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Monitoring of Human Onchocerciasis in Delta State, Nigeria

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Authors' contributions

The study was conceived by authors JOO, JCN and AOE. Author AOE supervised all aspects the study, author JCN analysed data with author JOO. Author JOO wrote the first draft of the manuscript while authors JCN and AOE finalized the manuscript. All authors read and approved the final version of the manuscript.

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ABSTRACT

Background: In Delta State, free doses of ivermectin are distributed annually to communities through the Community Directed Treatment with Ivermectin (CDTI). Despite this intervention approach, pockets of endemic foci still exits. Updated information of the epidemiology of human onchocerciasis is essential for planning effective control strategies. Thus this study aimed at investigating the current prevalence and distribution of human onchocerciasis in endemic communities of Delta State, Nigeria.
Methods: A cross-sectional study was carried out in three local government areas (Aniocha North, Aniocha South and Oshimili) comprising of 41 communities in Delta State, Nigeria. A total of 1,201 consented subjects were examined by skin snips biopsy. A pre-validated well structure questionnaire was used in collecting epidemiological information.
Results: The general prevalence of onchocerciasis in the studied communities was 11.5%. The prevalence did not vary among the three local government areas (P>0.05) though, the infection rate

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was highest in Aniocha North (12.5%), followed by Oshimili South (11.5%) and Aniocha South (10.7%). With respect to gender, the prevalence was insignificantly higher in males (12.2%) than in female (9.9%). Age-wise, the general pattern showed that the prevalence increased significantly with age. The prevalence of onchocerciasis generally differed widely among the various occupational groups sampled. The prevalence was almost two-fold among farmers (19.3%) compared to drivers and bike riders group (10.2%).

Conclusion: Although the prevalence of onchocerciasis has decreased, the infection still remainsa public health concern in the area. Occupation and age were significant risk factors that affected the prevalence of onchocerciasis. Thus, there is need for control measures to be tailored towards these high risk groups. Also, intensifying community treatment with ivermectin will help eliminate onchocerciasis in the studied communities.

Keywords: Onchocerciasis; Onchocerca volvulus; prevalence and pattern; distribution delta state; Nigeria.

1. INTRODUCTION

Onchocerciasis is well recognized as one of the major tropical diseases of public health importance in endemic parts of the world, especially in Sub-Saharan, Africa. It is a terminally blinding disease caused by *Onchocerca volvulus* and it is transmitted by members of *Simulium damnosum* in West Africa [1,2]. Studies have shown that over 37 million people are infected globally with about 90 million at risk of the disease in Africa [3].

In Nigeria, the most populous nation in Africa, it was estimated that about 7-10 million Nigerians are infected with *Onchocerca volvulus*, about 40 million are at risk of the disease, and 120,000 cases of onchocerciasis-related blindness [4]. Except for Lagos State, all the States of the federation are endemic to the disease [5]. The prevalence of onchocerciasis has also been reported in Delta State [6,7].

In Delta State, free doses of ivermectin are distributed annually to communities through the Community Directed Treatment with Ivermectin (CDTI) [8]. Despite this intervention approach, pockets of endemic foci still exits partly due to the spatial variation in the distribution of the infection as well as the presence of the vector. Adeleke et al. [9] reported an increased biting rate of the black flies in areas where ivermectin distribution had been successful.

Given the spatial distribution across geographical area, current information on the prevalence and distribution pattern are essential in developing effective control programmes for onchocerciasis. Therefore, this study was carried out to determine the prevalence and the pattern of distribution of onchocerciasis in the study area. It is expected that the result of this study will be valuable for the evaluation and monitoring of the CDTI in the study area.

