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Research Article
Co-endemicity of Filariasis and Malaria in Three Habitat Types of Cameroon

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Abstract

Background and Objective: Human filariasis are important tropical diseases world-wide. Certain types of zoonotic filariasis may also be transmitted to humans in climate zones cooler than the tropics. The aim of this study was to determine the prevalence of human onchocerciasis. **Materials and Methods:** The study was carried out in a portion of the Sanaga river located in the Sanaga valley from Edea in the forest area to Mbakoau in the Savannah area. Eight villages namely Mbebe, Nyanon-Kikot, Nyannon-Binoum, Ntol, Ntol-Lenouck, Bonepoupa, Ombe and Mbakaou were selected. In each of the 8 villages chosen, a sample of the population was admitted following the inclusion and exclusion criteria. A total of 609 persons were examined during the period of this study. Data was analyzed using Chi-Square statistics. The frequencies were calculated and presented on tables. The $p<0.05$ were considered significant. **Result:** A total of 11(1.8%) persons had mansonellosis. Most of these were from the transition habitat type. Eighty-six (14.1%) presented with common signs of epilepsy with higher percentages recorded in persons in the transition habitat type and among those above 10 years old. Studying the association of the various diseases, the results gave higher prevalence for epilepsy among people infected with onchocerciasis. **Conclusion:** Onchocerciasis, Malaria and Epilepsy appear to be of primary concern thus something must be done by health authorities and other sectors responsible for public health issues, in order to effectively control these insect-borne diseases and the nuisance they cause.

Key words: Prevalence, malaria, filariasis, co-endemicity, public health, parasitic diseases, insect-borne diseases

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Filariasis a global scourge and remains one of the major public health challenges worldwide[1]. The area along and between the Nyong and Sanaga/Mbam river is of very high potential economic importance and is critical for the development of Cameroon. It is a strategic location in Cameroon because it has high agricultural potential for national and export production and there are major industrial enterprises along the Sanaga (electricity, aluminium factory (Alubassa), plantations)[2]. However, the economic development of this latent economic engine is severely constrained by parasitic diseases most of them arthropod borne like onchocerciasis (River Blindness), malaria, loiasis and mansonellosis transmitted respectively by *Simulium* sp. (Blackflies), *Anopheles* mosquitoes, *Chrypsops dimidiata* and *C. silaceus* (horseflies) and *Mansonia* sp.[3]. These diseases and the nuisance of their biting vectors have untold devastating effects on the health and well-being of the communities along the Nyong/Sanaga river[4]. In recent years, many people have moved away from this area leading to a decline in agricultural production. These problems interact in a vicious circle that results in sustained poverty and suffering in the region. Farmers have two serious problems from vectors and pests[5]. These contribute to their poor health. With this, they cannot farm or protect their crops from pests, consequently low yield and quality and so cannot afford medication. On the other hand, with low yields and quality they are malnourished and this results to reduced disease resistance from vectors[6]. Onchocerciasis being one of the most prevalent diseases in this area which causes morbidity among the population[7] is thus important to assess its level of prevalence; furthermore, because of the concomitant presence of other parasitic diseases and epilepsy, a study of co-endemicity with the link between the diseases is important. This study was aimed to determine the prevalence of human onchocerciasis and compare it with that of other main diseases transmitted through insect bites in three habitat types, forest-savannah transition, forest and savannah.

MATERIALS AND METHODS

Area of study: A cross-sectional study was conducted from September, 2009-2010. The study was carried out in a portion of the Sanaga river located in the Sanaga valley from Edea in the forest area to Mbakoau in the savannah area. Eight villages namely Mbebe, Nyanon-Kikot, Nyannon-Binoum, Ntol, Ntol-Lenouck, Bonepoupa, Ombe and Mbakaou were selected. The portion of the study area is located between latitude 03°51′ N and 06°27′ N and longitude 10°08′ E and 12°37′ E and covers about 734 km from upstream of the Mbakaou dam to the Edea hydroelectric dam.

