

Corrected copy of Research Article

STUDY ON THE PREVALENCE OF *ONCHOCERCA VOLVULUS* INFECTION AMONG THE INHABITANTS OF AWGU AND OJI-RIVER LOCAL GOVERNMENT AREAS OF ENUGU STATE, NIGERIA.

ABSTRACT

This study was conducted to determine the prevalence of Onchocerciasis among the inhabitants of Awgu and Oji River Local Government Areas from October 2012 to March 2013. Simple random sampling method was used to select three communities in each Local Government Area. The prevalence of *O. volvulus* infection was determined by microscopic examination of skin snip samples for *O. volvulus* microfilaria. The subjects were selected from the communities by systematic random sampling method. Seven hundred and eighty six samples were collected and 250 (31.38%) were positive. Two hundred and ninety-five (295) individuals were sampled in Awgu Local Government Area and 36 (12.20%) of them were positive. In Oji River Local Government Area, 491 individuals were sampled and 214(43.58%) were positive for *O. volvulus*. Higher prevalence of Onchocerciasis was observed in males {108(48.43%)} compared to females {106(39.55%)} in Oji river Local Government Area. In Awgu Local Government Area, females had a higher prevalence of 19 (13.38%) as against 17(11.11%) by the males. The highest prevalence of onchocerciasis was seen among the age group 41-50 years in both Local Government Areas. Farmers had the highest prevalence in both Awgu (15.49%) and Oji River (50.43%) Local Government Areas. The highest prevalence was seen among the illiterates in Awgu (16.87%) and Oji River (54.66%) Local Government Areas. Despite efforts aimed at controlling Onchocerciasis infection in the two Local Government Areas of Enugu state, the infection is still hypoendemic (< 40%) in Awgu and mesoendemic (>40% but less than <60%) in Oji River Local Government Area.

INTRODUCTION

Onchocerciasis is a disease caused by the filarial parasite *Onchocerca volvulus*. The disease constitutes a huge public health and socioeconomic burden in many parts of tropical Africa, and to a lesser degree in Latin America (WHO, 1995; 2015). Man is the only natural vertebrate host of the parasite, and in Africa, the disease is transmitted by the black fly vectors of the genus, *Simulium* (WHO, 2015). In Nigeria, the infection is exclusively transmitted by members of the *Simulium damnosum* complex, which are widespread in the savanna, forest savanna mosaic and forest areas of the country (Okaka *et al.*, 2003). These vectors breed exclusively in fast flowing water, and thus, the disease is also called ‘river blindness’, a term depicting both the vector-preferred breeding site and the most severe effects of the disease; blindness (WHO, 1995). Onchocerciasis is most prevalent in Africa, where over 99% of the cases occur (Bump *et al.*, 2004: WHO, 2015). More than 99% of infected people live in 31 countries in sub Saharan Africa: Angola, Benin, Burkina Faso, Burundi, Cameroon, Central

African Republic, Chad, Republic of the Congo, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Sudan, Sudan, Togo, Uganda, and United Republic of Tanzania (WHO, 2015). It has also been introduced in Yemen (WHO, 2015). Onchocerciasis occurs in Nigeria with greater frequency than any other country worldwide and accounts for 40% of all cases of onchocerciasis in Africa (Bump *et al.*, 2004). In Nigeria, onchocerciasis is wide spread and a cause of blindness in most rural communities. Of all the countries of the world, Nigeria has the greatest number of persons with onchocerciasis (WHO, 2009; Evans *et al.*, 2011; Okonlawon and Osayintolu, 2012). Nigeria also has more people blinded by onchocerciasis than any other country, an estimated 100,000 cases out of the 268,000 that occur worldwide (WHO, 1995). The population of Nigerians blinded by onchocerciasis exceeded that of all 11 countries covered by OCP combined (Jiya, 1998; Umeh *et al.* 2010). The disease has a wider distribution in Nigeria than previously believed; about 10 million cases had been reported (WHO, 1992). Thirty one out of the existing thirty six states of Nigeria and the Federal Capital Territory have meso to hyper-endemic foci for onchocerciasis. Out of the 774 Local Government Areas in Nigeria, about 416 are rated high priority for onchocerciasis control (NOCP, 1996; Okonlawon and Osayintolu, 2012)).

