no limb elephantiasis. The prevalence of elephantiasis of the limb however, increased from 2.2% to 8.6% in the age groups 20–29 and 30–39 years respectively, with the peak prevalence 13.0% in 40–49 years old subjects (data not shown). Prevalence dropped (11.4%) in the age group 50–59 years and no limb elephantiasis was observed in ≥60 years individuals. Generally, limb elephantiasis was significantly higher in the older subjects compared with young individuals ($P < 0.05$). The youngest male with limb elephantiasis was 30 years old, while the youngest female was 20 years old. The prevalence of breast elephantiasis was 5.1% and showed no significant variation with age of the women ($P > 0.05$).

The least and the highest prevalence of the overall clinical manifestations was observed in age group 0–9 years and 50–59 respectively (Table 2). Prevalence of chronic clinical manifestations (20%) in male characterized by limb elephantiasis and hydrocele was significantly higher than in their female counterparts (10.9%) characterized by limb and breast elephantiasis ($P < 0.05$) (data not shown).

The total number of subjects with history of fever was 102 of which 72.5% of these were infected with *W. bancrofti*. There was a significant association between prevalence of *W. bancrofti* and occurrence of fever in the study population ($P < 0.0001$). The use of bed nets did not significantly reduce infection due to lymphatic filariasis ($P = 0.278$). Prevalence of infection varied significantly in the different occupational groups with farmers and the unemployed having the highest prevalence (Table 3). Occupation of the subjects was associated with infection patterns in the study area ($P < 0.0001$). However,

Table 2 Clinical manifestations of lymphatic filariasis in Ado-Odo Ota LGA, Ogun state.

Age (years)	Males			Females			Total	
	No examined	Limb elephantiasis (%)	Hydrocele (%)	No examined	Limb elephantiasis (%)	Breast elephantiasis (%)	No exam examined	Clinical manifestations (%)
0–9	8	0 (0.0)	1(12.5)	12	0(0.0)	0(0.0)	20	1(5.0)
10–19	12	0(0.0)	3(25.0)	26	0(0.0)	0(0.0)	38	3(7.9)
20–29	60	0 (0.0)	3(5.0)	78	3(3.8)	0(0.0)	138	6(4.3)
30–39	48	2 (4.2)	5(10.4)	33	5(15.2)	4(12.1)	81	16(19.8)
40–49	42	5(11.9)	9(21.4)	27	4(14.8)	0(0.0)	69	18(26.7)
50–59	13	0 (0.0)	9(69.2)	22	4(18.2)	10(45.5)	35	23(65.7)
60+	42	0 (0.0)	8(19.0)	77	0(0.0)	0(0.0)	119	8(6.7)
Total	**225**	**7(3.1)**	**38(16.9)**	**275**	**16(5.8)**	**14(5.1)**	**500**	**75(15.0)**

Table 3 Association between lymphatic filariasis and history of fever/risk factors of infection ($n = 500$).

Variables	Response	No. of respondents	Proportion (%)	No. infected (Prevalence of LF)	*P*-value
History of fever (in the last 3 weeks)	Yes	102	20.4	74(72.5)	<0.0001
	No	398	79.6	31(7.8)	
Use of bed net	Yes	79	15.8	13(16.5)	0.278
	No	421	84.2	92(21.9)	
Occupation	Farming	146	29.2	37(25.3)	<0.0001
	Trading	122	24.4	7(5.7)	
	Fishing	21	4.2	3(9.5)	
	Artisan	83	16.6	18(21.7)	
	C/servant	44	8.8	5(11.4)	
	Unemployed	84	16.8	35(41.7)	
Education	Primary	182	36.4	32(17.6)	0.270
	Secondary	116	23.2	23(19.8)	
	Tertiary	21	4.2	7(33.3)	
	Never attended	180	36.0	43(23.9)	
	No response	1	0.2	0(0.0)	

education was not associated to prevalence of lymphatic filariasis in the study ($P = 0.270$) (Table 3).

Discussion

Information on prevalence of lymphatic filariasis due to *W. bancrofti* and associated burdens is necessary to evaluate its public health implication and subsequently plan for control intervention. The study showed high endemicity of lymphatic filariasis in the local government. The overall prevalence 21% reported in this study is higher than other related studies conducted in Ogun state and other parts of Nigeria with prevalence ranging between 15 and 19%.[8,9,15,16,20] The high prevalence of infection could be attributed to poor living conditions of the people; most houses in the area have mud walls, thatched roofs and are without ceilings. Proximity to various breeding sites of the parasite's vectors seen in their poor environmental and unhygienic conditions is also implicated.

