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Original Article

Prevalence of *Onchocerca volvulus* among apparently healthy population in Adamawa-north senatorial zone

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ABSTRACT

Onchocerciasis is one of the tropical neglected diseases that is still prevalent in Nigeria. The disease is of considerable socio-economic and public health importance with a lot of implications. Therefore, this study aimed to determine the prevalence of human onchocerciasis in five communities of the Northern Senatorial District of Adamawa State, Nigeria. A total of 629 study subjects were randomly selected and enrolled for the study. Skin snip and venous blood were collected from 196 and 433 study subjects respectively and examined for microfilaria of *Onchocerca volvulus*. Results obtained showed an overall of 3.4% infection while different Local Government Areas had different distribution patterns vis-a-viz percentages. Mubi had the highest percentage of 32.4% infection followed by Michika at 2.5% and the least was Madagali with Zero prevalence. Among different occupational groups, students had 7.8% infection, farmers had 3.4%, and other groups had zero prevalence. As per the age bracket, 10-19 years had 9.1% infection followed by 50-59 years (5.0%), and the least was 60-70 years with 1.9%. The Northern Senatorial District population needs to be educated on the disease onchocerciasis as the infection rate is rather increasing or near status with modern-day technology. The government and Non-Governmental Organizations may come in to assist in lowering the infection rate by providing or identifying specific clinics for the treatment or providing preventive drugs free.

1. Introduction

Onchocerciasis, commonly known as river blindness, is caused by a filarial nematode *Onchocerca volvulus*, transmitted by a vector from the genus *Simulium,* blackfly [1]. The disease is endemic in Central and South America and Yemen but 99% of the disease occurs in Sub-Sahara Africa [2]. Onchocerciasis is the cause of clinical and epidemiological dermatologic, ophthalmologic, lymphatic, and systemic manifestations with blindness and impaired vision as the most dangerous disabilities associated with the disease. The disease has also been implicated in cases of musculoskeletal pain, epilepsy, inguinal hernias, secondary amenorrhea, spontaneous abortion, lactation difficulties, infertility, and sterility [3].

Onchocerciasis is a disease of rural areas though it is found in urban centers due to rural urban migration. It was found that the travellers, the missionaries and Peace- corps volunteers who were exposed to black fly bites in endemic areas are most at risk of contracting the infection. Developing countries are virtually associated with an agricultural economy; therefore there is little doubt that in many developing countries majority of the population dwells in rural

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areas. The incidence of the disease increases with the increase in human activities in the rural areas. The incidence of the disease increases with the increase in human activities along the river valleys which are the habitat of *Simulium* vectors [4]. Onchocerciasis is a disease of considerable socio-economic and public health importance with a lot of implications. It is a disabling disease that causes significant morbidity, psychosocial problems, and reduced work, especially reduced agricultural productivity in populations affected by the disease. About 37 million people in tropical Africa and 140,000 others in Latin America are infected [5, 6].

Nigeria alone accounts for the highest number of infected persons in the African continent. Thirty-one of the existing 36 States of Nigeria and the Federal Capital Territory have meso to hyper-endemic foci for onchocerciasis [7]. About 7-10 million Nigerians are infected and approximately 13 million are at risk of the disease, and there are 120,000 cases of onchocerciasis-related blindness [8]. In many endemic countries including Nigeria, onchocerciasis constitutes a major public health and socio-economic problem because of its dermal and ocular manifestations [9]. The epidemiology of the disease in Nigeria is complicated because of the diversity of the environmental conditions of the different regions.

The pathogenesis of onchocerciasis is caused by the microfilariae. These immature larvae migrate throughout the body, especially to the skin and eyes. The parasite is transmitted to humans through the bite of a black fly of the genus *Simulium*, the larval nematodes spread throughout the body. When the worms die, their *Wolbachia symbionts* are released, triggering a host immune system response that can cause severe itching, and destroy optical tissue in the eye [10].

Adamawa State has been neglected in the survey of onchocerciasis, as a result, many endemic communities have not been studied. However, to provide necessary baseline information for the disease database on human Onchocerciasis, this study investigated the prevalence of human Onchocerciasis in Adamawa North Senatorial District.

2. Materials and Methods

2.1. Inclusion and exclusion criteria

Only subjects who were living in the Adamawa-North senatorial district at the time of the research and were healthy were recruited for the study and all respondents who were not from the selected senatorial district and those who were physically ill were excluded from the study.

