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Original Article

Epidemiology of onchocerciasis in Ayedire L.G.A, Osun State, Nigeria

*[1]Awolaju, B. A., [2]Adekunle, O. N.,[2]Lawal, O. A. and [2]Abimbola, W. A.

[1]Department of Biology, University of Ilesa, Nigeria.
[2]Department of Zoology and Environmental Biology, Olabisi Onabanjo University, Nigeria.

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ABSTRACT

Onchocerciasis (river blindness), caused by *Onchocerca volvulus* and transmitted by *Simulium damnosum* blackflies, remains a public health concern in Nigeria despite sustained Mass Drug Administration (MDA). This study assessed disease prevalence and intensity across eight communities in the Ayedire Local Government Area of Osun State. A cross-sectional survey was conducted involving 372 volunteers. Disease status was determined using parasitological skin snips to detect microfilariae and physical examinations for palpable nodules. Seasonal entomological surveys were also performed, where blackflies were collected and dissected to determine parity and larval presence.The cumulative microfilarial prevalence was 2.2% (8/372). While Eleji, Obielu, Onigangan, and Osunwoyin recorded zero prevalence, Olubooku was identified as meso-endemic with a 40% prevalence and a Community Microfilarial Load (CMFL) of 1.08. Other communities were classified as hypo-endemic. The overall nodule prevalence was 4.8% (18/372). Statistical analysis showed significant variation in CMFL across communities ($X2=76.856, p=0.001$), no significant correlation existed between infection rates and age or gender. Additionally, significant seasonal variation in blackfly parity was recorded ($p<0.05$), although no infective larvae were found in dissected flies.While overall prevalence in Ayedire LGA is relatively low, the meso-endemicity in Olubooku highlights a localized transmission risk. To achieve total elimination, the government must ensure consistent, high coverage ivermectin distribution through strengthened MDA programmes.

Keywords: Blackflies, MDA, Microfilariae, Onchocerciasis, Prevalence.

***Corresponding Author's email:** bisiriyuajani@gmail.com/bisiriyu_awolaju@unilesa.edu.ng

INTRODUCTION

Onchocerciasis is a disease, commonly called river blindness. It is a neglected tropical disease (NTD). This disease is caused by a parasitic nematode (*Onchocerca volvulus*) which is transmitted to humans by black fly called *Simulium damnosum* [1,2].

The fly that transmits this parasite breed in a fast-flowing river [3]. Onchocerciasis is second to Trachoma that also causes blindness [4]. World Health Organisation [5] reported that more than 99% people were infected in Africa and Yemen while the remaining 1% were found on the border between Brazil and Venezuela (Bolivarian Republic). In 2017, Global burden of disease revealed that 14.6 million people suffered from skin disease while 1.15 million had ocular problems. Among the five countries that had been verified by WHO for being freed of onchocerciasis included, Colombia, (2013), Ecuador (2014), Mexico (2015), Guatemala (2016) and Niger, the only African country (2025). WHO reported that Senegal had stopped treatment and was under post – treatment surveillance in 2022. A record also showed that Equatorial Guinea, Ethiopia, Mali, Nigeria, Sudan, Tanzania, Togo, Uganda and Venezuela (Bolivarian Republic) had stopped Mass drug administration (MDA) in at least one focus. Report had it that onchocerciasis is targeted for elimination of transmission in WHO road map on neglected tropical diseases (2021 – 2030). WHO aims at stopping MDA with ivermectin in at least one focus area in 34 countries, in more than 50% of the population in at least 16 countries and in the entire endemic population in at least 12 counties. In an attempt to eliminate onchocerciasis, a total of 172..2 million people were treated, representing 69.0% global coverage in 2023.