The socioeconomic and psychological impact of its clinical symptoms are enormous (Eneanya and Nwaorgu, 2001; Okoye and Onwuliri, 2007). This constellation of problems amounts to a massive development obstacle in most of sub-Saharan Africa, where some 75 million people are at risk and where 99% of those infected live (Okeibunor *et al.*, 2004; Remme, 2004). Onchocerciasis ranks as the second leading infectious cause of blindness (Hall and Pearlman, 1999). The reactive skin lesions and persistent itching, apart from carrying a great social stigma, (Amazigo, 1994; Eneanya and Nwaorgu, 2001) are associated with diminished income-generating capacity, constituting discomfort for those infected and disaster for their families (Benton, 1998). Each year this filarial parasite is responsible for 250,000 of blindness, up to 500,000 or more cases of severe visual impairment and onchocerciasis global burden was put at 1 million disability-adjusted life-years (DALY) (WHO, 1995; 2008). Compared with their healthy counterparts, individuals with symptomatic infection have been found to spend an additional 15% of their annual income on health, infected children have been found to be more

likely to drop out of school and symptomatic farmers have, on the average, a third less land under cultivation-all differences that contribute to poverty (Fischer et al., 2002). Although onchocerciasis has been named the third most important cause of preventable blindness in the tropics (Narita and Taylor, 1993), it is the skin disease that is responsible for 60% of the DALY lost as the result of onchocercal infection. There is also some evidence that onchocerciasis may be associated with epilepsy and dwarfism (Basanez *et al.*, 2006) and the biting nuisance that black fly represent also has a real but unmeasured effect on economic activities (Hougard *et al.*, 1998).

The objective of the present study was to ascertain and compare the prevalence of onchocerciasis infection in Awgu and Oji river Local Government Areas of Enugu state, Nigeria and to determine the age, sex, occupational and educational distributions of the disease in these areas. It is expected that this study will be an eye-opener to the government, non-governmental organisations as well as community-based organisations to mount increased intervention programmes (like ivermectin provision, health education and treatment of water bodies) and help reduce the burden of the infection in the area.

MATERIALS AND METHODS

Study area

Oji River is a Local Government Area in Enugu State, Nigeria. Oji River Local Government Area has her headquarters at Oji town and has an area of 403km² and a population of 126,587 as at the 2006 census. Oji river lies between latitude 6°27'N/6°10'N and longitude 7°36'E/7°16'E longitude and has an altitude of 140m (156sq). Oji River Local Government Area has a major river that runs through most of the towns, hence the name. The Oji River is dammed at the Oji town to get the Oji River power station and this increased the rate of flow of the river. The tropical climate combined with fast running river provide conducive environment for the breeding of vector such as the black fly of the genus *Simulium*. Oji River Local Government Area is made up of six communities which include; Oji urban, Achi, Akpugoeze, Ugwuoba, Inyi and Awlaw.

Awgu Local Government Area is one of the 17 Local Government Areas in Enugu state. Awgu Local Government Area lies on the coordinates of 06°03'N latitude and 07°28'E longitude. It has a temperature of 33°C in the hottest period of April. Awgu has boundaries with Isi-agu in Ebonyi state, Oji river and Aninri Local Government Area in Enugu State. The people are mainly farmers, palmwine tappers, traders and few are civil servants. Awgu Local government area is made up of 20 communities; Awgu, Mgbowo, Nkwe, Ezere, Mgbidi, Awgunta, Ugwueme, Obeagu, Ogbaku, Ogugu, Agbogugu, Owelli, Ituku, Ihe, Isu-awa, Agbudu, Nenwenta, Amoli, Ugbo and Mmaku. Mmaku has a river 'mmamu river', which is a tributary to Oji River.

Sampling

Simple random sampling (take-a-pick lottery method) was employed in selecting three communities from each Local Government Area to participate in this study. The names of every community in each Local Government Area was written on pieces of paper and folded properly. Piece of papers containing the names of communities in a particular Local Government Area were put in a container and mixed properly three communities were picked from the folded papers. In Awgu Local Government Area, Awgu, Agbogugu and Mgbowo were selected to represent the Local Government Area and in Oji River Local Government Area, Achi, Inyi and Oji Urban were selected.

Subjects were selected for the study, using systematic random sampling technique as described by (Kreycie and Morgan, 1970) and (Baba, 2005). Every Kth person from a list of the willing population in each community was selected.

$$K=N/n$$

Where N=number of persons willing to participate in a community

n=number of subject required for the study in each community.