Ethical clearance: To carry out this research, an ethical clearance was obtained from the National Ethics Committee of Cameroon, in order to ensure consent and confidentiality of the participants under the registration number FWA IRBOOOO1954.

Sampling: In each of the 8 villages chosen (Table 1), a sample of the population was admitted following the inclusion criteria (adults and children of more than one year living in the village for at least 3 months) and exclusion criteria (all those who were not living in the village for more than 3 months per year).

Type of study: It was a cross-sectional study, taking place in 8 villages found within the three main habitat types of Cameroon, the forest habitat, savannah habitat and the forest-savannah transition habitat. Each person being satisfied with the criteria of the study was successively submitted to an interview, physical examination and collection of blood samples.

Interview: The interview was aimed at obtaining precise demographic data (age, sex and length of time in the village) and major manifestations experienced by the patients (itches, impaired vision and notion of epilepsy.

Clinical examination: Clinical examination was carried out just before samples were collected. The main signs observed were physical signs for filariasis (nodules, leopard skin lesions especially filarial rashes, impaired vision and blindness) and the effects of epilepsy.

Sample collection: The skin was swapped with 70% alcohol. A sterile lancet was inserted horizontally into the skin raised and a piece of skin cut with a scalpel. Two tiny slices of skin snips were taken from the iliac crest and shoulder blades and immersed in 9.8% saline solution in a micro titration plate[8]. Five milliliter of venous blood was aseptically collected by vein puncture into sterile EDTA blood tubes pre labeled with patient code for identification of malaria parasites, *Loa loa* and *Mansonella* species. The samples were transported into ice bags to the laboratory.

Methods of testing

Onchocerca volvulus: The skin snips from the titration plates and a drop of saline were placed on a microscope slide and examined with the 10X objective. The number of microfilariae that emerged were counted and recorded[8].

Malaria and other haemoparasites: Two drops of blood were placed at the lower edge of the slide, one above the other. A sterile slide was placed at 45° on the first drop of blood and slid forward to produce a thin film[8]. The other drop of blood was spread to produce a thick film. The number of *Plasmoduim* and other parasites i.e., *Loa loa* and *Mansonella* species were identified and recorded.

Statistical analysis: Data was analyzed using Chi-Square statistics. The frequencies were calculated and presented on tables. The $p<0.05$ were considered significant.

RESULTS

A total of 609 persons were examined during the period of this study. Of this number, 322 (52.9%) were from the Forest-Savannah transition habitat, 91 (14.9%) from the forest habitat and 32.2% (196) from the Savannah. Males comprised 51.6% of those examined while 48.4% were females. The 59.4% were above 30 years old while 15.8, 16.1 and 8.2%, were 21-30, 11-20, 5-10, 5 years, respectively (Table 1).

Clinical examination: After clinical examination of the study population, clinical signs of filariasis and malaria were observed as well as the manifestation of epilepsy. More than half of them had pruritus (58.6%), 35% had conjunctivitis, 23.6% impaired vision, 23.3% had palpable nodules and 6.2% were completely blind (Table 2). Fever, headache, arthralgia,

Table 1: Number of persons examined by sex and age group

	5 years		5-10 years		11-20 years		20-30 years		30 years		
Village	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total (%)
Forest-savannah transition habitat											
Mbebe	1	0	4	3	8	12	5	7	25	27	92 (15.1)
Nyanon-Kikot	0	0	5	4	7	10	6	5	26	16	79 (13.0)
Nyanon-Binoum	0	0	0	0	1	2	5	8	9	11	36 (59.0)
Nitol	0	0	1	1	7	5	5	7	19	18	63 (103.0)
Ntol-Lenouk	0	0	0	0	3	3	5	3	18	20	52 (85.0)
Total 1	1	0	10	8	26	32	26	30	78	92	322 (52.9)
Forest habitat											
Bonepoupa	0	0	0	2	3	5	8	7	14	20	59 (99.0)
Ombe	0	0	1	0	3	1	2	1	16	8	32 (52.0)
Total 2	0	0	1	2	6	6	10	6	30	28	91 (14.9)
Savannah habitat											
Mbakaou	1	1	19	10	17	11	10	12	60	55	196 (32.2)
Total 3	1	1	19	10	17	11	10	12	60	55	196 (32.2)
Grand total	2 (0.3)	1 (0.1)	30 (4.9)	20 (3.2)	49 (8.0)	49 (8.0)	46 (7.5)	50 (8.2)	187 (30.7)	175 (28.7)	609