2. MATERIALS AND METHODS

2.1 Study Area and Subjects

The study was carried out in 41 communities within Aniocha North, Aniocha South and Oshimili North Local Government Areas in north senatorial zone of Delta State, Southern Nigeria. It lies roughly between longitude 6° 10^1 and 6° 45^1 East and Latitude 6° 5^1 and 6° 30^1 North. The area has tropical climate marked by two distinct seasons: the dry and rainy seasons. The dry season occurs between November and March, while the rainy season begins in April and lasts till October. There exists a brief dry spell in August commonly referred to as “August break”. The average annual rainfall is about 190.5 cm. Rainfall is heaviest in July. The area has a high temperature, ranging between 29°C and 38°C with an average of about 30°C. The average annual relative humidity was between 68% and 77%.

The 41 communities with a combined population of about 450,000 people at the time of this study are socio-culturally similar. The subjects are predominantly farmers; however, those who are engaged in other occupations supplement their earnings with proceeds from subsistent farming.

2.2 Preparation for the Study / Ethical Clearance

Prior to the study, two field workers were recruited to function as facilitators and field assistants in each local government area. Furthermore, community leaders were first briefed on the relevance of the study, and their

cooperation was sought in the mobilization of their people. Informed consent was also sought from those who willing agreed to participate in the study. Ethical approval for the study was obtained from the department of Animal and Environmental Biology, Delta state University, Abraka, and Delta State Ministry of Health, Asaba.

2.3 Skin Snip Biopsy

Skin snips were aseptically taken from each subject from right iliac crest and the two gluteal folds (buttocks), were taken for parasitological examination from each individual during daytime using a Walser corneoscleral punch manufactured by surgitrac co. Ltd, 1902, Global trade center, 15, Wingkin Road, Kwai Chung, Hong Kong. The punch was treated with glutaradehyde and sodium hypochloride solution and rinsed with distilled water and alcohol [2,10]. The skin snips were separately placed in polystyrene microtitration plates with U-shaped wells (96 wells each) containing 0.3 ml of 0.95% physiological saline solution. When filled, the wells were covered with cellotape to prevent evaporation and spilling of the contents in transit [2,11].

2.4 Microscopic Examination

Skin snips collected in the field were incubated at room temperature before microscopic examination within 24 hours [12]. However, microfilarial suspensions which could not be examined within twenty four hours after collections were preserved by the addition of a drop of 10% formalin into each micro titration, pending microscopy [13]. The microfilarial suspensions together with the skin snips were sucked up with a Pasteur pipette into a clean slide and the wells were washed up so as to release microfilariae which may adhere to the wells. The specimen removed were teased out in physiological saline and examined under low power (x40 objective) for microfilariae of *0. volvulus.* Subjects were considered to be infected if more than one microfilaria are found in the two skin snips. The microfilariae were counted in each specimen and the average of the two specimens was recorded as the microfilarial score [14].

2.5 Data Analysis

Data from the parasitological survey was entered into Microsoft excel version 2010 and graphpad version 2010 was used for data analysis. In addition to measures of dispersion, that is, standard deviation, mean and standard error, Chi square analysis was employed to test for significance differences between the rates of Onchocercal infection among the subjects in the three local government areas. For age-related onchocercal infection, analysis of variance (ANOVA) was used to examine significant difference and thereafter a Post hoc test (Tukey honest or Multiple Comparisons test) was used to detect where the differences lied.

3. RESULTS

3.1 Prevalence of Human Onchocerciasis in the Study Area

The study included a total of 1,201 subjects from 41 communities in three different but contiguous local government areas in Delta north senatorial zone. The general prevalence of the disease in the three local government areas of Delta State, Nigeria, is presented in Table 1. Of the 1,201 examined persons, 138 were positive for *Onchocerca volvulus* - the onchorercal parasite. Thus, the overall prevalence of human onchocerciasis in the study area was therefore 11.5%. The highest prevalence was recorded in Aniocha North (12.5%), followed by Oshimili South (11.5%) and Aniocha South (10.7%). There was no significance difference in the prevalence of the disease ($P>0.05$) in the three local government areas. However, there was significant difference in the prevalence of onchocerciasis among the communities in all three local government areas (data not shown).

