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OCCUPATIONAL CLUSTERING OF FOUR FILARIAL SPECIES INFECTIONS IN ENDEMIC UPLAND COMMUNITIES OF SOUTHEASTERN NIGERIA

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ABSTRACT
The study was undertaken to assess the prevalence of four filarial species in the southeastern Nigeria in relation to the occupation of the people. Overall, farming was the most common occupation followed by trading and artisan work. The civil service was the occupation with the least number of individuals. Farming apparently accorded people more occupational predisposition to exposure to *W. bancrofti* and *O. volvulus* infections than artisan work, trading and civil service. On the other hand, artisan workers and traders got more infected with *M. perstans* and *L. loa*. Higher cadre civil servants were relatively the least infected with filariasis, probably because they were relatively most enlightened than others about the disease epidemiology, and hence took steps to protect themselves from the vectors bites, while the lower cadre civil servants such as night watchmen were occupationally exposed to infective bites of mosquito vectors nocturnally transmitted *W. bancrofti*. Other possible factors and cofounders are discussed in this paper.

KEYWORDS: Filariasis, occupation, farming, Nigeria.

INTRODUCTION

Occupation determines most of the daily activities of individuals including where and when an individual spends time. These movement restrictions and dictations over a long period of time, determine levels of exposure risks and predisposition to parasitic infections. Furthermore, parasitic infections are known to exploit human activities to their advantage, and using same for their breeding and perpetuation. Different occupations confer different exposure risks to different parasitic infections depending on the bionomics of the vectors of the parasites involved. There are proven relationships and clustering of some parasitic infections around some occupations in endemic areas. For example, there are reportedly strong associations between paragonimiasis and fishing as well as river-food processing occupations. Fishing and river-food processing occupations in Oyigbo respectively increased the risk of paragonimiasis 7 folds and 5 folds (Uttah *et al*., 2013). Even among non-vector-borne diseases such as infection by intestinal parasites, certain occupations constitute risk factors including food handling, domestic helps, and baby-sitting (Dash *et al*., 2010). Four species of human filarial worms infect man in southeastern Nigeria, namely, *Wuchereria bancrofti*, *Onchocerca volvulus*, *Loa loa*, and *Mansonella perstans*. These parasites have different species of insects as vectors, and these insect vectors have different biting preferences, circadian rhythms and bionomics. *W. bancrofti* is nocturnally transmitted by anopheline mosquitoes, while *L. loa* is diurnally transmitted by *Chrysops*, the horseflies. *O. volvulus* and *M. perstans* have no periodicities and are transmitted by blackflies and biting midges respectively. The microfilariae of these species of filarial worms are in the human superficial blood except for those of *O. volvulus*, which are found in the skin.

Relatively, prevalence of filarial infections are higher in areas proximal to breeding sites than areas far away from the breeding sites (Uttah, 2003). In other words, clustering of positive cases of filariasis could be around occupations that frequently bring individuals into contact with major breeding sites of the respective vectors. The mosquito vectors of *W. bancrofti* breed in streams and river edges, as well as selected collections of water. Mosquitoes are not long distance fliers. The blackflies breed only in fast flowing streams/ rivers because their larval stages need highly oxygenated water to survive (Desole *et al*., 1991). The blackflies are strong biters, and are long distance fliers that could bite up to 10 to 15 kilometers from their breeding sites (Crosskey, 1981). Horseflies of the family Tabanidae are vectors of *L. loa*. They breed in moist organically rich and muddy low-lying habitats (Wanji *et al*., 2002). Biting midges that transmit Mansonellosis breed on wet mud and leaf litter and eggs cannot withstand dessication (Boorman, 1993). With the emergence of filariasis as a parasitic infection of enormous public health importance, it has become necessary to study its clustering characteristics in order to identify the most important groups and clusters of persons infected or at risk of infection. This study is therefore a preliminary step aimed at ascertaining the pattern of clustering of prevalence of four different species of filarial infections in an endemic area of South-eastern Nigeria, in relation to the occupations of the people.

MATERIALS & METHODS

Description of the study area and study population

Details of the study area have been published earlier (Uttah, 2011). The study was conducted in 2006 in two neighbouring communities of Umuowaibu 1 and Ndiorji, in Okigwe Local Government area of Imo State, Nigeria. The two communities with a combined population of 1116 at the time of this study are socio-culturally similar, both inhabited by Ndiigbo, the majority tribe in southern Nigeria. The area is hilly with characteristic undulating plains. There are a total of seven streams and three rivers in addition to the Imo River.