Table 2: Frequency of clinical symptoms and signs of filariasis

	Forest-Savannah transition								
Clinical signs	Mbebe	Nyanon-Kikot	Nyanon-Binoum	Nitol	Ntol-Lenouk	Forest Bonepoupa	Ombe	Savannah Mbakaou	Total
Number of persons examined	92	79	36	63	52	59	32	196	609
Pruritus	67 (72.8)	57 (72.1)	24 (66.7)	42 (66.1)	41 (78.8)	35 (59.3)	12 (37.5)	79 (40.3)	357 (58.6)
Rashes	29 (31.5)	15 (19)	20 (55.6)	19 (30.2)	18 (34.6)	13 (22)	7 (21.9)	16 (8.2)	137 (22.5)
Depigmentation	17 (18.5)	7 (8.9)	6 (16.7)	10 (15.9)	9 (17.3)	12 (20)	3 (9.4)	0 (0.0)	64 (10.5)
Hyperkeratitis	6 (6.5)	0 (0)	0 (0)	3 (4.8)	3 (5.8)	9 (15.2)	1 (3.1)	19 (9.7)	41 (6.7)
Conjunctivitis	37 (40.2)	29 (36.7)	23 (63.9)	29 (46)	26 (50)	22 (37.3)	10 (31.2)	37 (18.9)	213 (35.0)
Impaired vision	27 (29.3)	5 (6.3)	7 (19.4)	11 (17.4)	10 (19.2)	22 (37.3)	13 (40.6)	49 (25.0)	144 (23.6)
Blindness	11 (12)	7 (8.9)	4 (11.1)	4 (6.3)	3 (5.8)	4 (6.8)	3 (9.4)	2 (1.0)	38 (6.2)
Nodules	33 (36)	20 (25.3)	18 (50)	23 (36.5)	21 (40.4)	21 (35.6)	5 (15.6)	1 (0.5)	142 (23.3)
Leopard Skin	5 (5.4)	3 (3.8)	2 (5.6)	3 (4.8)	3 (5.8)	7 (11.9)	1 (3.1)	5 (2.6)	29 (4.8)

Table 3: Frequency of clinical symptoms and signs of malaria

	Forest-Savannah transition								
Clinical signs	Mbebe	Nyanon-Kikot	Nyanon-Binoum	Nitol	Ntol-Lenouk	Forest Bonepoupa	Ombe	Savannah Mbakaou	Total
No. of persons examined	92	79	36	63	52	59	32	196	609
Fever	6 (6.5)	15 (19)	7 (19.4)	10 (15.9)	10 (19.2)	11 (18.6)	6 (18.8)	49 (25)	114 (18.7)
Headaches	8 (8.7)	20 (25.3)	5 (13.9)	13 (20.6)	6 (11.5)	14 (23.7)	5 (15.6)	40 (20.4)	111 (18.2)
Arthralgia	4 (4.3)	0 (0)	6 (16.7)	4 (6.3)	4 (7.7)	1 (1.7)	1 (3.1)	10 (5.1)	30 (4.9)
Pallor	24 (26.1)	12 (15.2)	7 (19.4)	12 (19)	8 (15.4)	6 (10.2)	3 (9.4)	26 (13.3)	98 (16.1)
Splenomegaly	19 (20.6)	8 (10.1)	12 (33.3)	4 (6.3)	5 (9.6)	4 (6.8)	2 (6.2)	30 (15.3)	84 (13.8)
Hepatomegaly	7 (7.6)	16 (20.2)	8 (22.2)	11 (17.4)	11 (21.1)	12 (20.3)	7 (21.9)	50 (25.5)	122 (20)
Jaundice	3 (3.3)	5 (6.3)	1 (2.8)	5 (7.9)	4 (7.7)	6 (10.2)	1 (3.1)	28 (14.3)	53 (8.7)