3.2 Gender-related Prevalence of Human Onchocerciasis in the Study Area

Table 2 shows the general gender-related prevalence of human onchocerciasis in the study area. Overall, the prevalence of onchocerciasis was slightly higher among male (12.2%) than female (9.9%). There was no significant gender difference ($P>0.05$) in the prevalence of the disease in the study area. The gender-prevalence by L. G. A. also reveals an insignificant higher prevalence among male subjects (Table 2).

3.3 Onchocercal Infection in Relation to Gender and Age in the Study Area

The age related onchocercal infection in the three local governments the study area of Delta State is presented in Table 3. In general, the prevalence of onchocerciasis increased

progressively with age until age group 50-59 years thereafter there was a sharp decrease in the prevalence. Similarly, the age-prevalence with respect to L.G.A followed similar trend. There was significant difference in the prevalence of onchocerciasis in relation to age. Furthermore, stratification of the prevalence by gender and age (Table 4) shows that for both sexes and across L.G.A, the prevalence increases with age with a peak at 50-59 years.

Table 1. General pattern of distribution of human onchocerciasis in the study area

L.G.A	Numberof communities sampled	Numberof individuals examined in each L.G.A	No. infected(%)
Aniocha north	11	344	43(12.5)
Aniocha south	15	432	46(10.7)
Oshimili north	15	425	49(11.5)
Total	41	1,201	138(11.5)

Table 2. General gender-related prevalence of human onchocerciasis in the study area

L.G.A	Numberof communities examined	Numberof individuals examined in each L.G.A	No. infected (%)
Aniocha north	M	201	29(14.4)
	F	143	14(9.8)
Aniocha south	M	296	35(11.8)
	F	136	11(8.1)
Oshimili north	M	329	37(11.3)
	F	96	12(12.5)
Total	M	826	101(12.2)
	F	375	37(9.9)

Table 3. Onchocercalinfection in relation to age in the study area

L.G.A	Number Examined	Number of infected	No (%) infected in Age groups						
			Age group (Yrs)						
			10-19	20-29	30-39	40-49	50-59	60-69s	≥70
Aniocha north	344	43	3(7.0)	4(9.3)	6(14.0)	11(25.6)	12(27.9)	6(14)	1(2.3)
Aniocha south	432	46	4(8.7)	3(6.5)	8(17.4)	13(28.3)	15(32.6)	3(6.5)	0(0.0)
Oshimili north	425	49	2(4.1)	6(12.3)	7(14.3)	8(16.3)	15(30.6)	7(14.3)	4(8.2)
Total	1,201	138	9(6.5)	3(9.4)	21(15.2)	32(23.2)	42(30.4)	16(11.6)	5(3.6)

Table 4. Onchocercal infection in relation to gender and age in the study area

L.G.A	Number examined	Sex	No (%) infected in Age groups						
			Age group (Yrs)						
			10-19	20-29	30-39	40-49	50-59	60-69s	≥70
Aniocha north	344	M	2(1)	2(1)	4(2)	8(4)	9(4.5)	4(2)	0(0)
		F	1(0.7)	2(1.4)	2(1.4)	3(2.1)	3(2.1)	2(1.4)	1(0.7)
Aniocha south	432	M	3(1)	2(0.7)	6(2)	10(2.4)	12(4.1)	2(0.7)	0(0)
		F	1(0.7)	1(0.7)	2(1.5)	3(2.2)	3(2.2)	1	0(0)
Oshimili north	425	M	2(0.6)	4(1.2)	6(1.8)	7(2)	11(3.3)	5(1.5)	2(0.6)
		F	0(0)	2(2.1)	1(1)	1(1)	4(4.2)	2(1.2)	2(2.1)
Total	1,201	M	7(0.9)	8(1)	16(1.8)	25(3)	32(3.9)	11(1.3)	2(0.2)
		F	2(0.5)	5(1.3)	1(1)	7(1.9)	10(2.7)	5(1.3)	3(0.8

3.4 Human Onchocerciasis in Relation to Occupation in the Study Area

A cross L.G.A, the prevalence of onchocerciasis varied with the occupation of the subjects (Fig. 1). The highest prevalence was observed among farmers, followed by traders and drivers. Analysis of variance showed no significant difference in the prevalence of onchocerciasis with occupation (F= 0.07, *P* = 0.93).