Record revealed that 99% of global cases of onchocerciasis occurred in African countries [6 – 8]. Nigeria has the highest prevalence of infection with approximately 40% of the global population at risk [8 – 9]. Other African countries such as Cameroon, Ghana, Central African Republic and Sierra Leone have high prevalence of the disease. In Cameroon, it was found that the prevalence of this disease was higher among the males compared to their female counterparts [10]. Age has also been found to play a significant role in onchocercal infection. For instance, in Cameroon, age group 61 and above had the highest rate of onchocerciasis which was linked to the long hours of farming activities of people within this age group. It was reported that the prevalence of onchocerciasis infection was found to be concentrated across Central Africa, with the highest prevalence areas in focal areas of Democratic Republic of Congo (DRC), Ghana, Nigeria, Cameroon and South Sudan [11]. This result was based on mean prevalence prediction at 5 x 5 Km resolution. Mean prevalence prediction was also found to be in the highest in Ghana (12.2%, 95% uncertainty interval [UI] 5.0 – 22.7) and Equatorial Guinea (9.7%, 8.0 – 11.7), with main estimatesalso exceeding 5% infection prevalence at the national level for Cameroon, Central African Republic, DRC, Guinea – Bissau, Sierra Leone and South Sudan.

Nigeria, recognised as one of the largest nations in West Africa, has been reported to exhibit a significant prevalence of Onchocerciasis infection [7,12,13]. Reports had shown that this disease is endemic in all other states of the federation, with the exception of Lagos State, Bayelsa, and Rivers [14].The provisional estimate suggested that 7 – 10 million Nigerians are infected with Onchocerciasis, approximately 40 million are at risk of the disease and 120 cases of onchocerciasis – related blindness with many thousands suffering from disabling complications of the disease [15]. A report of the study carried out in Enugu, showed

that nodule and skin microfilaria prevalences were still at meso – endemic level [16]. High endemity was recorded among the rural dwellers in Nigeria. Ovia recorded highest level of endemity [17] while prevalence of 54. 2 % was recorded in Ibarapa Local Government Area, Oyo State, Nigeria [18]. Critical study of the prevalence of onchocerciasis, revealed that males are more exposed to black fly than the females based on their farming occupation. There was report that age group between 50years and above (55.2%) were more vulnerable to *Onchocerca* parasite while the least infected subjects were those aged 20 – 29 years (15.4) in Ebonyi State, Nigeria [19].

The objective of this study is to determine the prevalence of onchocerciasis and the WHO threshold for stopping MDA in Ayedire Local Government Area of Osun State, Nigeria.

MATERIALS AND METHODS

Study area

The research was conducted in eight communities within the Ayedire Local Government Area (ALGA) of Osun State, Nigeria.These communities are Mamu–Abimbola, Obielu, Alabata, Onigangan, Eleji, Osunwoyin, Iwo railway station road community and Olubooku. The locations of these communities in ALGA with its headquarters in the town of Ileogbo, are as shown in the Map (Figure 1). It is located between latitude 7^{o} 47' 00'' to 7.7833^{o} N and longitude 4^{o} 12' 00'' to 4.20000^{o} E in the Western Nigeria. The area encompasses 262 km^{2} and had a population of 75,846 as at the 2006 National Census. The study area lies within the rainforest zone and a major river (Osun) passes through the villages involved in this study. The specific geo – coordinates of the selected study communities are as shown in Table 1.1. The communities predominantly consist of Yoruba ethnic group. The major economic activity in the communities is farming.

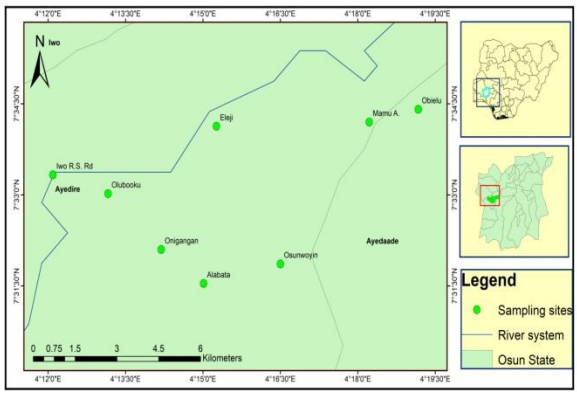

Figure 1: Map showing the locations of the study sites in Ayedire Local Government Area, Osun State

