



Prevalence and Distribution of Human Onchocerciasis and Dermatological Features in Kwande Local Government Area of Benue State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author AO designed the study, wrote the protocol. Author FIA wrote the first draft of the manuscript, performed the statistical analysis. Author MOI managed the literature searches and managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

The status of human Onchocerciasis in 10 randomly selected communities in Kwande Local Government Area of Benue State, after a decade of annual mass drug administration (MDA) was investigated, and this focused on the prevalence and distribution of human onchocerciasis and dermatological features. A total of 546 subjects were sampled using cluster and simple random methods. Subjects' skin snips were tested for presence of *Onchocerca volvulus*, and skins examined for signs of onchocerciasis. Interviews were also conducted on the distribution, treatment and control of the disease in the study area. Results were subjected to chi-square analysis (χ^2) at $P < 0.05$. Findings revealed that 122 subjects (22.23%) were infected with the disease. The highest infection was recorded at Ikyogen community (52.78%) and the lowest infection was recorded in

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Koti Shangev-Ya community (9.52%) and there were no significant differences between infection rate across the 10 communities ($p>0.05$). Community Microfilariae Load (CMFL) of 14.63 and 160 nodules were recorded without significant differences ($p>0.05$). Clinical manifestation of onchocerciasis observed were atrophy of the skin 54(9.88%), leopard skin 27(4.94%), skin rashes 107(19.58%) and itching/scratching 120(21.96%) with no significant differences ($p<0.05$). Infection rate in the male subjects was higher 70 (12.81%) than female subjects 52(9.52%). Infection cuts across all age groups in the study area, subjects in the age group 50-59 (38; 48.71%) had the highest infection rate while subjects in the age group 10-19 (11; 7.91%) had the lowest infection. From the results, its evident Onchocerciasis remains a threat to inhabitants of the study area. It was therefore recommended that there should be continues research on Onchocerciasis so that its status in the study area will be on check.

Keywords: Prevalence; ivermectin; human onchocerciasis; distribution; dermatological; Kwande; Nigeria.

1. INTRODUCTION

Onchocerciasis also known as river blindness and Robles disease is a disease caused by infection with the parasitic worm *Onchocerca volvulus* [1].

The parasitic worm is spread through repeated bites of a black fly of the *Simulium* species [1], found along the river bank of fast flowing streams [2]. Once inside a person the worms develop into larvae that make their way out of the skin. Here they can infect the next black fly that bites a person [1]. Symptoms include severe itching, bumps under skin, and blindness. It is the second most common cause of blindness, after trachoma [2].

Prevention is to avoid being bitten by the flies and may include the use of insect repellent and proper clothing as well as improved practices in water management in order to reduce the presence of the flies [2]. Effort to eradicate the disease by treating the entire people twice a year is ongoing in endemic areas of the World [1]. Treatment of those infected is with the medication; ivermectin every six to twelve months [3]. The use of antibiotics to eliminate *Wolbachia* intracellular bacteria within filarial nematodes appears to weaken the worms [4]. Removal of the lumps (nodules) under the skin by surgery may also be done [3]. The first Onchocerciasis Control Program (OCP) in West Africa was launched in 1974 through the efforts of four UN sponsoring agencies, which at its peak covered 30 million people in 11 countries.

Six (6) of the eleven countries were from West Africa which included Burkina Faso, Cote' d Voire, Ghana, Mali, Niger and Togo [5]. In 1992,

the Onchocerciasis Elimination Program for the Americans, which also relies on ivermectin, was launched [6]. On July 29, 2013, the Pan American Health Organization (PAHO) announced that after 16 years' effort, Columbia had become the first country in the world to eliminate the parasitic disease [7].

The success of the OCP and the migration of *Simulium* from areas outside the OCP led to the extension of the intervention to other countries. The African Program on Onchocerciasis Control (APOC) was established in 1995 to incorporate more countries. Nigeria was incorporated in this long term control program [8].

In Benue State, APOC started with 6 Local Governments, Ushongo, Kwande, Guma, Oju, Makurdi and Katsina-Ala as surveyed by Gemade and Dipeolu in 1980 and 1983 respectively [9]. The research therefore is aimed at assessing the effectiveness of the distribution, treatment and control of onchocerciasis in areas receiving mass treatment with Ivermectin.