4. DISCUSSION

Results from various studies have implicated Nigeria as an endemic area for onchocerciasis and estimates of prevalence of infection ranging from low to high rates were reported [1,2,5-7]. The prevalence of the infection as reported shows some spatial variation with highest endemicity of 83.0% in Edo State [1].

This study found that the prevalence of onchocerciasis in Delta North senatorial zone was 11.5% and the pattern of distribution was not significantly different (p>0.05) in the three local government areas. Adopting the endemic rates classification of World Health Organization, these communities can be regarded as hypoendemic for onchocerciasis. The prevalence observed in our study area was lower than the reports from some parts of the country including our study area. For instance, Nmorsi et al. [6] reported a prevalence of 41.1% in a rural farm settlement in Aniocha North Local Government Area in Delta State. Similarly, Emina and Okaka [7] observed a prevalence 91.9% in rural community of Okuetolo in Delta State. The reduction in the prevalence rate observed in this study is likely due to the onchocerciasis interventionby the Africa Programme on Onchocerciasis Control (APOC) with the distribution of ivermectin through the Community directed treatment with ivermectin (CDTI).

Furthermore, the disparity in the prevalence of onchocerciasis further explain that the focal nature of the disease depends on the presence of a specific ecology, including but not limited to fast-flowing waters and the characteristics of the vectors involved in the transmission.

