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Endemic mansonellosis in Emohua Local Government Area, Nigeria: human parasitaemia and *Culicoides* biting patterns

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ABSTRACT

Background & objectives: The study was aimed at elucidating the prevalence and intensity of *Mansonella perstans* microfilaraemia in the Emohua Local Government Area, Nigeria, and ascertaining the abundance, circadian, and the annual biting patterns of the *Culicoides* vector.

Methods: Thick smear of 50 µl finger-prick blood stained with Giemsa was examined microscopically in a cross-sectional study. Vector landing collection on human bait was employed in a longitudinal study of the vector biting patterns, carried out between July 2005 and August 2006.

Results: Of 1486 individuals examined, 11.2% of both males and females were positive for *M. perstans* microfilaraemia. Microfilaraemia appeared early in life. The overall geometric mean intensity among those with positive microfilaraemia was 117 mf/ml (121 mf/ml for males and 113 mf/ml for females). The differences in geometric mean intensity between different age groups were statistically significant (one-way analysis of variance; $p < 0.05$), being highest in the oldest age group (266 mf/ml). A total of 1183 female *Culicoides* sp were caught from September 2005 to August 2006. The abundance of *Culicoides* sp was seasonal. The circadian biting activity had a broad peak between 0700 and 1200 hrs. The monthly biting rates ranged from zero bite per person per month in January 2006 to 1151 bites per person per month in June 2006. The annual biting rate was 7382 bites per person per year.

Conclusion: Majority of those with positive microfilaraemia were poor socioeconomically, underscoring the need for health education and application of effective control measures against *Culicoides* biting midges in Emohua.

Key words Biting patterns; *Culicoides* sp; *Mansonella perstans;* mansonellosis; Nigeria

INTRODUCTION

Mansonellosis is the most widespread filarial infection of man in Nigeria[1, 2]. Unlike onchocerciasis and lymphatic filariasis, not much attention has been paid to it in terms of public health importance because of its reported association with little or no severe clinical manifestations[3]. However, the presence of *M. perstans* microfilaraemia has been associated with disease manifestations such as generalised itching of skin, joint and/or muscle ache, severe pain in the abdomen and liver region, neurological and psychic symptoms, endocrinological disturbances, recurrent lymphoedema in the limbs and face resembling Calabar swellings, and nodules containing adult worms in the conjunctiva or eyelids[3–6]. A more recent finding suggests that the host's regulatory responses are down-regulated in *M. perstans* infections[7].

Mansonella perstans is transmitted by tiny biting midges of the genus *Culicoides*. The vector species in the area have been identified as *C. grahami, C. austeni* and *C. fulvithorax* (Diptera: Ceratopogomidae)[8–10].

Although mansonellosis has been reported from the forest belt of Nigeria[2,10–12], none of these works included entomological investigations. To date there are no reports on the biting patterns of the vector in the forest belt of south-eastern Nigeria. This work is aimed at elucidating the prevalence and intensity of microfilaraemia of *M. perstans* in the Emohua Local Government Area in the forest belt of Nigeria, in addition to ascertaining the abundance, circadian and the biting patterns of the vector.

MATERIAL & METHODS

Study area and study population

The study was conducted in six neighbouring communities, in the Emohua Local Government Area of Rivers State, namely Oduoha, Rumuoro, Ahai, Rumuada, Okporoworo and Rumuakani. They are located about 15 km southeast of Port Harcourt, and the population of the six communities combined was 1832 people at the time of the study, and are inhabited mostly by the indigenous Ikwerre people.

A total of 474 houses were recorded in the six communities, with an average of four persons per house. The New Calabar River is the only river in the area. There are a few stagnant water collections, some of which are sacred. The area lies in the rainforest belt. There are two distinct seasons, the dry season (November–May), and the rainy season (June–October). A Meteorological station, a substation of the International Institute of Tropical Agriculture located at Onne, provided the meteorological data for the period. The annual rainfall between 2004 and 2006 averaged 2403 mm per annum, with most of the rainfall occurring in the months of June through October. The mean relative humidity for the three years was 81, 78 and 78%, respectively. Farming is the main occupation, and fishing is also a major occupation. Fish-smoking, a local traditional way of preserving fish is a regular practice among the women.

Consent and ethical approval

Department of Health of the Emohua Local Government Area (LGA), approved the survey after review of all ethical and professional details. The LGA also introduced the Project team to the local community heads (the *Nyenwalis*) and led all mobilization activities; and all these were comprehensively briefed about the project. The consent of all participants was obtained before their involvement in the study.

Census and mapping

All individuals in the selected communities who were more than one year of age were included in the study population. These comprised of natives as well as non-natives who had resided there for at least one year. The target population was 1000 persons. During the census, houses were given registration numbers. The appropriate positions and orientation to one another, of houses, markets, religious places, major roads and some track roads, as well as water bodies in the communities were noted.