The analysis was restricted to those who were 20 years and above in the four adult occupation categories, namely, farming, trading, artisan work, and civil service in the Upper Imo River Basin.

Collection of data

Structured questionnaire was administered on each of the consenting adults before blood samples were collected. The information collected included age, sex, occupation, and knowledge of epidemiology of filariasis.

Collection and processing of night and day blood samples

blood samples (50 µl) for parasitological examination were taken from every consenting person of age one and above between 22.00 and 02.00 h. Day blood samples (50 µl) were taken during the day from the same persons. These night and day blood samples were stained with Giemsa and hematoxylin respectively and then examined with high magnication (x 100 eyepiece) under the microscope following established laboratory techniques. Identification of microfilariae was conducted according to keys in Learning Bench Aid No. 3 (Tropical Health Technology).

Data analysis

The Epi-Info version 6.0 was used in entering data from parasitological survey, while SPSS for windows (1995 version) was used for data analysis.

RESULTS

The overall mean age for the adults in the area was 40.1 years and it ranged from 20 years to 86 years. The various occupations of the study population in relation to sex is shown in Table 1. Farming was the most common occupation; 41.6% of the population was farmers (50.5% for males, and 34.0% for females). This was followed by trading, which is the occupation of 39.6% of total adult population (13.5% for males, and 61.7% for females). Farming was the occupation of the relatively older people with a mean age of 46.6 years. A significantly higher proportion of males were farmers (50.5%) than females (34.0%) (χ^2: $p < 0.05$). Most females (61.7%) were traders. Relatively the youngest cluster of individuals (mean age: 30.5) were artisans. Artisan was predominated by males who constituted 97.1% of all artisans.

(i) *Wuchereria bancrofti* microfilaraemia

The relationship between *W. bancrofti* microfilaraemia and the various occupations is shown in Table2. The highest prevalence was among farmers and this was comparable between the sexes ($\times^2$-test; $p > 0.05$). Prevalence among traders and artisans ranked second and third respectively. No civil servant was positive for *W. bancrofti* microfilaraemia. The male farmers had the highest *W. bancrofti* mf prevalence among males of all occupations, whereas female traders had the highest mf prevalence among females.

(ii) *Onchocerca volvulus* microfilaraemia

The *O. volvulus* mf prevalence in each of the respective occupations was above 40.0% (see Table 3). Farming presented the highest mf prevalence followed by artisans and the least was among civil servants. The mf prevalence of male traders was significantly higher than the mf prevalence of female traders (χ^2-test, $p < 0.01$), but there was no statistically significant differences in *O. volvulus* mf prevalence between males and females in the other occupations (χ^2-test, $p > 0.05$ for all tests). Among males in all occupations, traders (76.7%) and farmers (66.1%) had the highest mf prevalence, whereas female civil servants (55.6%) and female farmers (55.2%) had the highest mf prevalence among females.

(iii) *Mansonella perstans* microfilaraemia

The overall prevalence of *M. perstans* microfilaraemia was 15.1% (see Table 4) and it was significantly higher among males than females (χ^2-test; $p < 0.05$). The prevalence was significantly higher among artisans than among the other occupations (χ^2-test; $p < 0.05$ for all tests). Among males the prevalence was highest among the artisans while farming presented the highest prevalence among females. There was no statistically significant difference in the mf prevalence between males and females among farmers and traders (χ^2-test; $p > 0.05$ for both tests).

(iv) *Loa loa* microfilaraemia

The prevalence of *L. loa* microfilaraemia was highest among traders and farmers (Table 5). Prevalence was comparable between the sexes ($\times^2$-test; $p > 0.05$). Overall prevalence of *L. loa* microfilaraemia among all occupations pooled together was 5.2% and this was comparable between males and females ($\times^2$-test; $p > 0.05$). Three sub-groups (male traders, female artisans and female civil servants) recorded no positive cases of *L. loa* microfilaraemia.

TABLE 1. The occupations in the study area showing mean age in relation to sex.