2. MATERIALS AND METHODS

2.1 Study Area

Kwande Local Government area in which the research was conducted derives its name from UKondugh, a Tiv word which literally translates as mountain dwellers' because of its hilly topography. The area is bordered in the west by Vandeikya Local Government area, in the south by Cross River State, in the east by Cameroun Republic and in the North and North- west by the Katsina-Ala and Ushongo Local Government Areas respectively. Kwande also shares a common boundary with Taraba State to the Northeast.

Kwande L.G.A lies between latitude 6:30⁰ N and 7:10⁰N longitude 90⁰ E to 9:40⁰ E. The area is rich agriculturally and the inhabitants are greatly involved in rice, yam, cassava and Soya beans cultivation. The rain season is from April through October and the dry season, November through March. There are characteristic waterfalls and rapids over rocks that make the area suitable for the breeding of *Simulium damnosum* [10]. These rivers and tributaries flow all year round.

Kwande Local Government area has a population of 248, 697 people from the 2006 census figures. This approximates to a population density of 2891 people per Sq. Km. Based on the above vast land, the 288 community directed distribution (CDD) centers cannot be covered. Ten villages were selected for the study, preference was given to district headquarters and villages along the river banks, River Amire (Utamen and Kiriki) and River Aya.

The areas include, Abenga, Ada, Adagi, Amahundu, Gbe, Gube, Ikyogen, Koti Shangevya, Nyihemba and Manyam.

2.2 Field Sample Size

Sample size of 546 was used for a total population of 248, 697 of Kwande L.G.A. Cluster and Simple random sampling were used to select the 10 communities along the river banks and district headquarters. Raosoft (2006) sample size formula was used [11].

2.3 Ethical Consideration

Ethical clearance was obtained from Benue State Ministry of Health and Human Service before the work began. Furthermore, the traditional rulers, chiefs, and leaders of town development unions were briefed about the project and their cooperation sought in the mobilization of their people. The purpose of the study was explained to each community head and the elders, and their consent was obtained for the mobilization of the respective communities. During the parasitological and clinical survey, health personnel (Onchocerciasis coordinators) were present to monitor safety standards.

2.4 Sample Collection Procedures

2.4.1 Assessment of skin snips for the presence of *Onchocerca volvulus*

Skin snips were aseptically taken from each subject from the right iliac crest and the two

gluteal folds (buttocks) using a holth type cornesceral punch with 1.5 mm bite. The skin snips were then placed in microtitre wells containing 0.3ml of phosphate buffer saline (PBS) and covered with cellophane to prevent evaporation and spillage during handling. A pasture pipette was used to place some of the liquid content on a microscope and observed at 10x magnification for the presence of *O. volvulus* microfilariae within 1 hour of sample collection. The microtitre plates containing skin snip were further incubated for 24 hours and re-examined for microfilariae when samples were negative. The results were compared using student t-test of significance. When samples were positive, microfilariae were seen wriggling in the saline [11].

2.5 Assessment of Skin for Signs of Onchocerciasis

A typical examination of each subject was carried out for obvious signs of Onchocerciasis such as visible nodules, hanging groins, pruritus as well as dermatitis and atrophy.

2.6 Interviews with the Study Population

Interviews were also conducted on the study population about the mode of distribution of ivermectin, when the distribution started, people's perception of the drug. Health workers of St. Monica's Hospital Adikpo; General Hospital Adikpo, Local Government Health Centres and NOCP area office in Adikpo assisted in providing information for the study.

2.7 Statistical Analysis

Data collected were analyzed using percentages, Mean and Chi-square test to determine whether there is a significant difference between the use of ivermectin for Onchocerciasis treatment, gender prevalence to compare with the rate in villages along the river banks and those further away and geometric mean was used to calculate the Community Microfilariae load (CMFL).

3. RESULTS

3.1 Prevalence of Onchocerciasis in Kwande Local Government Area

The survey was across ten communities in the Local Government area covering about 546 subjects. Of the 546 examined 122(22.32%) were positive for Onchocerciasis with Ada

community having the highest infection rate 18(33.33%), while Koti Shangev-Ya had the lowest [4(9.52%) (Table 1)]. Chi-square analysis showed no significant difference in the prevalence of communities in Kwande Local Government area at $p > 0.01$ ($\chi^2 = 2.80$, $df = 9$, $P = 0.903$).

Table 2 presents gender-specific prevalence in male and female subjects in the study area. Male subjects had a higher infection rate 70(25.74%) out of the 272 subjects than female subjects 54(19.71%) out of 274 subjects. Male subjects in Ada community had the highest infection rate 43.33% and the lowest infection rate was in Koti

Shangev-Ya 9.09%. Gube Community recorded the highest infection rate among the female subjects while Gube and Koti Shangev-Ya recorded the lowest infection rate 10.00% respectively.