Ethical Approval and pre-survey visits

Ethical approval, designated by the number OSHREC/PRS/569T/233 (Appendix II), was secured from the Osun State Ministry of Health, located in Osogbo, prior to the initiation of the study. The ethical approval was submitted to the Head of the Primary Health Care Authorities of ALGA. In the company of the ALGA onchocerciasis Co – ordinator, the heads of the study communities were visited and a sensitizitation meeting was held with them about the study. At mobilization, Informal consent of the study subjects was obtained at another meeting that was held in the presence of the community Informed consent forms were duly executed by the willing participants or their respective guardians.

Study subject selection

The study subjects consisted of inhabitants of the eight selected communities. Among the eight communities, two communities, Eleji and Mamu – Abimbola, which were located at a variable distance to Osun River were chosen for the collection of blackflies for entomological studies. Volunteers among the inhabitants between the age five (5) and above were involved in this study after their consent had been obtained at a meeting preceding the study.

Sample collection and examination

a. Parasitological examintion

Bloodless skin snip biopsies were aseptically obtained from the subjects using the standard method of microscopy [3]. For each subject, the skin was cleansed with a spirit swab, and a fold was subsequently squeezed between the thumb and forefinger. The epidermis was removed in a small section (3–5mg) using a corneoscleral punch. The slice of epidermis was immersed in normal saline (0.85% NaCl) to facilitate the observation of microfilariae. As a result of this standard saline solution, microfilariae were observed to emerge from the epidermis of positive participants. The emerging microfilarae were counted to estimate the microfilarial load.

b. Entomological Examination:

Collection of adult black flies, *Simulium damnosum* was done twice in a fortnight for each month from January 2022 to December 2022 at Eleji and Mamu – Abimbola communities. Human Landing Catch (HLC) method was used for the collection of the flies between 0600 to 1800 hours [20]. Insect collected were dissected to identify parous and nulliparous blackiflies.

Data analysis

All data collected were entered into Microsoft Excel Spreadsheet and analyzed graphically using custom scripts in R and SPSS version 22 (IBM SPSS Incorporation). Frequencies and percentages were used to group variables. Microfilaria (mf) occurrence was defined as a proportion of positive result among participants from whom skin snip was obtained in addition to palpation for nodules examination. Variation and association in microfilaria prevalence in all communities/LGA examined was examined using Pearson's Chi square test, setting $p < 0.05$. ArcGIS 9.3 software was employed for maps and geo-referencing.

RESULTS

Prevalence of onchocerciasis in the study communities

In this study, the prevalence of infection by communities ranged from 1.4% to 40% with a cumulative microfilarial prevalence of 2.2% (8/372) with exceptions of four communities namely Eleji, Obielu, Onigangan and Osunwoyin which recorded 0% prevalence. Nodule palpation showed a nodule prevalence of 4.8% (18/372) (Figure 2). Highest prevalence of 40% (4/10) was recorded among participants in Olubooku and lowest in Mamu-Abimbola 1.4% (1/73). Olubooku showed the highest intensity of infection with Community microfilarial load (CMFL) value of 1.08 while the intensity of infection in the remaining villages ranged from 0.00 – 0.82. CMFL, showed a significant difference between studied communities ($X^2 = 76.856$, df = 7, $p = 0.001$) (Table 1). No significant difference was recorded between nodule palpation and studied communities when compared ($X^2 = 6.525$, df = 7, $p = 0.480$)

(Table 1). Also, Olubooku, recorded the highest CMFL, (1.08) followed by Iwo railway station road (0.82), Mamu – Abimbola (0.76) and Alabata (0.59) while the remaining four communities recorded zero (0) intensity of infection.. Olubooku was seen as a potential "hot – spot" because of its nearness to river Osun and a "hard – to – reach" site for Primary Health Officers to effect mass drug administration (MDA). Thus, Olubooku was seen to be meso-endemic while other villages were hypoendemic, based on World Health Organization classification of endemicity.