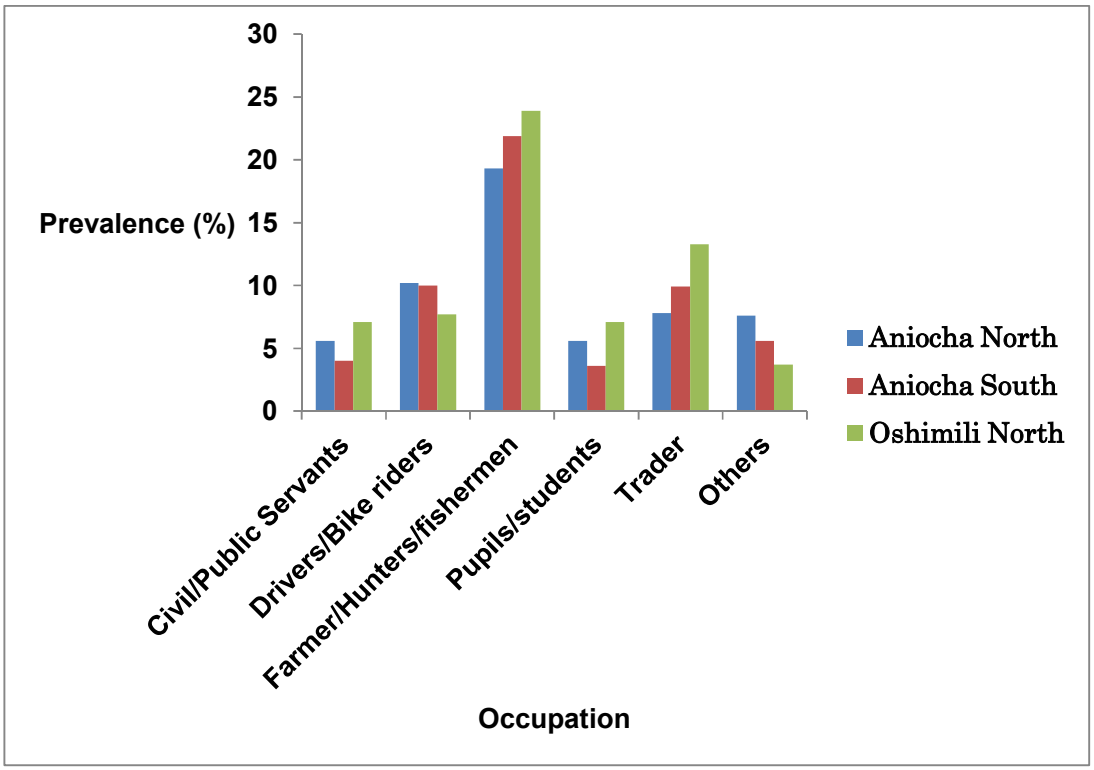

Fig. 1. Prevalence of onchocerciasis in relation to occupation in the study area

Given the enormous effort by the APOC in the yearly distribution of Ivermectin, it is not surprising to observe that the study area is still considered an hypoendemic area for onchocerciasis as this is partly explain by 1.) the presence of the vector; black fly 2.) communities are located close to relatively fast flowing rivers (0.51 – 0.95 m/s) such as Rivers Ohe, Namormai and Otor, as well as other tributaries which favour the breeding of *Simulium* vectors and 3.) the presence of bushes made up of trees, and shrubs near many homes, whose twigs and canopies provide desirable resting shades for the vector flies.

In this study, there was a numerical gender bias in the participation in the survey. The number of male who volunteered to participate in this study was over twice the number of female counterparts. Factors responsible for this could be associated with cultural (where in females are a traditionally expected to be more conservative or reserved compared to males), and also inadequate health education. This finding is in line with that of Abdulahi and Oyeyi [15] in Tudun Wada and Doguwa Local Government Areas of Kaduna State, where more males than females were examined in a similar survey. Although, religious factors such as pudah often also contributes to the reluctance of females in northern Nigeria to participate in surveys of this nature.

In spite of the obvious numerical bias in favour of examined males over females in this survey, the general picture of human onchocerciasis in the study area of Delta state showed that there was no significant difference between the proportion of infected males and females ($P > 0.05$). This finding agrees with that of Okonkwo et al. [2] where infection rate between males (38.9%) and females (26.7%) were not significantly different ($P>0.05$) among farmers in Ebonyi state. Also, the finding of this study is in agreement with that of other researchers in other parts of Nigeria as referenced above in onchocercal gender-related infection, but at variance with the report of Akinbo and Okaka [16], who found significant gender difference in the prevalence of onchocerciasis in Ovia North East Local Government Area of Edo State, Nigeria.

The age-related prevalence increased progressively with age with a slight decline from 60 years to 70 years and above. This observation is in line with existing reports on human onchocerciasis. For instance, Dadzie et al. [17] and Little et al. [18] separately explained that this was due to a steady buildup of infection as a result of early human-vector contact which is sustained throughout the period of existence. Worthy of note here, is the fact that the most infected ages of 20 to 59 years are the most functional working age bracket, thus impacting negatively on the rural economy. Generally more subjects were infected with human onchocerciasis as individuals advanced in age, the worst being 50 – 59 years when the infection stabilized and decreased beyond this age. Similarly, Okonkwo et al. [2] in Ebonyi State, Nigeria observed highest infection rate of 55.3% in subjects aged 50 years and above, while the least infection of (15.5%) was within the age range of 20–29 years. Each of the three local government areas had results similar to that of the overall with respect to age-related prevalence of onchocerciasis in the study area. It is not surprising that the highest infection rates was within the working age; since this group were the ones who go out to farms or other places of work very early in the morning and stayed till very late in the evening. This exposed them to more frequent bites of blackflies thus predisposing them to infection. Result of the prevalence of onchocerciasis in relation to gender and age in the current study indicates that males and females of the different age groups had similar propensity to the disease.