Table 4: Manifestation of epileptic cases by village and sex in the study population

	Sex					
	Male		Female		Total	
Village	Number of examined	Number of epileptic (%)	Number of examined	Number of epileptic (%)	Number of examined	Number of epileptic (%)
Forest-savannah transition habitat						
Mbebe	43	9 (20.9)	49	13 (26.5)	92	22 (23.9)
Nyanon-Kikot	44	10 (22.7)	35	7 (20)	79	17 (21.5)
Nyanon- Binoum	15	4 (26.7)	21	1 (4.8)	36	5 (13.9)
Nitol	32	11 (34.4)	31	11 (35.5)	63	22 (34.9)
Ntol-Lenouk	26	10 (38.4)	26	0 (0)	52	10 (19.2)
Total 1	160	44 (27.5)	162	10 (6.1)	322	76 (23.6)
Forest habitat						
Bonepoupa	25	2 (8)	34	1 (2.9)	59	3 (5.1)
Ombe	22	3 (13.6)	10	0 (0)	32	3 (9.4)
Total 2	47	5 (10.6)	44	1 (2.3)	91	6 (6.6)
Savannah habitat						
Mbakaou	107	1 (0.9)	89	3 (3.4)	196	4 (2.0)
Total 3	107	1 (0.9)	89	3 (3.4)	196	4 (2.0)
Grand total	314	50 (15.9)	295	36 (12.2)	609	86 (14.1)

Table 5: Prevalence of onchocerciasis by village and sex

	Sex					
	Male		Female		Total	
Village	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)
Forest-savannah transition habitat						
Mbebe	43	29 (67.4)	49	20 (40.8)	92	49 (53.2)
Nyanon-Kikot	44	22 (50.0)	35	17 (48.5)	79	39 (49.4)
Nyanon- Binoum	15	10 (66.6)	21	16 (76.1)	36	26 (72.2)
Nitol	32	23 (71.8)	31	18 (58.0)	63	41 (65.1)
Ntol-Lenouk	26	18 (69.2)	26	14 (53.8)	52	32 (61.5)
Total 1	160	102 (63.7)	162	85 (52.40)	322	187 (58.1)
Forest habitat						
Bonepoupa	25	18 (72)	34	16 (47)	59	34 (57.6)
Ombe	22	4 (18)	10	2 (20)	32	6 (18.7)
Total 2	47	22 (46.8)	44	18 (40.9)	91	40 (43.9)
Savannah habitat						
Mbakaou	107	16 (14.9)	89	9 (10.1)	196	25 (12.8)
Total 3	107	16 (14.9)	89	9 (10.1)	196	25 (12.8)
Grand total	314	140 (44.5)	295	112 (37.9)	609	252 (41.4)

Table 6: Prevalence of *Loa loa* by village and sex

	Sex					
	Male		Female		Total	
Village	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)
Forest-savannah transition habitat						
Mbebe	43	3 (6.9)	49	2 (4.4)	92	5 (5.5)
Nyanon-Kikot	44	6 (13.6)	35	3 (8.5)	79	9 (11.4)
Nyanon- Binoum	15	0 (0)	21	0 (0)	36	0 (0)
Nitol	32	4 (12)	31	3 (9.6)	63	7 (11.1)
Ntol-Lenouk	26	2 (7.7)	26	2 (7.7)	52	4 (7.7)
Total 1	160	15 (9.3)	162	10 (6.1)	322	25 (7.8)
Forest habitat						
Bonepoupa	25	5 (20)	34	4 (11.7)	59	9 (15.3)
Ombe	22	4 (18.1)	10	1 (10)	32	5 (15.6)
Total 2	47	9 (19.1)	44	5 (11.2)	91	14 (15.4)
Savannah habitat						
Mbakaou	107	0 (0)	89	0 (0)	196	0 (0)
Total 3	107	0 (0)	89	0 (0)	196	0 (0)
Grand total	314	24 (7.6)	295	15 (5.1)	609	39 (6.4)