Prevalence of Clinical manifestation of Onchocerciasis in the study area

Figure 3 shows the clinical manifestations of onchocerciasis the study communities. Majority of the communities showed nodules which was followed by Leopard skin while two communities (Olubooku and Eleji) had blindness and only one community (Eleji), showed pruritus. According to World Health Organization (WHO), classification of prevalence, Olubooku was meso - endemic (prevalence $>$ 40%) for microfilaria and 20% for nodule prevalence respectively while the remaining communities were hypoendemic with nodule prevalence $<$ 20% and microfilaria prevalence $<$ 35%.

Prevalence of clinical manifestations of onchocerciasis among adults and children at the study sites

In Figure 4, most of the clinical manifestations were found in adults, nodules (6.3%), blindness (1.1%), Leopard skin (4.2%), pruritus (0.4) and microfilarial worms (2.8%) while Leopard skin (2.3%) was found in children. The prevalence of these clinical manifestations in accordance with WHO standard existed below 35% (, 35%) of endemicity (Hypoendermic), for both adults and children.

Prevalence of onchocerciasis on gender and age of the participants in the study site

Table 2 shows that there was no significant relationship between age and microfilaria prevalence of *Onchocerca volvulus (O. volvulus)* ($X^2 = 8.646$, df = 6, p=0.194). Prevalence of onchocerciasis exhibited variation across diverse age groups within all the study communities, four communities recorded zero occurrence of onchocerciasis. Highest prevalence 4.8% (3/62) was recorded among participants within the age group 25-34 years and lowest 4.5% (2/44) and 4.5% (3/67) among age group 55-64 and ≥65 years respectively. Among genders, there was no significant relationship ($X^2 = 3.351$, df = 1, p = 0.067) between microfilaria prevalence. Of the 211 females, 2 were infected representing 0.9% and 6 out of the 161 males representing 3.7%

Transmission indices of *S. damnosums. l* in the study area

Out of the 816 flies dissected in Eleji, 261 (32.0%) were parous and 555 (68.0%) were nulliparous. Out of the 435 flies dissected in Mamu-Abimbola, 176 (41.4%) were parous and 259 (59.6%) were nulliparous. None of the total 437 parous flies exhibited infection with any stage of *0. volvulus* larvae throughout the duration of the study. The month of February and March, which are both within the dry season recorded the highest percentages of parous flies for Eleji (40.0%) and Mamu-Abimbola (42.9%) respectively, while the least was recorded in July (8%) and September (8%) for Eleji and August (9.1%) for Mamu-Abimbola (Figure 5 and Table 3). The seasonal

variation in monthly parity demonstrated statistical significance ($P < 0.05$)

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Table 1: Prevalence of Onchocerciasis across the study Communities in the area

Communities	Nodule	Palpation	Microfilaria in	skin snip	CMFL
	Nunber examined	Number positive (%)	Nunber examined	Number positive (%)	
Alabata	25	0(0)	25	2(8)	0.59
Eleji	56	4(7.1)	56	0(0)	0.00
Iwo railway station rd.	64	4(5.3)	64	1(1.6)	0.82
Mamu - abimbola	73	4(5.5)	73	1(1.4)	0.76
Obielu	31	1(3.2)	31	0(0)	0.00
Olubooku	10	2(20.0)	10	4(40)	1.08
Onigangan	57	3(5.3)	57	0(0)	0.00
Osunwoyin	56	0(0)	56	0(0)	0.00
Total	372	18(4.8)	372	8(2.2)	

Community microfilarial load (CMFL), ($X^2 = 76.856$, df = 7, $p = 0.001$)
Nodule palpation, ($X^2 = 6.525$, df = 7, $p = 0.480$)