2.2. Study area

The region lies between latitude 9^0 30’ and 11^0 north of the equator and longitude 13^0 and 13^0 45’ east of the Greenwich meridian. Adamawa North Senatorial District is bordered by Borno state, in the west by Hong and Song local government areas, and in the south and east by the Republic of Cameroon, the Mandara Mountains. It has a land mass of 4728.77 km^2 and a population of 759,045 in 2006. The temperature is warm which is relatively distributed throughout the year with mean annual rainfall ranging from 900 mm to 1050 mm. The vegetation falls within the Sudan Savanna belt of Nigeria and is best referred to as combretaceous woodland savanna [11, 12]. The Senatorial District consists of Five Local Governments namely; Mubi-North, Mubi-South, Maiha, Michika and Madagali. However, only four were considered in this study.

2.3. Study population

The Study population consists of healthy individuals living in the study area starting from age nine (9) and up to 70.

2.4. Sample collection

Of the 629 samples 196 bloodless skin snips and 433 blood samples were collected and examined for microfilariae. Bloodless skin-snips were taken from the shoulder and left iliac crest using the standard method adopted from [13]. Each snip was placed in a microtitre plate (Flat bottom, 96 wells) containing saline solution. The plate was then incubated at room temperature for 24 hours. Microfilaria that emerged was examined and recorded. Preparations were fixed in methyl alcohol, stained with Giemsa, and examined under the microscope using x10.

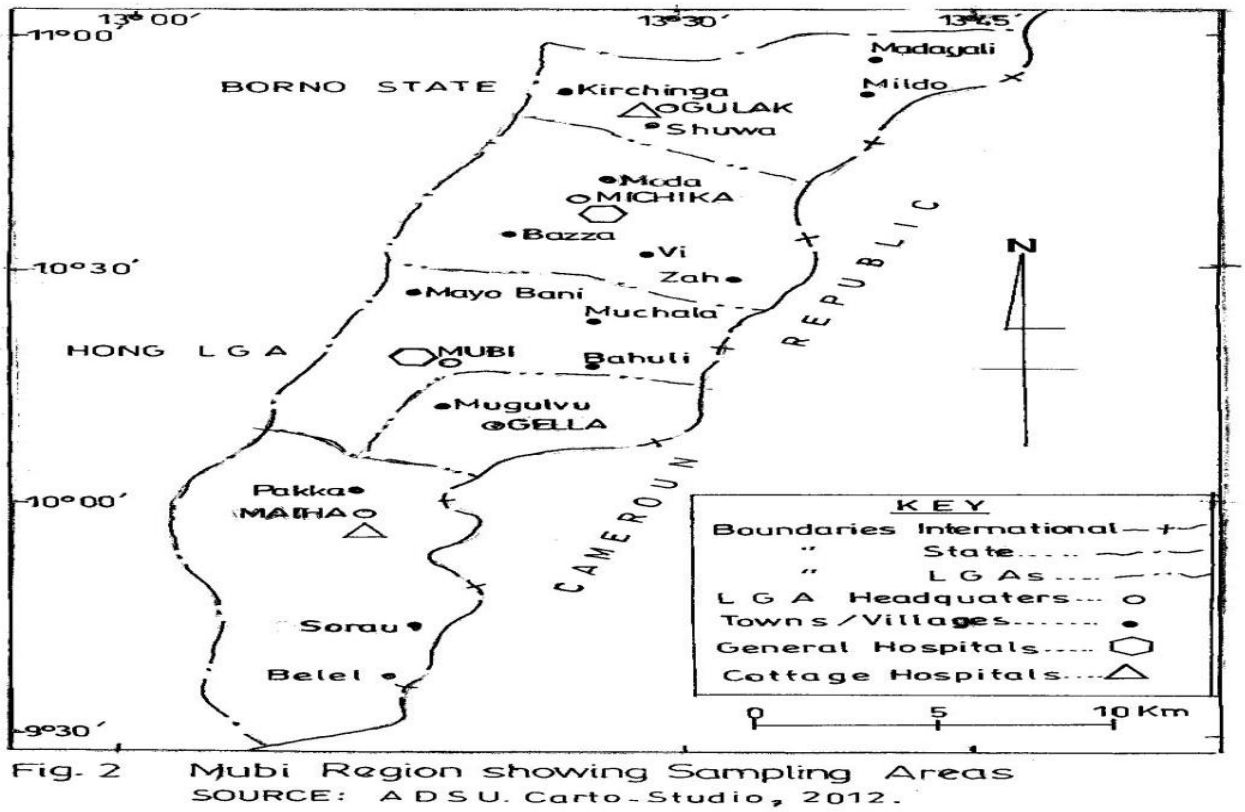

Fig. 1. Map of Northern Senatorial District of Adamawa State. Source: Adamawa State University Carto-Studio

2.5. Skin snip collection

The skin was raised with a needle and the tip sliced off with a scalpel blade. Biopsy specimens were placed in warm normal saline in a well of a microtitre plate for 30 minutes or longer and were examined for microfilariae that migrate from the tissue. If no microfilariae were seen, the preparation would be left overnight and re-examined for microfilariae. Live microfilariae can be seen moving vigorously in the medium by direct microscopy. They can be distinguished from other species of microfilariae after staining with Giemsa or Mayer's haemalum [14].