Parasitological surveys

Blood samples for parasitological examination were taken from every consenting person of one year old and above. Using a sterile lancet, 50 µl of finger prick blood was taken from the left thumb, drawn into a blood pipette and used to prepare a thick smear on the glass slide. This was dried overnight and taken to the laboratory, dehaemoglobinized and fixed in methanol for one min, stained with Giemsa (one part of Giemsa stock solution with 14 parts of buffered distilled water) for 30 min[8]. Thereafter, these were immersed briefly in water and dried. The slides were examined under microscope using ×40 – ×100 magnification. Identification of microfilariae was conducted according to keys in Learning Bench Aid No. 3 (Tropical Health Technology).

Adult vector collection and examination

Vector landing collection on human bait was conducted outdoors at places where villagers had activities during day-time, such as farmlands, river bank areas and near residential areas. Six collectors working in pairs had their legs and feet exposed and collected blood sucking *Culicoides* landing using tubes. The collection started at 0600 hrs and ended at 1800 hrs daily. There was a systematic shifting from one location to another in a pre-selected catching round. The collectors alternated in pairs each hour between collecting and resting. Collected vectors were brought to the laboratory, sexed, and identified to the genus level based on standard external morphology keys[13].

Data analysis

The Epi-Info version 6.0 was used in entering data from parasitological survey, and SPSS for windows (1995 version) was used for data analysis. The geometric mean intensity (GMI) of microfilaraemia was calculated as Antilog ($\Sigma\log(x+1)/n$), with x being the number of mf per ml of blood in microfilaraemic individuals and n the number of microfilaraemic individuals examined. ANOVA, χ^2 and student's t-test were performed using SPSS for Windows.

RESULTS

Parasitological studies

A high percentage (82.1% overall; 82.2% for males and 82% for females) participation in the study was obtained from those registered during the mapping. The microfilarial (mf) prevalence in relation to age and sex is presented in Fig. 1, while the mf geometric mean intensity (GMI) in relation to age and sex is presented in Fig. 2. Of a total of 1486 individuals examined, 116 (7.8% for both males and females) were mf positive for *M. perstans*. The youngest mf positive boy was 4 yr old, while the youngest positive girl was 6 yr old. The mf prevalence was lower in the 1–9 yr age group than in those $\geq$10 yr old, but the difference was not statistically significant (χ^2 test; $p>0.05$). There was no significant difference between male and female mf prevalence either overall or in any of the age groups (χ^2 test; $p>0.05$ for all tests).

The overall mf GMI among mf positives was 117 mf/ml (121 mf/ml for males and 113 mf/ml for females). There was no significant sex-related difference in the overall mf GMI (t-test; $p>0.05$); but there was significant

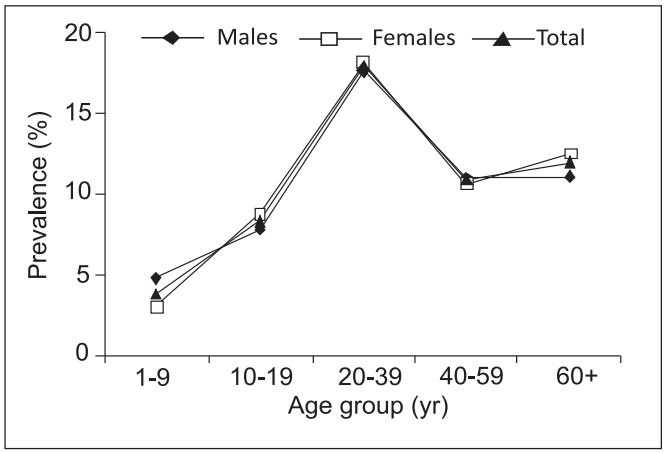

Fig. 1: Prevalence of *M. perstans* microfilaraemia in relation to age and sex in Emohua Local Government Area, Nigeria

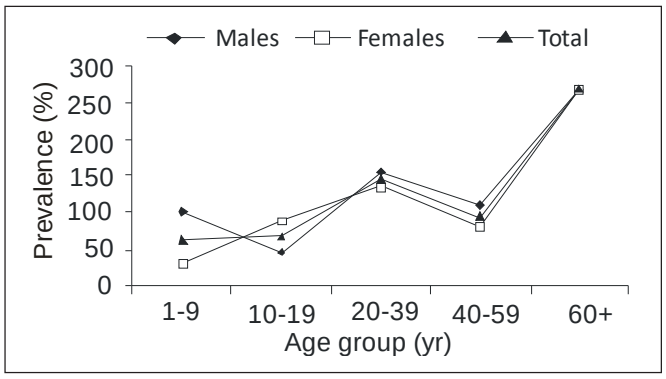

Fig. 2: Mansonella perstans mf GMI in relation to age and sex in Emohua Local Government Area, Nigeria