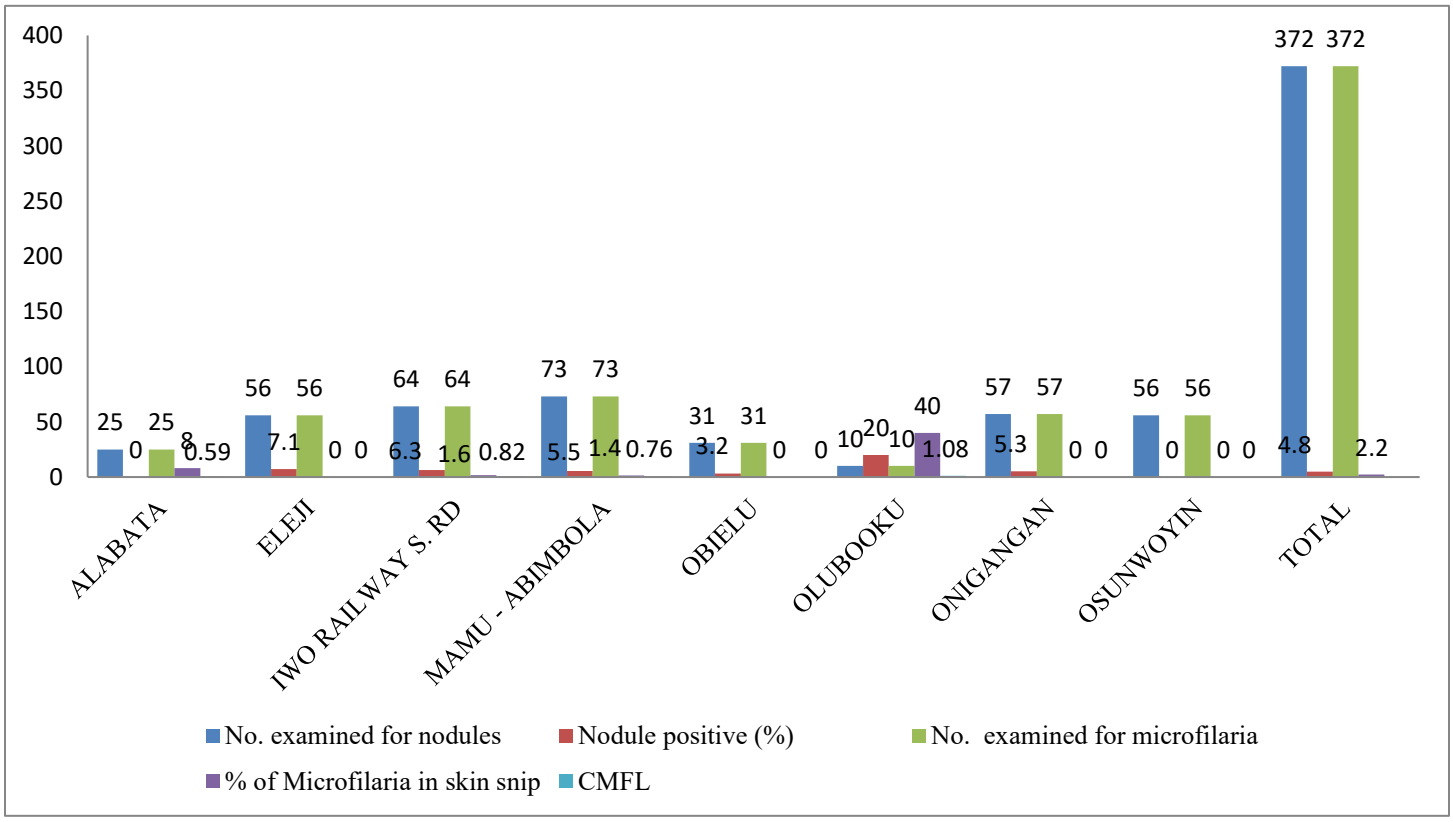

Figure 2: Prevalence of onchocerciasis across the study communities

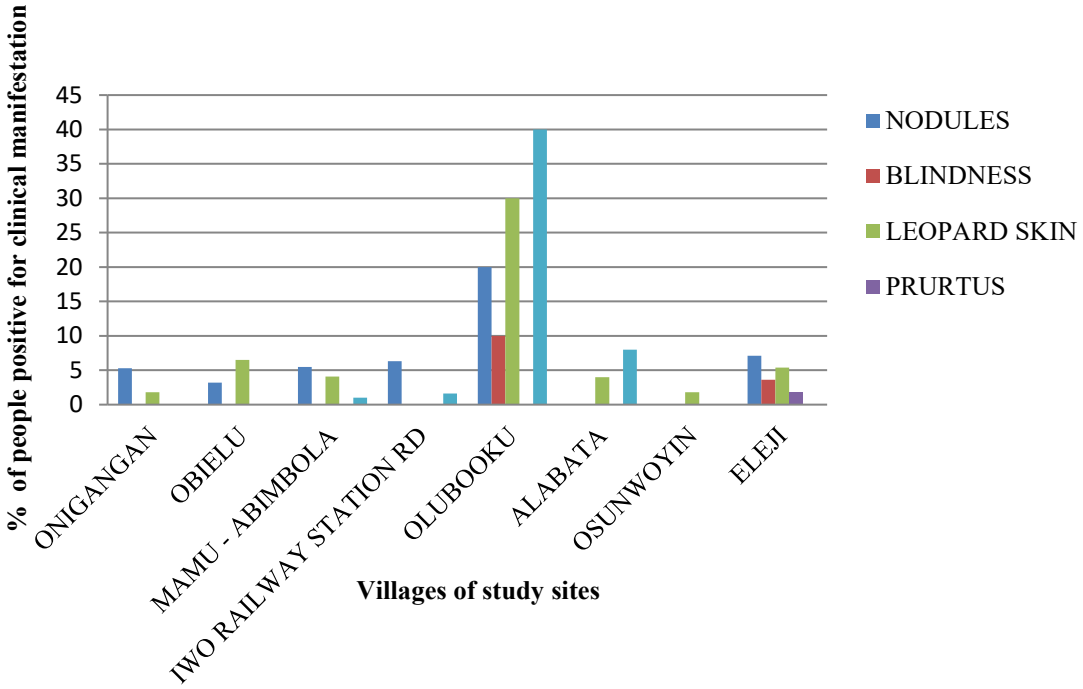

Figure 3: Prevalence of clinical manifestation of onchocerciasis in the study area