The first Kth subject was randomly selected from the first few subjects on the list of willing participants. The subsequent subjects were selected by adding the already determined value of K to the number of the first subject.

Ethical clearance

The Department of Parasitology and Entomology, Faculty of Biosciences Nnamdi Azikiwe University, Awka approved this study and permission was obtained from Enugu State Ministry of Health to embark on the study. In each village, the purpose of the study was explained to the chief, village elders and political ward counselors and their permission secured. At recruitment, informed verbal consent was sought and obtained from each study participant after explanation of the purpose, procedures and possible risks and benefits from the study were explained to them.

Procedure for skin sniping

Skin snip for microfilaria, was used to determine the prevalence of onchocerciasis.

Sample collection

The skin was cleaned with spirit and allowed to dry. Skin snip was collected by elevating a small cone of skin about 2-3mm in diameter and 0.1mm-0.5mm deep, with a sterile needle and shaving it off with a sharp sterile razor.

Biopsies (skin snip), were taken from the iliac crest and calf. These sites are known to harbour high concentration of microfilaria (Ufomadu *et al.*, 1988). The samples were labeled and transported to the laboratory for examination.

Laboratory examinations

The bloodless snip was immersed in Physiological saline and covered with cover a cover glass. It was incubated at room temperature and examined after 4 hours. The skin snip was not teased as it was not necessary and can damage microfilaria. The prepared slide was examined using 10x objective with the condenser iris closed sufficiently to give good contrast. The slide was recorded as positive when microfilaria is present and negative when it is absent.

Data Analyses

Data analysis was performed on GraphPad Prism version 6. The independent student t-test, chi square, Spearman's Correlation and percentages were used to analyze the data. Statistical significance was set at $P < 0.05$.

RESULTS

Seven hundred and eighty six (786) samples were examined for microfilaria of *O. volvulus* and 250 (31.80%) were positive in both Awgu and Oji river Local Government Areas. A prevalence rate of 12.20% and 43.58% was observed in Awgu and Oji River Local Government Area respectively. Out of the three communities studied in Awgu Local Government Area, Mgbowo had the highest prevalence of 14.29%. There was no statistical difference in the prevalence of *O. volvulus* infection in the communities in Awgu Local Government Area ($P > 0.05$). Among the three communities studied in Oji River Local Government Area, Achi had the highest prevalence rate of 46.08%. There was no statistical difference in the prevalence of *O. volvulus* in the communities in Oji River Local Government Area ($P > 0.05$) (Table 1).

Table 1: Overall prevalence of *O. volvulus* infection in Awgu and Oji River Local Government Areas.

LOCAL GOVERNMENT AREA/COMMUNITY	Number Examined	Number Positive N (%)
AWGU LOCAL GOVERNMENT AREA		
Awgu	93	12 (12.29%)
Mgbowo	126	18 (14.29%)
Agbogugu	76	6 (7.89%)
Total	296	36 (12.20%)
OJI-RIVER LOCAL GOVERNMENT AREA		
Oji Urban	134	54 (40.08%)

Achi	176	81 (46.08%)
Inyi	181	79 (43.65%)
Total	491	214 (43.58%)
Grand Total	786	250 (31.80%)

Out of the 410 females and 376 males examined in this study, 30.49% and 33.24% prevalence rate was recorded for female and male populations respectively. There was no statistical difference in the male and female prevalence rates ($P>0.05$). 11.11% of males examined in Awgu Local Government Area were positive and 13.38% of the examined females were positive. However there is no significant difference in the sex prevalence Awgu Local Government Area ($P>0.05$). In Oji River Local Government Area, a prevalence of 48.43% for males and 39.55% for females was recorded. However, this difference was not statistically significant ($P>0.05$) (Table 2).

Table 2: Prevalence of Onchocerciasis as it relates to sex in Oji River and Awgu Local Government Areas.

