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Biting on human body parts of *Simulium* vectors and its implication for the manifestation of *Onchocerca* nodules along Osun River, southwestern Nigeria

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ABSTRACT

Background: The biting preference of *Simulium* vectors has been known to influence the distribution of *Onchocerca* nodules and microfilariae in human body. There is, however, variation in biting pattern of *Simulium* flies in different geographical locations. This study investigates the biting pattern on human parts by *Simulium* vectors along Osun river system where *Simulium soubrense* Beffa form has been implicated as the dominant vector and its possible implication on the distribution of *Onchocerca* nodules on human body along the river.

Methods: Flies were collected by consented fly capturers on exposed human parts namely head/neck region, arms, upper limb and lower limb in Osun Eleja and Osun Budepo along Osun river in the wet season (August–September) and the dry season (November–December) in 2008. The residents of the communities were also screened for palpable *Onchocerca* nodules.

Results: The results showed that number of flies collected below the ankle region was significantly higher than the number collected on other exposed parts ($p < 0.05$) while the least was collected on head/neck region in both seasons. The lower trunk was the most common site (60%) for nodule location at Osun Eleja followed by upper trunk (40%). Nodules were not found in the head and limb regions. At Osun Budepo, the upper trunk was the most common site of the nodule location (53.8%) followed by the lower trunk (38.5%) and head region (7.7%).

Conclusion: Though, most of the flies were caught at the ankle region, the biting of other parts coupled with the presence of nodules at the head and upper trunk regions showed that *Simulium* vectors could obtain microfilariae from any part of the body, thus increasing the risk of onchocerciasis transmission.

Key words Biting pattern; human parts; nodules; onchocerciasis; *Simulium* vectors

INTRODUCTION

Human onchocerciasis (river blindness) is a disease caused by a filarial nematode *Onchocerca volvulus*[1]. The transmission of the infection is achieved through the bite of the fly belonging to the Genus *Simulium*. The adult worms of the parasite reside in the subcutaneous region of the human body where they produce millions of microfilariae[2,3] . The microfilariae normally migrate in the intercellular spaces of the skin which usually leads to many reactions including leopard skin, premature ageing and blindness[1].

The congregation of the adult worms and subsequent fertilization to produce microfilariae in subcutaneous tissues has been known to elicit nodules[4]. The examination of the palpable nodules in human body in the endemic communities has been adopted as a rapid diagnostic method of assessing onchocerciasis endemicity as it requires less ethical complications[5]. The location of the *Onchocerca* nodules on human body has however been correlated with the biting preference of human parts by *Simulium* vectors[6].

In west Africa, *Simulium damnosum sensu lato* has been reported to prefer biting the lower limbs of the body, therefore, producing high density of nodules and microfilariae at this location[7,8]. Though, earlier report in Nigeria showed that head nodules were rare[9] but Onigbo[10] and Ubachukwu[6] later reported the prevalence of head nodules in southeastern Nigeria. Ubachuckwu[6] for example reported 41.2% prevalence of head nodules among primary school children in Uzo-Uwani, Enugu State, Nigeria. Since the geographical cytospecies of *S. damnosum s.l.* and *O. volvulus* strains exist, the differences in the epidemiological and clinical signs of onchocerciasis in the endemic regions had been attributed to these variations[6,11]. It, therefore, becomes imperative to document the biting

preference of the *Simulium* flies in different regions with the underlying aim of understanding the expected pattern of distribution of *Onchocerca* nodules and microfilariae and thus, better our knowledge on the epidemiology on the disease. This study investigates the biting pattern on human body parts by *Simulium* vectors along Osun river where *S. soubrense* Beffa form has been reported as the predominant vector[12] and its possible implications on the distribution of nodules and microfilariae in human populations in the area.

MATERIAL & METHODS

Study area

The study was conducted at two communities; Osun Eleja (in a derived savannah: Latitude 07°16"N; longitude 04°08"E) and Osun Budepo (in a rain forest: latitude 07°04"N; longitude 04°08"E) along Osun river system. The details of the study area have been previously described elsewhere[3].

Ethical clearance

Written consent was sought and obtained from the Ogun State Ministry of Health before the commencement of the study. Informed consent was also sought and obtained from the communities and subjects used for the study.

Experimental design for fly collection

The biting preference of adult *S. damnosum s.l.* to different human parts was investigated at Osun Eleja and Osun Budepo during the wet season (August–September 2008) and the dry season (November–December 2008). The data were collected twice every month. Two male fly catchers were positioned at each of the catching points. The fly catchers were instructed to wear short knickers and armless shirts. Only one person in sitting position exposed himself for every catching hour while the second person collected the flies perching on the exposed parts of his colleague. The sites of collection were categorized as: head/neck region, arms, calf and below the ankle. The human bait worked alternately between 0700 and 1800 hrs every catching day.