Table 7: Prevalence of *Mansonella perstans* by village and sex

	Sex					
	Male		Female		Total	
Village	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)
Forest-savannah transition habitat						
Mbebe	43	0 (0)	49	0 (0)	92	0 (0)
Nyanon-Kikot	44	0 (0)	35	0 (0)	79	0 (0)
Nyanon- Binoum	15	0 (0)	21	0 (0)	36	0 (0)
Nitol	32	1 (3.1)	31	0 (0)	63	1 (1.6)
Ntol-Lenouk	26		26		52	0 (0)
Total 1	160	1 (0.6)	162	0 (0)	322	1 (1.6)
Forest habitat						
Bonepoupa	25	4 (16)	34	3 (8.8)	59	7 (11.9)
Ombe	22	2 (9.1)	10	1 (10)	32	3 (9.4)
Total 2	47	6 (12.8)	44	4 (9.1)	91	10 (10.9)
Savannah habitat						
Mbakaou	107	0 (0)	89	0 (0)	196	0 (0)
Total 3	107	0 (0)	89	0 (0)	196	0 (0)
Grand total	314	7 (2.2)	295	4 (1.4)	609	11 (1.8)

pallor, splenomegaly, hepatomegaly and jaundice taken as symptoms and signs of malaria were observed in more than half of the population studied as seen on Table 3. Eighty-six (14.1 %) presented with common signs of epilepsy with higher percentages recorded in persons in the transition habitat type (Table 4) and among those above 10 years old. Fifty (15.9%) males and 36(12.2%) females had epilepsy. There was no association between epilepsy and sex ($p>0.05$), however, there was an association between epilepsy and habitat ($p<0.05$) (Table 4).

Parasitological examination: Of the total population examined for filariasis from the three habitat types using the skin snip method, 41.4% were positive with onchocerciasis, while people from the transition and forest habitats were more infected than those in savannah (Table 5). There was no association ($p>0.05$) between the prevalence of onchocerciasis and sex ($p>0.05$). There was an association ($p<0.05$) between the prevalence of onchocerciasis and habitat types.

When thick film smears were examined for *Loa loa* parasite, 6.4% of the people were positive, with none in the Savannah area had about twice the percentage of the transition area (Table 6). There was an association ($p<0.05$) between the prevalence of loiasis and habitat types ($p<0.05$).

Table 8: Prevalence of malaria by village and sex

	Sex					
	Male		Female		Total	
Village	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)	Number of examined	Number of positive (%)
Forest-savannah transition habitat						
Mbebe	43	10 (23.3)	49	8 (16.3)	92	18 (19.6)
Nyanon-Kikot	44	13 (29.5)	35	10 (28.6)	79	23 (29.1)
Nyanon- Binoum	15	2 (13.3)	21	5 (23.8)	36	7 (19.4)
Nitol	32	11 (34.4)	31	13 (41.9)	63	24 (38.1)
Ntol-Lenouk	26	1 (3.8)	26	4 (15.4)	52	5 (9.6)
Total 1	160	37 (23.1)	162	40 (24.7)	322	77 (22)
Forest habitat						
Bonepoupa	25	9 (36)	34	3 (8.8)	59	12 (20.3)
Ombe	22	2 (9.1)	10	3 (30)	32	5 (15.6)
Total 2	47	11 (23.4)	44	6 (13.6)	91	17 (18.7)
Savannah habitat						
Mbakaou	107	37 (34.6)	89	26 (29.2)	196	63 (32.1)
Total 3	107	37 (34.6)	89	26 (29.2)	196	63 (32.1)
Grand total	314	85 (27.1)	295	72 (24.4)	609	157 (25.8)