LGA	SEX			
	MALE		FEMALE	
	Number Examined	Number positive N (%)	Number examined	Number positive N (%)
AWGU	142	19 (52.78%)	153	17 (42.22%)
OJI	286	106 (39.55%)	223	108 (48.43%)
TOTAL	410	125 (30.49%)	376	125 (33.25%)

This study revealed that the age group with the highest prevalence rate is the age group 41-50 years in both Awgu and Oji River Local Government Areas, with prevalence rates of 14.49% and 48.96% respectively. A positive association was observed between prevalence and age in Oji River LGA ($r=0.9$) ($P<0.05$). A positive association was also observed between prevalence and age in Awgu Local Government Area ($r=0.9285$) ($P<0.05$) (Table 3).

Table 3: Prevalence of onchocerciasis as it relates to age in Oji River and Awgu Local Government Areas of Enugu state.

AGE GROUP (IN YEARS)	LOCAL GOVERNMENT AREA			
	AWGU		OJI RIVER	
	Number examined	Number positive N (%)	Number examined	Number positive N (%)
0-10	49	5 (10.20%)	76	31 (40.79%)
11-20	43	6 (13.95%)	80	34 (42.50%)
21-30	32	4 (12.50%)	92	41 (4.5%)
31-40	62	7 (11.29%)	45	20 (44.44%)
41-50	69	10 (14.49%)	96	47 (48.96%)
>50	40	4 (10.00%)	102	41 (40.20%)
Total	259	36 (12.20%)	491	214 (43.58%)

The study showed that the occupation with the highest prevalence rate for onchocerciasis is farming in both Awgu and Oji River LGAs, with prevalence of 15.49% and 50.43% respectively. A positive association was observed between prevalence and occupation in Awgu LGA ($r=0.8125$) ($P<0.05$). A positive association was also observed between prevalence and occupation in Oji River LGA ($r=0.9792$) ($P<0.05$) (Table 4).

Table 4: Prevalence of onchocerciasis as it relates to occupation in Oji River and Awgu Local Government Areas.

OCCUPATION	LOCAL GOVERNMENT AREA			
	AWGU		OJI RIVER	
	Number examined	Number positive N (%)	Number examined	Number positive N (%)
Farmer	71	11 (15.49%)	234	118 (50.43%)
Trader	48	5 (10.42%)	76	29 (38.16%)
Teacher	26	4 (15.38%)	20	7 (35.00%)
Student	50	6 (12.00%)	51	18 (35.29%)
Unemployed	36	4 (11.11%)	39	17 (43.59%)
Self employed	29	3 (10.34%)	46	18 (39.13%)
Civil servants	35	3 (8.57%)	25	7 (28.00%)
Total	295	36 (12.20%)	491	214 (43.58%)

In Awgu Local Government Area, those with primary level of education have the least prevalence rate of 8.93% for onchocerciasis. The highest prevalence rate was seen among the illiterates (16.87%). In Oji River Local Government Area, the highest prevalence rate was also observed among the illiterates (54.66%) and the least prevalence rate was observed among those with secondary level of education (36.99%). A positive association was observed between prevalence and age in Awgu Local Government Area ($r=0.833$) ($P<0.05$). A perfect positive association was observed between prevalence and age in Oji River Local Government Area ($r=1$) ($P<0.05$) (Table 5).

Table 5: Prevalence of *Onchocerca volvulus* as it relates to **Education** in Oji River and Awgu Local Government Areas of Enugu state.

LEVEL OF

EDUCATION	LOCAL GOVERNMENT AREA			
	AREA			
	AWGU		OJI RIVER	
	Number examined	Number positive N (%)	Number examined	Number positive N (%)
Illiterate	83	14 (16.87%)	150	82 (54.66%)
Primary	112	10 (8.93%)	176	69 (39.20%)
Secondary	54	6(11.11%)	73	27 (36.99%)
Tertiary	46	6 (13.04%)	92	36 (39.13%)
Total	295	36 (12.20%)	491	214 (43.58%)

In Awgu Local Government Area, those with primary level of education have the least prevalence rate (8.93%). The highest prevalence rate was seen among the illiterates (16.87%). In Oji River Local Government Area, the highest prevalence rate was observed among the illiterates (54.66%) and the least prevalence rate was observed among those with secondary level of education (36.99%). There is no statistical difference in the prevalence among the various educational levels in Awgu ($P>0.05$). A positive association was observed between prevalence and Age in Awgu Local Government Area ($r=0.833$) There is statistical difference in the prevalence among the various educational levels in Oji River ($P<0.05$). A perfect positive association was observed between prevalence and Age in Oji River Local Government Area ($r=1$)