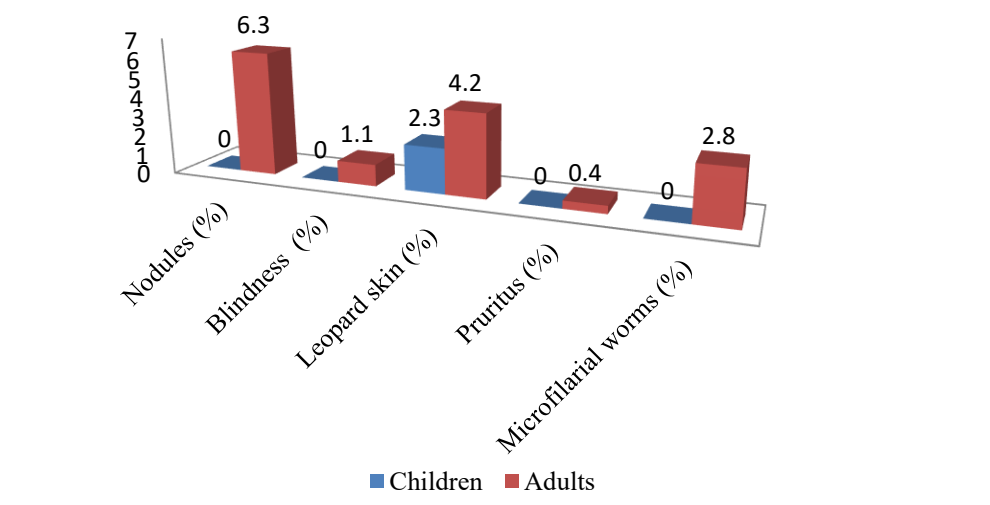

Figure 4: Clinical manifestation of onchocerciasis among adults and children in the study area

Table 2: Prevalence of onchocerciasis and its relationship with age and gender in Ayedire Local Government Area, Osun State