Table 3 shows the Community Microfilariae load and the positive nodules in the subjects examined. A perusal results indicate that Amahundu had the highest infection of 22 subjects with community microfilariae load of 3.93 in the skin test and 75 positive nodules. The lowest was recorded in Koti Shangev-Ya with 4 subjects infected out of 42 examined (the least number of nodules in communities examined

Table 1. Prevalence of Onchocerciasis in 10 Communities in Kwande local government area, Benue State, Nigeria

| Community | Number examined | Number infected | Total % of infection |
|-----------------|-----------------|-----------------|----------------------|
| Abenga | 60 | 13 | 21.66 |
| Ada | 54 | 18 | 33.33 |
| Adagi | 48 | 07 | 14.58 |
| Amahundu | 96 | 22 | 22.91 |
| Gbe | 36 | 06 | 16.66 |
| Gube | 36 | 10 | 27.77 |
| Ikyogen | 36 | 09 | 25.00 |
| Koti Shangev-Ya | 42 | 04 | 9.52 |
| Manyam | 72 | 19 | 26.38 |
| Nyihemba | 66 | 14 | 21.21 |
| Total | 546 | 122 | 22.32 |

$\chi^2 = 2.80$ $df = 9$. $P = 0.903$

Table 2. Prevalence of Onchocerciasis in Kwande local government in relation to sex

| Community | Sex | Number examined | Number infected | % Infected | % Diff. B/w male & female infection | Total % infection |
|-----------------|--------|-----------------|-----------------|------------|-------------------------------------|-------------------|
| Abenga | Male | 28 | 09 | 32.14 | | 21.66 |
| | Female | 32 | 04 | 12.50 | 19.64 | |
| Ada | Male | 30 | 13 | 43.33 | | 33.33 |
| | Female | 24 | 05 | 20.83 | 22.50 | |
| Adagi | Male | 22 | 04 | 18.18 | | 14.58 |
| | Female | 26 | 03 | 11.53 | 6.63 | |
| Amahundu | Male | 45 | 07 | 15.55 | | 22.92 |
| | Female | 51 | 15 | 29.41 | -13.38 | |
| Gbe | Male | 16 | 04 | 25.00 | | 16.67 |
| | Female | 20 | 02 | 10.00 | 15.00 | |
| Gube | Male | 19 | 04 | 21.05 | | 27.78 |
| | Female | 17 | 06 | 35.29 | 13.24 | |
| Ikyogen | Male | 19 | 06 | 31.58 | | 52.78 |
| | Female | 17 | 03 | 17.65 | 13.90 | |
| Koti Shangev-ya | Male | 22 | 02 | 9.09 | | 9.52 |
| | Female | 20 | 02 | 10.00 | -0.91 | |
| Manyam | Male | 37 | 12 | 32.43 | | 26.39 |
| | Female | 35 | 07 | 20.00 | 12.43 | |
| Nyihemba | Male | 34 | 09 | 26.47 | | 21.21 |
| | Female | 32 | 05 | 15.62 | 10.85 | |

$\chi^2 = 1.20$ $df = 6$ $P = 0.97$

during the study period), However the least number of nodules observed was in 4 subjects in Adagi community of Kwande. The result of the Chi square analysis showed that there was no significant difference at $p>0.01$ ($\chi^2= 0.80$ $df= 9$. $P= 0.99$).

The result in Table 4 shows the manifestations of Onchocerciasis in Kwande LGA of Benue State. The results revealed that out of 546 persons that were examined across the LGA, 122 (22.32%) were infected with microfilaria and 54 (9.88%) have atrophy of the skin, 27 leopard skin, 107 with skin rashes and 120 were itching/scratching their skins as signs of manifestation of onchocerciasis during the study period. Itching/scratching was the most prevalent sign as it was observed in 120 out of the 122 subjects that were infected. The result of the chi-square analysis was not significant at $p>0.01$ ($\chi^2= 2.60$ $df= 6$. $P= 0.85$).

Table 5 presents the prevalence of onchocerciasis in Kwande Local Government Area in relation to age group. The infection cut across all age groups. Age group 50-59 years recorded the highest prevalence 38 (48.71%) and was closely followed by age group 60-69; 09 (35.50%) while the group of 10-19 years was the least infected population 11 (7.91). In most of the communities surveyed, age group ≥ 70 years recorded no infection. Result was not significant across the age group ($\chi^2= 4.40$ $df= 6$ $P= 0.22$).