DISCUSSION

The human onchocerciasis infection rate of 12.20% seen in Awgu Local Government Area points to the fact that the sampled population is hypoendemic ($< 40\%$) (WHO, 1987). Infection occurred in all the villages surveyed, with the level of endemicity varying from village to village. Oji River Local Government Area is mesoendemic ($> 40\%$), by having a prevalence rate of

43.58%. This relatively high prevalence is not surprising because of the presence of the fast flowing Oji River, which is a good breeding site for the black fly. Invariably more people were exposed to the bite of black flies and subsequent transmission of onchocerciasis. This observation is in conformity with the previous findings of Akogun and Onwuliri (1991). The presence of onchocerciasis in communities in Awgu Local Government Area can be explained by the fact that the *Simulium* black flies are strong flyers and can travel several kilometers away from their breeding sites. Female *S. damnosum*, has been known to fly 85km to establish new colonies (Wilcock and Manson-Bahr, 1976). The report of earlier studies such as Nwoke *et al.*, 1987; Okereke, 1989; Nwoke, 1992, indicate that communities situated where fast flowing streams and rivers abound, are highly affected by the onchocerciasis. Apart from the proximity of Awgu Local Government Area with Oji River Local Government Area, presence of onchocerciasis in Awgu Local Government Area could also be explain by the presence of the Mmamu river, in Mmaku community of Awgu Local Government Area, which is relatively fast flowing river and has many aquatic plants for black fly larval attachment.

The higher prevalence rate shown by females when compared to males in Oji River LGA is in agreement with the result obtained in Ovia North East Local Government Area of Edo State, Nigeria where females had 93% onchocerciasis infection and males 74.5% (Akinboye *et al.*, 2010). Onchocerciasis infection rate is higher in males than in females in Awgu Local Government Area and this agrees with the result obtained by Uzoigwe *et al.* (2012) in Nasarawa state, Central Nigeria, where males recorded a prevalence of 8.7% and females 5.1%. This differences in infection rates with regards to sex may be due to endemicity, occupational exposure and susceptibility of individual (Iroha *et al.*, 2010). Males are involved in outdoor activities thereby exposing themselves to bites from black flies. In addition, the lower prevalence rate in females could be attributed to yet unexplainable protective hormonal factors as earlier suggested by Anderson *et al* (1974) and Ottensen (1984).

Infection with onchocerciasis was confined to the middle age groups in both LGAs. Those within the age group 41-50 are usually the most active members in the society and have had a long time exposure to the bite of the *Simulium* vectors because of their involvement in outdoor activities

such as farming and fishing. The peak prevalence of onchocerciasis infections observed between 41-50 years age group in this study agrees with previous reports (Gemade and Dipeolu, 1983; Ufomadu *et al.*, 1992).

The highest rates of onchocerciasis infection in both LGAs were observed among the farming population. In Oji River Local Government Area, this was closely followed by the self-employed group and the unemployed. This suggests that the self-employed and some unemployed may have engaged in some farming activities to make ends meet or until the unemployed secure a permanent job (Dozie *et al.*, 2003). The relatively high prevalence of onchocerciasis recorded among teachers in the study area, may be due to the fact that the inhabitants of these communities farm very close to human dwelling and schools also have farms.

Educational status seems to have effect on the onchocerciasis infection status. The illiterates had the highest prevalence and this may be because majority of these illiterates were famers and fishermen, whose occupation exposed them to bites from black flies (Wilcock and Manson-Bahr, 1976). Contrary to the observation that poor level of education exposes the inhabitants to the infection as it determines their occupation to some extent, in Awgu Local Government Area, a relatively high prevalence was seen among those with tertiary education..

CONCLUSION AND RECOMMENDATION

Despite efforts aimed at controlling *O. volvulus* infection in Enugu state (vector control, ivermectin administration and health education), the infection is still endemic in Awgu and Oji River Local Government Areas. This may be due to poor adherence to drug regimen and lack of proper awareness on the method of prevention of the disease. Occupation and educational status as seen in this study are also major predisposing factors to onchocerciasis infection. More emphasis should be placed on control measures such as Ivermectin provision, vector control, health education and the use of protective clothing (for people whose occupation exposes them to black fly bite). The state and federal government should give the people every encouragement needed to better their lot and pull them out of the shell which they seem to have built around themselves.

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