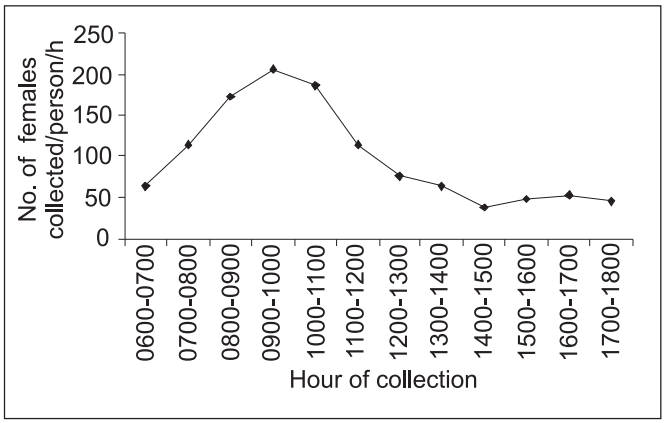

Fig. 3: The circadian biting pattern of *Culicoides* sp in the Emohua Local Government Area, Nigeria

age-group related differences in mf GMI (one-way ANOVA; $p < 0.05$). The mf GMI was relatively high in the oldest age group (266 mf/ml), and in the 20–39 yr age group (145 mf/ml). The highest mf intensity was 2690 mf/ml from a 63 yr old woman.

Table 1. Monthly entomological indices of *Culicoides* sp. landing on human bait in Emohua Local Government Area, Nigeria

Month	No. of catch days	No. of female *Culicoides* collected	MBR*
Sep 2005	4	147	1103
Oct	4	93	605
Nov	5	38	198
Dec	5	9	47
Jan 2006	4	0	0
Feb	4	13	85
Mar	4	86	559
Apr	4	174	1131
May	6	183	793
Jun	4	177	1151
Jul	4	142	923
Aug	4	121	787
Total	52	1183	7382†

*MBR—Monthly biting rate; †ABR: Annual biting rate.

Entomological studies

A total of 1183 female *Culicoides* specimens were caught in the study area from September 2005 to August 2006 by landing on human bait catch as shown in Table 1. The abundance of *Culicoides* sp was seasonal, with reduced numbers from October through March. The circadian biting activity however, had a broad peak between 0700 and 1200 hrs and then declined (Fig. 3). The monthly biting rates ranged from zero bites per person per month in January 2006 to 1151 bites per person per month in June 2006. The annual biting rate (ABR) was 7382 bites per person per year.

DISCUSSION

Mansonellosis is widespread in the south-eastern parts of Nigeria[2,14], and in West African countries[15]. The prevalence of *M. perstans* microfilaraemia in this study is comparable to that reported among nomadic Fulani of south-eastern Nigeria[16], but lower than most reports in parts of south-eastern Nigeria[14,17]. Prevalence as reported thus far from the northern region of the country[18] was lower than observed in Emohua. The possibility of higher prevalence in the urban than in rural areas has been reported in a population in the savannah belt of Nigeria[19]. However, in the forest belt of Nigeria and in other endemic foci in Africa, Mansonellosis has had dominant presence in rural areas[3,7,10]. This is because it is not only a disease of the poors[10], but that the rural areas provide the right conditions for the vector-breeding such as wet mud and leaf

litter[20], or the underbrush, and rotten banana stems[21]. These ecological factors may precursor gradual increase in the prevalence of Mansonellosis from the northern to southern parts of Nigeria[19,22]. Furthermore, the incidence of *M. perstans* correlates with rainfall[23].

Higher prevalence of microfilaraemia in adults (≥ 20 yr) than among children was also reported at Igwun River Basin[24], Bori community[11], and in selected areas of Imo and Abia states[25]. This may be related to greater exposure among adults due to their occupations and daily engagements. Comparable prevalences in males and females as observed in this study were corroborated by another report from south-eastern Nigeria[26]. Gender-related occupational exposures, which vary from one locality to another, may be chiefly contributory to similarity or differences in prevalence among sexes. At Emohua Local Government Area, both sexes equally engaged in outdoor activities, and there was no sociocultural outdoor restrictions. There seemed to be a relatively lower microfilaraemia intensity among women of reproductive age as has been reported for *Wuchereria bancrofti* [24,27].

The abundance of biting midges (*Culicoides*) was seasonal with peaks during the rains and shortly after the rains, during which time the temperature was moderately high. Apart from the harmattan (a harsh, desiccating weather condition brought by the Northeast Trade Wind) period, between December and February, relatively serious biting activity seemed to occur all the year. This could be because the biting midges require moisture for oviposition. *Culicoides* eggs normally deposited on wet mud, the underbrush, or leaf litter, cannot withstand desiccation[20]. A reduction in *Culicoides* population due to influence of weather condition on development of immature stages has been reported. The breeding habits of *Culicoides* make the forest areas attractive to them[8].

The circadian biting pattern of *Culicoides* showed sustained peak in the morning hours at Emohua and is in tandem with observations made at Uganda[7]. This morning-peak-biting proclivity could be due to the vector's need for cool and humid conditions; an adaptational development that ensures successful transmission of the microfilariae to human.

Majority of those with positive microfilaraemia were poor socioeconomically, underscoring the need for health education. Furthermore, urgent application of effective control measures against *Culicoides* biting midges is indicated in Emohua Local Government Area of Nigeria.

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