The results in Fig. 1 revealed that out of the 546 persons examined, 122 were infected with Onchocerciasis and 160 nodules were recorded on the patients. Most of the subjects were reported with itching/scratching of the skin (114) and 27 subjects had leopard skin. There was no significant difference in the lesions of the Onchocerciasis among the subjects in Kwande LGA using chi-square analysis ($\chi^2= 1.60$ $df= 4$ $P= 0.45$).

Table 3. Community Microfilariae load (CMFL) and Positive Nodules in Communities of Kwande Local Government Area, Benue State, Nigeria

| Community | No. examined | No. infected | CMFL | No. of nodules (%) |
|-----------------|--------------|--------------|--------------|--------------------|
| Abenga | 60 | 13 | 1.93 | 10(16.67) |
| Ada | 54 | 18 | 0.71 | 11(20.37) |
| Adagi | 48 | 07 | 0.46 | 04(8.33) |
| Amahundu | 96 | 22 | 3.92 | 75(78.12) |
| Gbe | 36 | 06 | 0.34 | 07(19.44) |
| Gube | 36 | 10 | 0.64 | 09(25.00) |
| Ikyogen | 36 | 09 | 0.73 | 12(33.33) |
| Koti Shangev-Ya | 42 | 04 | 0.09 | 08(19.05) |
| Manyam | 72 | 19 | 3.85 | 13(18.06) |
| Nyihemba | 66 | 14 | 1.97 | 11(16.66) |
| Total | 546 | 122 | 14.63 | 160(29.30) |

$\chi^2= 0.80$ $df= 9$. $P= 0.99$

CMFL * calculated as geometric mean of mf. counts.

Table 4. Manifestation of Onchocerciasis on communities in Kwande L.G.A of Benue State Nigeria

| Community | No. Examined | No. Infected (mf.) | Atrophy of the Skin | Leopard Skin | Skin Rashes | Itching/ Scratching |
|-----------------|--------------|--------------------|---------------------|--------------|-------------|---------------------|
| Abenga | 60 | 13 | 12 | 06 | 13 | 13 |
| Ada | 54 | 18 | 05 | 06 | 18 | 18 |
| Adagi | 48 | 07 | 02 | 0 | 07 | 07 |
| Amahundu | 96 | 22 | 02 | 0 | 10 | 22 |
| Gbe | 36 | 06 | 04 | 02 | 06 | 06 |
| Gube | 36 | 10 | 03 | 01 | 09 | 09 |
| Ikyogen | 36 | 09 | 07 | 03 | 09 | 09 |
| Koti Shangev-Ya | 42 | 04 | 03 | 0 | 04 | 04 |
| Manyam | 72 | 19 | 11 | 05 | 18 | 18 |
| Nyihemba | 66 | 14 | 05 | 04 | 13 | 14 |
| Total | 546 | 122 | 54 | 27 | 107 | 120 |

$\chi^2= 2.60$ $df= 6$. $P= 0.85$

Table 5. Prevalence of Onchocerciasis in Kwande local government in relation to age group of subjects

| Age | No. examined | Communities / No. positive | | | | | | | | | | |
|--------------|--------------|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------------|-----------|-----------|-------------------|
| | | Abenga | Ada | Adagi | Amahundu | Gbe | Gube | Ikyogen | Koti Shangev-Ya | Manyam | Nyihemba | Total/% |
| 10-19 | 139 | 01 | 01 | 01 | 04 | - | - | 01 | 01 | 02 | - | 11(7.91) |
| 20-29 | 77 | - | 06 | - | 01 | - | 01 | 01 | - | - | 02 | 11(14.28) |
| 30-39 | 114 | 03 | 03 | 01 | 06 | 01 | 01 | - | 01 | 02 | 03 | 21(18.42) |
| 40-49 | 94 | 03 | 03 | 04 | 04 | - | 03 | 01 | - | 04 | 04 | 26(27.65) |
| 50-59 | 78 | 05 | 04 | - | 06 | 04 | 03 | 04 | 02 | 07 | 03 | 38(48.71) |
| 60-69 | 24 | 01 | 01 | 01 | 01 | - | 01 | 01 | - | 03 | - | 09(37.51) |
| ≥70 | 20 | - | - | - | - | 01 | 01 | 01 | - | 01 | 02 | 06(30.00) |
| Total | 546 | 13 | 18 | 07 | 22 | 06 | 10 | 09 | 04 | 19 | 14 | 122(22.32) |