2.6. Blood collection

Blood samples were collected from individuals whose skin snips had been collected. Thin and thick blood films were prepared on the same slide. The blood films are then fixed in methanol, stained with Giemsa, and examined microscopically for microfilariae [15].

2.7. Data analysis

Data collected was analysed using simple percentages to determine the prevalence in all locations, while Chi-square was used to ascertain the association between Onchocerciasis infection and the variable of interest of the study subjects

3. Results

Out total of 629 samples were examined for *Onchocerca* microfilaria, 29 (3.4%) were positive for *O. volvulus* filarial worm. The highest prevalence rate was recorded in Mubi North with 12(32.4%), Maiha had 7(1.6%) and Michika had 3(2.5%). No positive case was recorded in Madagali as shown in Table 1. Statistically, Onchocerciasis infection is associated with the locality of the subject ($P<0.05$).

Table 1. Distribution and prevalence of onchocerciasis in Adamawa North Senatorial Districts

Local Government	No. Examined	No. Infected	% Infected
Mubi North	37	12	32.4
Maiha	436	7	1.6
Michika	120	3	2.5
Madagali	36	0	0
Total	629	22	3.4

X^2= 3.45, df=3, P< 0.05

The prevalence was found to be highest (9.1%) among children of 10-19 years, while the age bracket of 50-59 had 5% and 1.9% was observed among the adults (60-above). (Table 2). Onchocerciasis infection was not associated with the age range of the subjects (P>0.05)

Table 2. Age-related prevalence of Onchocerciasis in Adamawa North Senatorial Districts.

Age	No. Examine	No. Infected	% Infected
10-19	33	3	9.1
20-29	69	2	2.9
30-39	138	4	2.9
40-49	195	5	2.6
50-59	140	7	5.0
60-70	54	1	1.9
Total	629	22	3.4

X^2= 6.23, df=5, P>0.05

Concerning gender, the results revealed that males were more infected 17(4.3%) as compared with their female counterparts 5(1.9%). Statistically Onchocerciasis infection was not associated with the gender of the study subjects (X^2=8.9, df= 1, P>0.05). In Mubi North 7(43.8%) was highest followed by Michika with 3(3.9%) and Madagali had the least prevalence of 0(0%). For females, Mubi North had a higher percentage 5(23.8%) while Maiha, Michika, and Madagali had no infection as shown in Table 3.

Table 3. Sex-related prevalence of onchocerciasis in Adamawa North Senatorial Districts

	Males			Females		
Local Govt.	No. Examined	No. Infected	% Infected	No. Examined	No. Infected	% Infected
Mubi North	16	7	43.8	21	5	23.8
Maiha	274	7	2.5	162	0	0
Michika	76	3	3.9	44	0	0
Madagali	12	0	0	24	0	0
Total	378	17	4.3	251	5	1.9

X^2=8.9, df=1, P<0.05

The occupational-related prevalence of Onchocerciasis in this study as shown in Table 4, shows that students had 4(7.8%) and farmers, 18(3.4%). While civil servants and traders were found not to be infected. Onchocerciasis infection was not associated with the different occupations of the subjects (P>0.05).

Table 4. Occupational-related prevalence of Onchocerciasis in Adamawa north senatorial districts.

Occupation	No. Examine	No. Infected	Infected **(%)**
Civil Servants	49	0	0
Students	51	4	7.8
Farmers	522	18	3.4
Traders	7	0	0
Total	629	22	3.4

X^2=2.34, df=3, P>0.05

4. Discussion

Contrary to the prevalence rates reported for this infection in other climatic zones of Nigeria which show a high prevalence of 19.2%, 15.8%, and 37%, respectively [15, 16], the overall infection in this study is generally low. Perhaps the perception of the people about the disease has improved. In developing countries such as Nigeria, there is a complex set of beliefs and values associated with onchocerciasis [17]. People's attitudes to a disease process, manifestation, treatment, and various aspects of prevention are influenced by their knowledge and perception of the condition [18], differences in climate change would also be responsible for differences in prevalence rates [19].