Occupation	No. examined (% of total)		Total	Mean age (range) in years		Total
	Males	Females		Males	Females	
Farming	112 (50.5)	87 (34.0)	199 (41.6)	47.0 (24-86)	46.1 (24-68)	46.6 (24-86)
Trading	30 (13.5)	158 (61.7)	188 (39.3)	39.6 (20-58)	36.7 (20-75)	37.1 (20-75)
Artisan	66 (29.7)	2 (0.8)	68 (14.2)	30.7 (21-51)	24.0 (21-27)	30.5 (21-51)
Civil service	14 (6.3)	9 (3.5)	23 (4.8)	35.1 (22-45)	37.8 (25-50)	36.1 (22-50)
Total	222 (46.4)	256 (53.6)	478 (100.0)	40.4 (20-86)	39.8 (20-75)	40.1 (20-86)

TABLE 2. Relationship between *W. bancrofti* microfilaraemia and occupation in the study area

Occupation	Males		Females		Total	
	No. exam	No. +ve (%)	No. exam	No. +ve (%)	No. exam	+ve (%)
Farming	112	12 (10.7)	87	3 (3.4)	199	15 (7.5)
Trading	30	0 (0.0)	158	12 (7.6)	188	12 (6.4)
Artisan	66	3 (4.5)	2	0 (0.0)	68	3 (4.4)
Civil service	14	0 (0.0)	9	0 (0.0)	23	0 (0.0)
Total	222	15 (6.8)	256	15 (5.9)	478	30 (6.3)

No. exam = Number examined.
No. +ve = Number positive for *W. bancrofti* microfilariae

TABLE 3. Relationship between *O. volvulus* microfilaraemia and occupation in the study area.

Occupation	Males		Females		Total	
	No. exam	No. +ve (%)	No. exam	No. +ve (%)	No. exam	+ve (%)
Farming	112	74 (66.1)	87	48 (55.2)	199	122 (61.3)
Trading	30	23 (76.7)	158	70 (44.3)	188	93 (49.5)
Artisan	66	39 (59.1)	2	1 (50.0)	68	40 (58.8)
Civil service	14	5 (35.7)	9	5 (55.6)	23	10 (43.5)
Total	222	141 (63.5)	256	124 (48.4)	478	265 (55.4)

No. exam = Number examined.
No. +ve = Number positive for *O. volvulus* microfilariae

TABLE 4. Relationship between *M. perstans* microfilaraemia and occupation in the study area.

Occupation	Males		Females		Total	
	No. exam	No. +ve (%)	No. exam	No. +ve (%)	No. exam	+ve (%)
Farming	112	15 (13.4)	87	13 (14.9)	199	28(14.1)
Trading	30	5 (16.7)	158	22 (13.9)	188	27(14.4)
Artisan	66	17 (25.8)	2	0 (0.0)	68	15(22.1)
Civil service	14	2 (14.3)	9	0 (0.0)	23	2 (8.7)
Total	222	39 (17.6)	256	35 (13.7)	478	72 (15.1)

No. exam = Number examined.
No. +ve = Number positive for *M. perstans* microfilariae

TABLE 5. Relationship between *L. loa* microfilaraemia and occupation in the study area

Occupation	Males		Females		Total	
	No. exam	No. +ve (%)	No. exam	No. +ve (%)	No. exam	+ve (%)
Farming	112	7 (6.3)	87	3 (3.4)	199	10 (5.0)
Trading	30	0 (0.0)	158	11 (7.0)	188	11 (5.9)
Artisan	66	3 (4.5)	2	0 (0.0)	68	3 (4.4)
Civil service	14	1 (7.1)	9	0 (0.0)	23	1 (4.3)
Total	222	11 (5.0)	256	14 (5.5)	478	25 (5.2)

No. exam = Number examined.
No. +ve = Number positive for *L. loa* microfilariae

DISCUSSION

The upland study area is a predominantly an agrarian population. The *W. bancrofti* microfilaraemia was most common among farmers, and least among civil servants. This is consistent with findings in other studies in Nigeria (Anosike and Onwuliri, 1994; Udonsi, 1986). Bancroftian filariasis is a nocturnally transmitted parasitic infection but farming is a diurnal activity. The epidemiological link between the two is indirect. The association between farming and bancroftian filariasis in the study population is related to poverty and ignorance. Of all occupational categorizations in the area, farming is the occupation of the poorest of all. These poor villagers are more ignorant of the disease epidemiology and also have relatively worse quality of houses (Uttah, in press) and can least afford requisite resources for personal and family protection. Poverty would reflect in the house type the individual lives in, as well as the individual's ability to afford protective measures against the nocturnally biting mosquito vectors. House type is a principal risk factor in bancroftian filariasis in the Imo River Basin. The civil servants, especially the high-income earners, are relatively more knowledgeable as regards filariasis epidemiology and also more conscious of personal protection against the vectors; and also have relatively better economic power to achieve family protection. This is shown in the findings in this study where no civil servant was infected. The civil servants in the study area were mostly primary and secondary school teachers who have better understanding of the epidemiological importance of mosquitoes and therefore took appropriate protective measures thereby ensuring paucity of infection. Similar findings were made in Bauchi (Anosike and Onwuliri, 1994). The high prevalence of microfilaraemia (33.3%) among the female artisans was because of low sample size, as only two individuals were positive, while the relatively lower