$\chi^2 = 4.40$ $df = 6$ $P = 0.22$

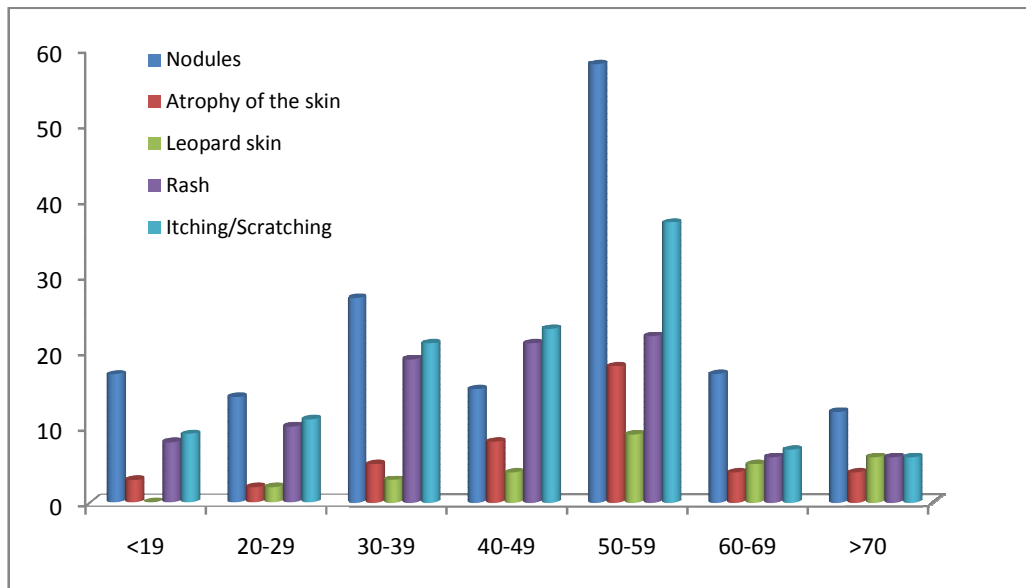


Fig. 1. Onchocercal Lesions in Kwande local government with respect to age range

4. DISCUSSION

This study revealed that onchocerciasis remains a problem in this part of the country despite the treatment with ivermectin for more than a decade. This is similar to the earlier report by WHO [1] that onchocerciasis is endemic in Kwande Local Government area. A total of 546 persons were examined in 10 communities and 122(22.32%) were infected with Onchocerciasis. It was also established from the result that Ada community had the highest infection rate followed by Gube and Koti Shangev-ya with the least infection. These are contrary to the high rate of infection reported by Gemade and Dipeolu [12] with skin snip results of 61% and 71% at Kuhe near Gbe and Gube respectively, while the present result shows only 16.66 and 27.77% infection at Kuhe and Gube respectively. There was a drastic reduction in the prevalence of onchocerciasis. However, the result agrees with findings of CDC, Brunette, Fetu, [2,4,13] who reported that Onchocerciasis was more prevalent among communities along the river banks.

Similarly, Ogbu et al. [14] reported a micro-filarial positive skin snip analysis at 83.6% (Amahundu), 63.7% (Kyogen), 32.8% (Kuhe) and 25.7% (Jato-Aka) respectively. The present results indicated a reduced onchocercal microfilarial percentage due to intake of ivermectin. The drop in percentage of 22.9% (Amahundu), 25.0% (Kyogen), and 27.8% at Gube respectively, points to the fact that the

use of ivermectin in the control of onchocerciasis was producing a positive result with an appreciative drop in the infection rate. Abendazole has also been combined with ivermectin for treatment of filariasis and onchocerciasis in Kwande local Government which is in compliance with Ogbu et al., CDC [14, 15], who gave recommendations for complete elimination of microfilarial worms. The reduction in microfilaria prevalence may be due to good treatment coverage of ivermectin in the 10 villages.