Parameters		ALABATA		ELEJI		IWO-RAILWAY STATION RD.		MAMU-ABIMBOLA		OBIELU		OLUBOOKU		ONIGANGAN		OSUNWOYIN		TOTAL	
		Ne	Ni	Ne	Ni	Ne	Ni	Ne	Ni	Ne	Ni	Ne	Ni	Ne	Ni	Ne	Ni	Ne	Ni
Sex	FEMALE	12	0(0)	34	0(0)	43	0(0)	47	0(0)	18	0(0)	5	2(40)	25	0(0)	27	0(0)	211	2(0.9)
	MALE	13	2(15.4)	22	0(0)	21	1(4.8)	26	1(3.8)	13	0(0)	5	2(40)	32	0(0)	29	0(0)	161	6(3.7)
Age	5 – 14	5	0(0)	13	0(0)	2	0(0)	26	0(0)	0	0(0)	0	0(0)	15	0(0)	5	0(0)	66	0(0)
	15 – 24	3	0(0)	3	0(0)	5	0(0)	7	0(0)	3	0(0)	0	0(0)	7	0(0)	2	0(0)	30	0(0)
	25 – 34	5	1(20)	16	0(0)	10	1(10)	7	1(14.3)	7	0(0)	2	1(50)	11	0(0)	6	0(0)	62	3(4.8)
	35 – 44	4	0(0)	4	0(0)	21	0(0)	9	0(0)	3	0(0)	0	0(0)	11	0(0)	12	0(0)	54	0(0)
	45 – 54	1	0(0)	6	0(0)	16	0(0)	4	0(0)	7	0(0)	2	0(0)	8	0(0)	5	0(0)	49	0(0)
	55 – 64	3	0(0)	5	0(0)	7	1(14.3)	4	0(0)	2	0(0)	2	1(50)	8	0(0)	15	0(0)	44	2(4.5)
	≥ 65	4	1(25)	9	0(0)	13	0(0)	15	0(0)	9	0(0)	4	2(50)	5	0(0)	11	0(0)	67	3(4.5)

Ne: Number examined, Ni: Number infected, Figures in parenthesis represent %
Gender : $X^2 = 3.351$, df = 1, p = 0.067
Age – group: $X^2 = 8.646$, df = 6, p=0.194

Table 3: Transmission Indices of *S. damnosum s. l* at the sampling sites

Parameters	Eleji	Mamu - Abimbola
Total flies dissected	816	435
Nunber (%) of parous flies	261(32)	176(41.4)
Number (%) of nulliparous	555(68)	259(59.6)
Months (%) with highest parous	February (40)	March (42.9)
Months (%) with lowest parous	July (8), September (8)	August (9.1)
Infected (%) flies with *O. volvulus*	0 (0)	0 (0)

Monthly parity was statistically significant ($p < 0.05$)