The only visible difference in the result is that infection rate was higher in males at most age groups than females of the same age groups. For instance, the highest prevalence of 3.9% was generally recorded in males of age group 50 – 59 years. In the communities of Aniocha North Local Government Area, the highest prevalence of 12.5% was respectively recorded in the males and females of age group 50–59 and 30-39 years in Philip's camp. Similarly, the females within 50–59 years in Ewulu recorded the highest prevalence with 22.2% in Aniocha South Local Government Area, followed by the males (50–59 years) of Umute (19%). In surveys of this nature, malesubjectsoften record higher prevalence compared to female counterpart in the communities because men usually stay outside the house more and so have greater exposure to bites by vector black files [15]. The results of the communities of Oshimili North Local Governemnt Area showed that females in Asoko (20–29 years), Ilah (50–59 years) and Ugwu-Ozalla (60–69 years) recorded the highest prevalence of 20%. This of course was a deviation from the overall prevalence.

The prevalence of human onchocerciasis among the various occupational groups sampled in the study area of Delta State shows that the disease is related to occupational. That is, the occupational groups that carry out most of their activities outdoors, especially with most parts of their bodies exposed are more predisposed. Rasheed [19] alluded to this, when he reported that the prevalence of the disease was associated with activities like farming and washing near rivers. Inhabitants' vocations therefore, have some effect on the pattern of distribution and prevalence of onchocerciasis infection.

In Aniocha North Local Government Area, results of the occupational – related prevalence shows that infection rates and occupation were associated. The infection was more prevalent among farmers, hunters and fishermen, followed by the drivers and bike riders. Statistical analysis of the results did not however reveal any significant difference ($P > 0.05$) between the occupational groups. However, in Aniocha South and Oshimili North Local Government Area respectively, there was significant difference ($P < 0.05$) in the prevalence with respect to occupational. The reason for this variation is unclear. However, it is reasonable to attribute this difference to variation in vectorial capacity or degree of human-vector contact. The observed association between prevalence and occupation is in accordance with report on human onchocercasis elsewhere [2]. This no doubts may be as a result of higher frequency of contact of these occupational groups with infected vectors. Also, local transporters (drivers and bike riders) ranked second the in the prevalence of onchocerciasis. This is not an expected finding as they are constantly moving from one rural area to another, secondly, they often wait for passengers at junctions and under shades while in the evening, they gathered at the corner of streams or pools of water to wash their bikes or caps at the close of the day. Theses pattern of activities predispose them to vectorialinoculation. Thus this may explainsthe relatively high prevalence of the infection among this occupational group.

Other vulnerable groups were the school age children, 10 years and above. These groups are often sent to fetch water from nearby streams and many of whom delight in washing, bathing or doing their laundries in the streams. Also, poor living conditions among some rural dwellers often deprive most school aged children from going to school. Rather, they follow their parents to farms and bush markets. Therefore, it is pertinent to point out that people whose daily activities and engagements frequently bring them in close proximity to infected black fly are the most venerable groups in endemic areas.

The moderately high infection rate of civil/public servants and traders (particularly in Oshimili North Local Government Area) may not be unconnected with the fact that some of them may have in the time past or are currently engaged in other outdoor activities such as farming, hunting or fishing. Another explanation that appears plausible for the relatively high infection rate in traders is that a good number of them travel from one bush market to another. Some of them actually go to buy and/or sell in markets that are close to fast flowing streams or rivers which may be breeding sites for *Simulium* vector.

5. CONCLUSION

In summary, the study has revealed that there are relationships in the rate of infection of onchocerciasis with gender, age, occupation and location in the study area. Thus, it is recommended that comprehensive epidemiological surveys of onchocerciasis in remote areas should be carried out and all the affected population treated with ivermectin. The CDTI programme of APOC should be extended by ten more years beyond 2015. It should even be consolidated upon, in order to ensure a consistent ivermectin delivery to inhabitants of the area and to monitor compliance with drug usage.

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CONSENT AND ETHICAL APPROVAL

Informed consent was also sought from those who willing agreed to participate in the study. Ethical approval for the study was obtained from the department of Animal and Environmental Biology, Delta state University, Abraka, and Delta State Ministry of Health, Asaba.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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