Age-related infection rates corroborate with previous studies which showed that prevalence rises with age.[21–23] However a slight variation in this general observation in age 10–19 years old was inexplicable. The increase in infection spanned to the very older group 60+ years contrary to some reports that observed lower prevalence in the group.[9,20] The increase in infection rate from 30 to 60+ years in our study indicates higher proximity of older age groups to the mosquito vectors of infection than the lower age groups. Larger proportions of the older adults are farmers in the study area; hence the probable higher predisposition to mosquito bites than the younger groups. The overall geometric mean intensity recorded in this study is higher than those earlier reported.[9,11] The high intensity recorded in the younger individuals (0–9 years) could be due to lack of acquired immunity against infection by *W. bancrofti* in the group. The significant higher infection rate among the male subjects suggests their higher level of exposure to the vectors especially through farming and other behavioral practices that could make them to be more prone to infection.

The prevalence of observed clinical manifestations in this study was higher than a similar report in Ogun state.[16] As with microfilaraemia, the prevalence of clinical manifestations increased with age and was significantly higher in male. Hydrocele in males was the most common chronic manifestation. Similar observations have been reported.[24,25] The public health importance of elephantiasis should, however, not be underemphasized, since this condition often has severe personal and social consequences for the affected individuals.[25] More females than males had limb elephantiasis, finding which was also similar to other studies.[26–28] This seems surprising considering the higher infection rate of microfilaraemia in males than in females in the same communities. Studies, however, have implicated an important role for secondary bacterial or fungal infections in the development of lymphedema and elephantiasis[29] with the presence of filarial worms being a predisposing factor. Thus, although women have a lower prevalence of filariasis, they may be more exposed to the microbiological agents resulting in progression of the lymphatic lesions to elephantiasis.[25] In the predominantly farming communities of the present surveys where farm work is carried out equally by the two sexes, the exposure of the lower extremities in the female folks could as well have predisposed them to limb elephantiasis.

Children even though infected did not show early clinical signs other than hydrocele. The peak incidence of noticeable hydrocele seems to occur in early adulthood between the ages of 30–34 years when men are physically robust and active socially. This is also a time when they pursue career and family goals. This disease not only interrupts these pursuits but it very location thereafter affects the integrity of the body and an organ that is associated with self-esteem, sexuality, fertility and masculinity.[30] In addition, to the recalcitrance of few individuals with pronounced scrotal elephantiasis, our sampling method could however result in underrepresentation of individuals with very poor mobility due to advanced elephantiasis in the current

study. The absence of limb elephantiasis even though is a sign of chronic manifestation of infection due to *W. bancrofti* in age 60 years and above in our study is inexplicable and therefore requires further studies.

The use of bed net has been shown in the present study to reduce infection. However, the lack of association between infection and bed net usage could be as a result of the very few individuals that used it. Where a larger proportion of the population uses bed net, a probable association may result. The proper use of bed net and using of the insecticide treated types will help to better manage infection due to *W. bancrofti* in the study area. The unemployed constituted predominantly individuals of age 60 and above in the present study. High prevalence of infection in the group could have resulted from new and carried over (from the youthful age) infection. Infection seemed not to be associated with the people's educational attainment as standard of living is generally poor and all the subjects in the different occupational categories engaged in farming activities, though the degree varied.

The Global Alliance to Eliminate Lymphatic Filariasis has advocated mass drug administration of albendazole and ivermectin as one of the most effective control strategies of lymphatic filariasis in endemic areas. The impact of mass drug administration has undoubtedly reduced the incidence of new cases of clinical diseases associated with lymphatic filariasis in some regions of Africa[31] and some parts of Nigeria. With the high sensitization towards eradication of lymphatic filariasis in some parts of Nigeria, some areas are however still neglected due to lack of up to date geographical distribution map for the disease in the country. Instability in the political and management system which often times hampers effective drug delivery to the affected areas is also a contributing factor limiting the implementation of mass drug chemotherapy.

The present study identified lymphatic filariasis as a major health problem in Ado-Odo Ota Local Government Area, Ogun state, Nigeria, and intervention programs ought to be initiated. However, no obvious measure is available for control of filariasis in this area. Application of conventional insecticides or implementation of measures for source reduction, as means of vector control in the mainly *Anopheles*-transmitted foci, appear impracticable, because of the demanding logistics and the many scattered and inaccessible mosquito breeding sites. The use of insecticide treated net to prevent infection is advocated for the management of the disease. School-based mass chemotherapy in lower age groups is necessary to abate the morbid clinical manifestations associated with filarial worm infection in the adults later in life. Routine introduction of treatment to women at antenatal clinics in endemic areas is also recommended.

Conflict of interest

No conflict of interest to declare.

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