Table 9: Comparison of the prevalence of filariasis, malaria and epilepsy in the three ecological zones

Prevalence of diseases	Forest-savannah	Forest number of infected (%)	Savannah number of infected (%)	Total number of infected (%)
Number examined	322 (52.9)	91 (14.9)	196 (32.2)	609
Prevalence				
Number of (%) positive with *O. volvulus*	187 (58.1)	40 (44)	25 (12.8)	252 (41.4)
Number of (%) positive with *Loa loa*	25 (7.8)	14 (15.4)	0 (0)	39 (6.4)
Number of (%) positive with *M. perstans*	1 (0.3)	10 (11)	0 (0)	11 (1.8)
No. of (%) positive with *P. falciparum*	77 (22.0)	17 (18.7)	63 (32.1)	157 (25.8)
No. of (%) with epilepsy	76 (23.6)	6 (6.6)	4 (2)	86 (14.1)

Table 10: Association between epilepsy, filariasis and malaria

Village	Number of examined	Epilepsy	Onchocerciasis and epilepsy	Loiasis and epilepsy	Mansonellosis and epilepsy	Malaria and epilepsy
Forest-savannah transition habitat						
Mbebe	92	22	11	1	0	3
Nyanon-Kikot	79	18	12	2	0	4
Nyanon- Binoum	36	5	4	0	0	1
Nitol	63	22	19	2	0	7
Ntol-Lenouk	52	8	6	1	0	3
Total 1	160	37 (23.1)	162	40 (24.7)	322	77 (22)
Forest habitat						
Bonepoupa	59	3	2	0	0	0
Ombe	32	3	0	0	0	0
Total 2	91	6	2	0	0	0
Savannah habitat						
Mbakaou	196	6	0	0	0	0
Total 3	196	6	0	0	0	0
Grand total	609	87	54	6	0	18

Mansonella perstans was rare in all three habitat types as shown in Table 7. There was no association between the prevalence of mansonellosis with sex and habitat types ($p<0.05$).

The prevalence of *P. falciparum* malaria was highest in the Savannah habitat than in the other two (Table 8). The infection rates in the forest-savannah transition habitat type ranged from 9.6% in Ntol-Lenouk to 38.1% in Ntol village. In the forest habitat, rates in the two villages were 15.6% in Ombe and 20.30% in Bonepoupa. The only village (Mbakaou) studied in the savannah habitat had a prevalence of 32% (Table 8). There was no association between the prevalence of malaria and sex ($p>0.05$), however there was an association with habitat types ($p<0.05$).

People of the transition habitat were the most affected by filarial parasites and malaria. A percentage of 58.1% were infected by *Onchocerca volvulus*. A total of 11(1.8%) persons had mansonellosis as seen in Table 9.

Association of different pathologies: Association of epileptic cases with the pathologies showed a higher number of people having onchocerciasis and epilepsy, followed by epilepsy and malaria (Table10).

DISCUSSION

The results showed that the majority (75.2%) of people examined were adults. This may probably be due to the rural exodus of youths to the cities for search of employment. The number of males and females examined was about the same. Children below five years old were very few, probably because of high infertility rate in these areas. Same-Ekobo[3] reported that blackfly bites and the disease they cause were capable of causing infertility. Nnorchin[9] reported that a number of abortions and miscarriages were reported in the early 50_s in hospitals in the old Enugu province due to onchocerciasis.

Prevalence of 9 clinical features of filariasis was observed namely pruritus, rashes, depigmentation, hyperkeratitis, conjunctivitis, impaired vision, blindness, nodules and Leopard skin in 139 inhabitants and the majority of these signs are related to onchocerciasis. The pattern showed preponderance towards the adult inhabitants who are involved in open door and water-related activities. These results are similar to those obtained by Gallin *et al*.[10], who observed that onchocerciasis is plaguing Africa in all bioclimatic latitudes and that in Cameroon, there exist two African varieties of the disease, forest onchocerciasis with a predominance of skin lesions and Savannah onchocerciasis with dominant eye lesions and blindness[11-15].