The study also established that male subjects had higher infection rate than the female subjects. The occupational status of males and females differ especially in the rural areas where women are pre-occupied with domestic scores while the men hunt, farm and fish. This exposes men to more hazards of infection because the possibility of contracting *O. volvulus* through the bite of *S. damnosum* is very high in these areas. The rate of infection in males has decreased while that of females increased as compared to Gemade, Gemade and Dipeolu [16,17]. This might be due to increasing population amongst females subjects and also they participate in serious farming activities to compliment male's effort. Also the distributions of ivermectin in the area by APOC through Community Directed Distributors (CDDs) were only to males, non-pregnant women, breast feeding mothers of more than seven (7) days after delivery, children more than 5 years old and healthy persons, (very

sick persons exempted) as recommended by WHO and CDC [18,19]. Majority of the highly affected communities are mostly found near rivers and streams. This is a significant epidemiological factor because people in the area usually farm in the riverine areas which are good breeding zones for the vectors, this agrees with the findings of WHO: Chandler and Read; Mounkaila et al. [18,20,21]. The occurrence of the fast flowing tributaries of Katsina-Ala River, River Amire-u-vesen and Amire-u-kiriki in the area seems to attest to this. These are favourable areas conducive for the development of larvae of *S. damnosum* [22,23].

Prevalence of *Onchocerca volvulus* microfilariae and positive nodules among the gender in communities of the study area indicated that out of the 546 subjects examined in ten communities of Kwande, female subjects were the highest with 274 infections out of which Gube had the highest female infections and Gube and Koti Shangev-ya had the lowest of female *Onchocerca* infections each. The male subjects examined during the study period recorded the highest infection rate in Ada and the lowest in Koti Shangev-ya village. This clearly showed that women responded to treatment more than the male subjects. Women were also more eager to be tested and examined for signs and symptoms of Onchocerciasis, agreeing with findings of Fetu [13] carried in Freetown, Sierra Leone.

However, the males subjects were the most infected with 70 individuals while only 50 female individuals infected. Among the infected females, Ada had the highest numbers of 13 and Koti Shangev-ya recorded the lowest with 2 male individuals infected. It could be attested to the fact that Ada is located at the bank of River Amire-u-kiriki which breeds *Simulium damnosum* complying with reports of WHO, Otubanjo [8,18]. Regards to infection, the male subjects recorded more microfilariae count than the females. Nevertheless, more positive nodules (95) were obtained in the female subjects as compared to males that recorded 65 positive nodules in spite of the fact that males were more infected. Reasons for this could be as a result of women activities such as farming and fishing.

In the findings of the present study, onchocerciasis prevalence is less than the 26.9% recorded by Nwaorgu et al. [24] in onchocerciasis mesoendemic area of Enugu state, and higher than 4.74% recorded by Manyi et al. [25] in Kwande L.G.A of Benue State,

Nigeria. The study finding also supported the work of other researchers in different parts of Nigeria as referenced above in *Onchocerca* gender infection but differs with the work reported in Ovia North East LGA of Edo state, Nigeria with 93% onchocerciasis prevalence in females and 74.5% in males Akinbo and Okaka, [26]. Wogu and Okaka [27] reported onchoceciarsis infection in Okpoje Owan L.G.A of Edo state with 27.5% infection in males and 20% in females and also Manyi et al. [25] reported 2.55% in males and 2.19% in females in Kwande L.G.A of Benue state Nigeria.

The result of the study showed progressive increase in infection with increase in age, also the rate of *Onchocerca* diseases manifestation follows the same trend. A similar observation was made in Ibarapa L.G.A of Oyo State, Nigeria by Akinboye et al. [28] and in Garaha, Duste community, Adamawa State by Rebecca et al. [29].

However, reduced lesions could be attributed to level of education and intake of ivermectin more than a decade WHO [30] Like elsewhere such as Colombia, Ecuador and Mexico were declared free of onchocerciasis in 2013, 2014 and 2015 respectively, WHO [30]. In Africa, 65% of onchocerciasis infection has been controlled with livermectin treatment by APOC as reported by WHO, WHO., Coffeng et al. [30,31,32]. In Nigeria, there are conflicting survey reports as cited before; however the rate of infections and transmission of Onchocerciasis has reduced particularly in Kwande LGA of Benue State.

5. CONCLUSION

The study demonstrated a relatively high prevalence of *O. volvulus* infection in Ada, Gube and Manyam village of Kwande L.G.A. It is therefore recommended that the Epidemiology unit of the Ministry of Health should create record keeping /monitoring section for Onchocerciasis Control Programme, because records are rare especially in Benue State and Kwande in particular; and also Community Directed Treatment with ivermectin (CDTi) staff should be given permanent appointment as health workers to intensify their efforts in the distribution of ivermectin and / or focal vector elimination.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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