Of the four Local governments, Mubi-North recorded the highest prevalence rate of 32.4%, which corroborates similar work done by previous research [19] that there are high rates of vectorial activities and, therefore increased incidence of human onchocerciasis. Michika and Madagali accounted for 2.5% and 0% prevalence rates respectively. This could be due to Ivermectin treatment in the areas carried out by the Nigerian Onchocerciasis Control Project (NOCP), which expectedly resulted in a drastic reduction in the prevalence of onchocerciasis [20, 21]. This, however, is not the case in Mubi where there was no Ivermectin treatment.

This study showed a significantly higher prevalence of onchocerciasis in males 4.3% than females 1.9%. This finding is in contrast with most findings [22, 23]. This pattern of prevalence could be attributed to the apparent outdoor nature of men's work such as fishing, farming, cattle rearing, etc. Conversely, the prevalence of human onchocerciasis in females in Mubi exceeds that of their male counterparts in both Maiha and Michika communities. This is expected especially in areas where the exposure rates of females to infective bites are high due to outdoor domestic activities such as fetching of firewood, farming, collecting water from the river as well as washing in the river sides. However, it is not in agreement with the findings of previous research [18].

Observation in the age-related prevalence of human onchocerciasis revealed a scanty distribution. While infection spread across the various age groups, it was found to be higher among the children of 10-19 years (9.1%), followed by the group of adults 50-59 years (5.0%). The active groups of 20-29 and 30-39 years had 2.9% prevalence each. This finding is partly in line with the work of previous reseaches [24, 25] that it has been reported irregular patterns in the distribution of infection. Unlike the findings of previous researches [3, 26] that reported regularity in the pattern of infection. This, however, does not follow that pattern.

Onchocerciasis, which remains a serious public health problem in Nigeria, is only now receiving attention. This being so, many international agencies and Non-Government and Development Organizations (NGDOs) are currently collaborating with the Federal Ministry of Health and Human Services in the control of onchocerciasis through the distribution of Mectizan in endemic communities. Areas covered in this study that had Mectizan therapy did not show much prevalence. Individual prevention can include protective measures to avoid contact with black flies in endemic areas, including avoiding areas in which the disease is systemic, using insect repellent, and wearing appropriate clothing [27-29].

The high prevalence in children 10-19 years (9.1%) may be due to the children being exposed to vector bites as most of those examined reside along the river banks where the vectors breed. The 2.9% and 5.0% prevalence in the 20-29 and 50-59 age groups, respectively, could be because older individuals have been exposed early in their lives and wade off the vector bites because of prior early knowledge, mostly farming in the field. The peak biting time is in the late morning hours thus coinciding with the farmers being on the field. The occupational prevalence was observed to be statistically insignificant (P>0.05), Students 7.8% and farmers 3.4% were the only groups affected. Although farmers and Nomads are the groups mostly affected because of their occupation, the variation in this study could be attributed to the differences in the number of subjects examined.

There is therefore the need for more aggressive advocacy, awareness, and sensitisation programs in communities of Adamawa Northern senatorial districts. This picture, therefore, calls for continued efforts of the control program of Onchocerciasis.

5. Conclusion

At present, there is transmission of human onchocerciasis in Adamawa North senatorial districts and the control of insect vectors of this filarial parasite is not feasible due to the profusion of streams and breeding grounds of Simulium (Black fly) vector. In this regard active mobilisation and health education of the inhabitants and the biting pattern of the vector. Parasites encountered and the need for protective attire are suggested. Above all, the provision of ivermectin which has proved effective in reducing microfilarial loads will invariably interrupt disease transmission shortly This could only be feasible by aggressive, semi-annual Mectizan therapy in these endemic communities.

Conflict of Interests

All authors declare no conflict of interest.

Ethics approval and consent to participate

Before the commencement of sample collection, a courtesy visit was made to the

Village/District Heads of the various communities involved in this study through the Primary Health Care Development Agency of the respective Local Government Areas. The consent of the participants was sought and obtained. Samples collected were stratified by sex, age, and occupational status, individual identities of the participants were kept confidential and solely used for the study.

Consent for publication

All authors read and approved the final manuscript for publication.

Informed Consent

The authors declare not used any patients in this research.

Availability of data and material

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Authors' contributions

Conceptualization: Seni James Barka.
Data curation: Ahmed Usman.
Formal analysis: Ismail Muhammad.
Investigation: Seni James Barka, Ismail Muhammad.
Methodology: All authors.
Project administration: Ahmed Usman, Tanko Mahmoud Mohammed.
Resources: All authors.
Validation: Seni James Barka, Ismail Muhammad.
Visualization: Ahmed Usman, Tanko Mahmoud Mohammed.
Writing–original draft: All authors.
Writing–reviewing & editing: All authors.

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