Palpation for Onchocerca nodules in human population

The residents from 15 years and above were mobilized for the study in each community. The participants were examined for palpable nodules to the extent that decency permits.

Statistical analysis

The analysis of the data was carried out with t-test using SPSS version 16.0 after the data had been transformed by $\sqrt{x + 0.5}$ to standardize the variance.

RESULTS

The results showed that the number of flies collected below the ankle region was significantly higher than the number collected on other exposed parts ($p < 0.05$) at Osun Eleja during the wet and dry seasons. Similar observations were made at Osun Budepo where significantly higher number of flies was collected below ankle while the least was collected on head/neck region during both the seasons (Table 1).

The results of the overall biting preference of *S. damnosum s.l.* to the exposed parts at both the locations are presented in Fig. 1. The region below the ankle recorded significantly higher number of flies than other exposed parts at both the study sites ($p < 0.05$). However, there were no significant differences in the number of flies collected on arm and calf; and head and arm at both Osun Eleja and Osun Budepo ($p > 0.05$).

Five out of 33 people examined at Osun Eleja had nodules while 13 out of the 61 participants examined at Osun Budepo harboured palpable nodules. The lower trunk was the most common site (60%) for nodule location at

Table 1. Seasonal biting preference of *Simulium damnosum* complex to exposed human parts at the study sites

Human parts	Flies caught in percent			
	Budepo		Eleja	
	Wet season	Dry season	Wet season	Dry season
Head	9.0[c]	6.7[c]	12.2[c]	0[d]
Arm	19.1[b]	1.0[d]	16.0[c]	7.69[c]
Calf	27.7[b]	23.3[b]	26.3[b]	15.5[b]
Below the ankle	44.2[a]	60[a]	45.5[a]	76.9[a]

Values with different letters are significant at $p < 0.05$.

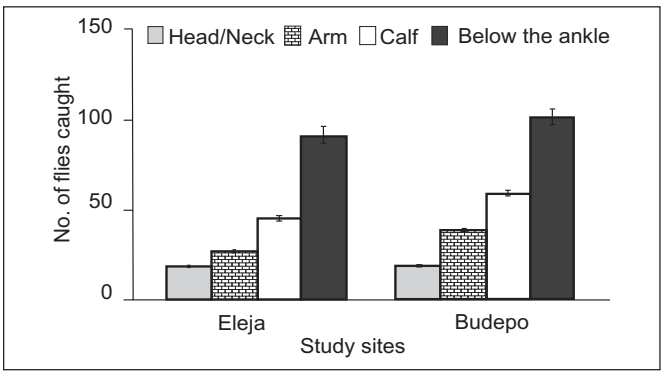

Fig. 1: Biting preference of *Simulium damnosum* complex to the exposed human parts at the study sites.

Osun Eleja followed by upper trunk (40%). Nodules were not found in the head and limb regions. At Osun Budepo, the upper trunk was the most common site of the nodule location (53.8%) followed by the lower trunk (38.5%) and head region (7.7%).

DISCUSSION

The present investigations have revealed that the appetitive *Simulium* flies could utilize any part of the body to obtain the blood meal needed for the maturation of the eggs as flies were caught on all exposed human parts. In Africa, the biting of *S. damnosum s.l.* and *S. neavei* have been reported to be occurring in the ankle region, therefore, producing higher density of nodules and microfilariae in the lower part of the body while in central America, *S. ochraceum* bites mostly in the head and neck regions producing higher density of nodules and microfilariae in the upper part of the body[6,8].

Though, the larger proportion of the flies was caught at the ankle region, the biting of other exposed human parts like arms and head/neck region is of interest and could have accounted for the pattern of distribution of nodules in the study area. Coincidentally, nodules were found at the head and upper trunk in one of the study communities which contradicts with the general information documented on the distribution of nodules in Africa. It has been known in Africa that nodules are largely confined to the lower trunk especially around the hip region[7,8,13]. Earlier report by Crosskey[9] showed that head nodules were rare in Nigeria but the prevalence of head nodules was later documented in eastern part of the country[6,10]. The present study has also confirmed the presence of head nodules in southwestern Nigeria. This observation has many epidemiological implications as *Simulium* vectors could obtain microfilariae from any part of the body thus increasing the risk of onchocerciasis transmission.

The variation in the location of *Onchocerca* nodules in human populations in the two communities may not be attributed to variation in biting species of *Simulium* flies as *S. soubrense* Beffa is the predominant vector in both the locations. The variation could be a reflection of the level of body exposure of the residents or variation in strains of *O. volvulus* harboured by human hosts in the study area. It could also be as a result of other human factors that are not assessed in this study. This observation is, however, recommended for further investigation.

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