prevalence of microfilaraemia among the female traders was probably because many of them engaged in fish-smoking, which inadvertently and considerably protected them from the mosquito attacks (Uttah, 1998). Similar findings from southern India showed that women and girls were protected from mosquito vectors of Japanese encephalitis by thick smoke from wood or cow-dung fires circulating in the small rooms (Reuben and Panicker, 1979). Generally in areas where *W. bancrofti* is of nocturnal periodicity, exposure to vectors is principally not occupation-related; rather, exposure occurs during sleeping hours as the vectors are night-biting (Day *et al.*, 1991; Bryan, 1986). The exceptions however are the night based occupations such as night watchman which is capable of exposing the individual to more infective bites from the vector, or a situation whereby fishermen spend substantial period of the night by the river where man-fly contact is high (Akogun, 1991). The prevalence of *O. volvulus* microfilaraemia was highest among farmers. This is consistent with observations from an endemic area in Nigeria (Nwoke, 1986). This is understandable since the blackfly vectors bite during the day and farming also is a diurnal activity. Secondly, farming is field-based activity and therefore farmers are more seriously exposed while at work in their farms, which most times are nearer the breeding sites of the blackfly vectors, than other working sites of other occupations. It has been shown that individuals in places near the breeding sites (such places as farmlands) receive more blackfly bites than individual's farther away (Davies *et al*, 1981; Duke, 1972, 1968). Farming as practiced in the Imo River Basin study population is at the subsistent level, and individuals in other occupations also engage in farming as hobby. The prevalence of *O. volvulus* microfilaraemia was significantly higher among male farmers than among female farmers. This is in accordance with findings in some studies in Nigeria (Nwoke, 1986). This may be due to the greater body exposure while at work, which is characteristic of men in this area who work bare-bodied in the farms. Furthermore, some of the reasons behind the theory of household or familial clustering in filariasis may actually be due to exposure when farming in the field considering the land tenure system in Nigeria in which related families own lands adjacent to one another. As intensity of transmission could be higher in a particular part of a community so is it highly probable that fields adjacent to one another could accord similar level of risks. This means that members of extended families who would own farmlands adjacent to one another in Nigeria would be exposed to similar level of risks of infection. The second highest prevalence of *O. volvulus* in this study was observed among artisans, who included among others, hunters and wood carvers who depended on forest for their livelihood. As expected the lowest prevalence was among civil servants. The *Mansonella perstans* microfilariae have no known periodicity. The prevalence of *M. perstans* microfilaraemia was highest among artisans. This is an out-door occupation and therefore predisposes villagers to exposure to vector infective biting. However, in the Calabar area, microfilaraemia was observed mostly among farmers (Ejezie and Akpan, 1992). It is noteworthy that most people who have other occupations also engage in subsistent farming in the area. The occupational clustering of *M. perstans* microfilaraemia in this study has, perhaps, shown that the transmission of mansonellosis is not "forest-based" but is considerable around residential areas, where the breeding sites: wet organically rich and muddy underbrush are mostly found. The prevalence of microfilaraemia was comparable in both sexes, agreeing with the findings in an endemic area in Nigeria (Anosike, 1994).

The prevalence of *L. loa* microfilaraemia was comparable in all occupations. This differs from the findings in the Calabar area where Ejezie and Akpan (1992) observed microfilaraemia mostly among farmers. In this study, the overall low prevalence resulted in striking disparities in sex-related differences among occupations.

CONCLUSION

In conclusion, the clustering of filariasis in the study population is a consequence of different risk levels presented by the various occupations. The relationship between prevalence of microfilaraemia and various occupations could be complicated and a product of many interacting factors. Some confounders could be at play including poverty, personal lifestyle, hobbies, and house quality among others. Individuals in the same occupation have exposure differentials to vector biting occasioned by personal lifestyle, vector-evading attitudes and wearing of protective clothing. The quality of lifestyle is dependent on personal hygiene, awareness of epidemiological implications of vector biting and effective vector avoidance strategies. Awareness campaign on the implications of incessant exposure to vector biting and on protective measures against vector biting will go a long way in reducing the prevalence of microfilaraemia in the study area. In the short term, targeted drug administration using appropriate drug combination is necessary in reducing the prevalence of filariasis in the area.

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