In this study, eight clinical features were observed. Hepatomegaly, fever and headache were observed as the most common signs among the adults and splenomegaly among the children. High prevalence of hepatosplenomegaly in children infected with malaria has been documented by many writers including Harry[16].

The features of epilepsy were observed among people who have lived in the area for a long time or children born there. Dongmo *et al*.[17], Kamgmo *et al*.[18] and Pion *et al*.[19] had in the past noted a high prevalence of epilepsy in the villages situated along the Sanaga river.

The results obtained in this study for filariasis in the three habitat types match with previous results of Mbuagbaw *et al*.[20] in the Ntui area situated in the forest-savannah transition habitat, during which the following prevalence were obtained. 79.6% for *O. volvulus*, 16.6% for *Loa loa* and 14.1% for *M. perstans.* The link between the two pathologies had been reported by some authors including Kamgno *et al*.[18] and Newell *et al*.[21], who had described the association between epilepsy-onchocerciasis.

Generally in Cameroon, the prevalence of *Loa loa* gradually increases with distance from the savannah and while in forest habitat it increased from 1.9-19.5% . In the Mbam valley found in the forest-savannah transition habitat, these prevalence increased from 1.9-19.5% according to Boussinesq *et al*.[22]. In the Evodoula area, some 30 km from Mbere, Boussinesq and Gordon[23] reported a prevalence of 25% for *Loa loa*. The distribution of *M. perstans* is similar to that of *Loa loa*earlier reported by Same-Ekobo[3].

The number of people with *P. falciparum* parasite varies within the villages in the habitat types and between the habitat types. According to Same-Ekobo[3], the prevalence of malaria in Cameroon is mesoendemic with some foci of hyperendemicity in the forest zone whereas in cities malaria is hypoendemic.

It has been noted that in villages situated along the banks of the Sanaga where onchocerciasis microfilarial loads are high, the prevalence of epilepsy is also high. Other studies carried out by Raper and Ladkin[24], Kaiser *et al*.[25] and Boussinesq[26] in many countries including Uganda and Cameroon have related onchocerciasis with other pathologies such as epilepsy, retarded growth, mental retardation and weight loss.

Although some people with loiasis have epilepsy, the link between these two pathologies has not yet been proven. However, co-infection of onchocerciasis-loiasis filariasis seems to be strongly linked to epilepsy in this study. This co-infection has been studied by many authors. According to Chippaux *et al*.[27], the co-existence of onchocerciasis and loiasis in some areas has damaging effects following treatment with Ivermectin. *M. perstans* was not found in any of the epileptic persons examined.

Association between malaria and epilepsy did not show any clear link between the two diseases in this study, though there are some suggestions that cerebral malaria may cause epilepsy, but this seems not to be well documented. However, the co-endemicity of malaria and other filariasis can be well explained by the status of the vectors of these diseases. They are all insect-borne diseases and their vectors tend to live in the same temperature range that is found most of the time in area of study.

CONCLUSION

The villages within the forest-savannah transition habitat were the most affected by river blindness followed by villages of the forest habitat. However, infection in the savannah habitat was hypoendemic. Onchocerciasis, Malaria and epilepsy appear to be of primary concern thus something must be done by health authorities and other sectors responsible for public health issues, in order to effectively control these insect-borne diseases and the nuisance they cause.

SIGNIFICANCE STATEMENT

This study discover the prevalence of human onchocerciasis and compare it with that of other main diseases transmitted through insect bites in three habitat types, forest-savannah transition, forest and savannah that can be beneficial for health authorities and other sectors responsible for public health issues, in order to effectively control these insect-borne diseases and the nuisance they cause. This study will help the researcher to uncover the critical areas of filariasis and malaria that many researchers were not able to explore. Thus a new theory on the co-endemicity of filariasis and malaria may be arrived at.

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