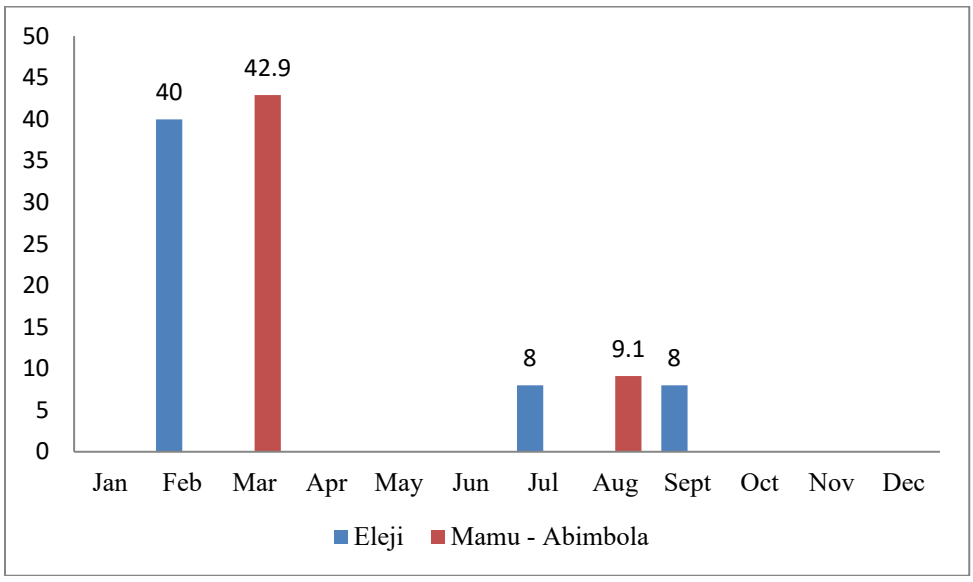

Figure 5: Percentage parity showing the transmission indices of *S. damnosum s. l.* in the study area

DISCUSSION

It was revealed in our study that the most reported clinical manifestations were nodules skin depigmentation (leopard skin) and ocular onchocerciasis (visual impairment and blindness. This result was different from the results of other studies in which dermatitis and ocular onchocerciasis, characterised by visual impairment and blindness were reported [21]. It was also observed that some community members did not possess microfilariae but had dermatitis. Adults were more infected than children by showing prevalence of clinical manifestations such as nodules, skin depigmentation (Leopard skin) and blindness.

Futhermore, the results of our showed that males were more infected than their female counterpart because of their long staying on the farm during their agricultural practices. Thus, they are more exposed to the bites of infected black flies. This result agrees with the result of the research conducted by Nyagang [10], Umoke [22] and Akinboye [18], in which males were reportedly infected than the females as a result of longer hours spent on the farm than their female counterparts. On the other hand, the result of this present study differs from the result of the study conducted by Akimbo and Okaka [17], in which females were more infected than males. Also, it was observed in Figure 6 that months of February and March recorded the highest percentages of parous flies for Eleji (40.0%) and Mamu-Abimbola (42.9%) respectively, while the least was recorded in July (8%) and September (8%) for Eleji and August (9.1%) for Mamu-Abimbola. The finding of this study was in agreement with the research carried out by Adeleke[23], which affirmed that the percentage parous rate was significantly higher during the dry season (February – March) and early April. The results of our study, also agreed with other study in which dry months consistently showed rates above 50% in

Agbokim while September recorded 44.7% parity rate [24].

CONCLUSION

The study across eight (8) villages revealed an overall infection prevalence of 4.8%, indicating that for every 100 people in the total population of 372, approximately Five (5) are infected. This study further showed that there was a heterogeneous distribution of infection because it was not evenly spread. While the site – wide average was near 5%, i. e, 4.8%, individual village varied drastically from 0% to 20%. Five villages found to cross 5% nodule prevalence threshold (5.3%, 5.5%, 6.3%, 7.1% and 20%), could be described as a high – risk areas. The village with 20% prevalence identified a critical area requiring urgent intervention. Similarly, six (6), failed 1% of 90% threshold for elimination of onchocerciasis. It can be deduced from the results derived from
this study that despite the efforts made by Government in eliminating onchocerciasis through regular annual mass drug administration for the past ten years, this Local Government Area has not reached the threshold of stopping mass drug administration of ivermectin. For elimination to be considered successful, the prevalence would need to drop significantly across almost all the study sites. Based on these results Government must not relent in her effort by making ivermectin available as annual MDA at ensuring the elimination of onchocerciasis in Ayedire Local Government Area of Osun State, Nigeria.

DECLARATIONS SECTION

1. *Ethical approval for this study was obtained from the ethical review board of Osun State Ministry of Health with reference number OSHREC/PRS/569T/233. All participants were duly informed of the objectives of the study and the protocol for sample collection. All participants signed an informed consent form.*

2. AUTHORS CONTRIBUTION

All authors contributed to the development of the final manuscript and approved its submission.

3. DISCLOSURE OF CONFLICT OF INTEREST

There was none.

4 DISCLOSURE OF FUNDING SOURCE

The study received financial support from TETfund for Postgraduate study (PhD Programme).

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