Original Research Article

Pathological impact and Disease burden of Human Onchocerciasis in Endemic areas of Delta State, Nigeria.

ABSTRACT

Background to the Study/Aim: The context of onchocerciasis being one of the neglected tropical diseases (NTDs) in Nigeria; and the predicted increase in the rate of spread of tropical diseases and vectors to higher altitude, as a result of climate change and global warming, underscores the need for more studies on the disease. Thus, this research was conducted to examine the pathological impact and disease burden of human onchocerciasis on the infected in endemic communities in three local government areas of Delta State, Nigeria.

Materials and Methods: The study was carried out in two phases. The first phase involved four stages. Stage one was visual acuity test on those who volunteered to take part in the research. Stage two was the physical examination of individuals for characteristic onchocercal lesions. The third stage was the collection of skin snips from individuals while the fourth stage was microscopic examination of the skin snips for microfilariae of *Onchocerca volvulus*. The second phase examined the impact of the disease and was carried out with the aid of a structured questionnaire.

Results: The results showed that human onchocerciasis existed in the study area. Out of the 1,201 persons, comprising of 826 (68.8%) males and 375 (31.2%) females examined, 138 were positive for the onchocercal parasite. The infected, consisted of 101 (12.2%) males and 37 (9.9%) females. Generally, infected persons had manifestations ranging from ocular defects, visual problems to skins disfiguration.

Conclusion: In addition to the administration of ivermectin and vector control, psychosocial and economic needs of the infected should be addressed through counseling and offering of palliating assistance to reduce their economic problems and give them feeling of independence.

Keywords: Onchocerciasis, Depigmentation, Ivermectin, Hydrocoele, Microfilaria.

Introduction

Onchocerciasis is a filarial disease that occurs only in the tropical and subtropical regions. It is an insidious nonfatal parasitic disease caused by *Onchocerca volvulus* and the world's second leading infectious cause of blindness (Oyene*et al,* 2003). Though, the disease is known to be widespread in the country, the distribution and complications are inadequately documented especially in the rain forest zone (Nwoke *et al.,* 1994; Nmorsi *et al.,* 1996). Since the commencement of the Africa Programme for Onchocerciasis Control (APOC), free doses of the drug known as ivermectin has been distributed annually too many communities in Delta State through the Community Directed Treatment with Ivermectin (CDTI). Some individuals in the study area recalled the sporadic distribution of this drug of choice. However, the targeted end of intervention by APOC was in 2015 (Mbanefo *et al.*, 2010). Adeleke *et al.* (2011) observed that the intense biting of the black flies without protection raises the possibility of recrudesce, even in areas where ivermectin distribution had been successful, since the drug

does not kill the adult.

In the Nigeria master plan for Neglected Tropical Diseases (NTDs) 2013 – 2017 (2012), climate change, global warming and the resulting increase in global temperatures were reported to be encouraging tropical diseases and vectors to spread to higher altitudes in mountainous regions, and to higher latitudes that were previously spared. This therefore calls for more investigation regarding the pathology and socio-economic impact of onchocerciasis in the state.

MATERIALS AND METHODS

Study Area.

The study area comprise of three contiguous local government areas namely, Aniocha North, Aniocha South and Oshimili North, Delta State, south south geopolitical zone, Nigeria. It lies roughly between longitude 6^0 10^1 and 6^0 45^1 East and Latitude 6^0 5^1 and 6^0 30^1 North. It is bounded by Edo State to the North, Ika North east and Ika South Local Government Areas to the West, Oshimili South Local Government Area and the River Niger, to the East, Oshimili South Local Government Area to the South East and Ukwuani Local Government Area to the South west.

Ethical Consideration

Ethical permit for the study was first obtained from the department of Animal and Environmental Biology, Delta state University, Abraka, on the 6th of September, 2010. Asimilar permit was also obtained from Delta State Ministry of Health, Asaba, on the 18th January, 2011. The purpose of the research was explained to individuals that volunteered to participate in the study.

Epidemiological Investigation on Human Onchocerciasis

Epidemiological studies on human onchocerciasis involved four stages. The first three stages were done in the field while the last was carried out in the laboratory. The socio-economic aspect was done in the field by observation and the use of a questionnaire titled ‘Epidemiology Field Form’ which was later evaluated.

Personal Data

On the scheduled days, volunteers who arrived at the appointed places for examination were registered with the aid of the epidemiology field form.

Two field workers were recruited specifically as field assistants in each Local Government Area to in entering personal information about the individuals on the Epidemiology Field Form, showing sex, age, occupation, community/village, and questions relating to their perception of black flies and cnchocerciasis.

Physical Examination

This aspect of the work was done in two parts namely:

i. Measurement of visual acuity
ii. Other clinical manifestations.

i. Measurement of Visual acuity

This was done outdoors with enough light. As no complete ophthalmologic examination was carried out, visual acuity was measured on subjects aged 5 years and above using the procedure described by Emina and Okaka (2004). The volunteers were given serial numbers. The visual acuity was taken at six meters distance with a standard "E" charts (Nwoke, 1990). They were asked to tell where the "Es" were facing while seating. The left eye was first covered and the right eye was used to read and vice versa. The daylight offered standard illumination for this test which was conducted under roofed shade.
The visual acuities were recorded as follows:

i. Total blindness, that is, without perception of light.
ii. Low vision, that is, less vision in the better eye with correction.
iii. Reduced vision, that is, less vision in the better eye without correction.
iv. Standard vision, that is, clear vision in both eyes.
v. Partially sighted, that is, less correction on the better eye.

Cases of visible or obvious ocular defects were noted. The result of the visual acuity was recorded in the Epidemiology Field Form.

ii. Other Clinical Manifestations

After an individual had been examined for visual acuity outdoors, physical examination for clinical manifestations of human onchocerciasis followed. This was carried out inside a room with enough light. Males and females were examined in separate rooms or at different times. Each respondent was stripped to a maximum extent that decency permits for physical examination. The whole body was examined and palpated in search of characteristic onchocercal lesions. Subcutaneous nodules were palpated and particular attention was given to the subcutaneous tissues and lymphatic systems. Each subject was also asked to indicate the position of nodules. Skin conditions were examined for the presence of characteristic manifestations of onchocerciasis such as nodules, pruritis, depigmentation or leopard skin and lizard skin. Also, presence of hydrocoele, scrotal elephantiasis, elephantiasis of the limbs, hanging groin and other complications of onchocerciasis were recorded on the form. Subjects were interviewed to ascertain whether they had ever taken any anti-onchocercal drugs before or used any form of local herbs or concoction for treatment of onchocerciasis.

Parasitological Analysis

Microfilariae detection in the study population was carried out by the following methods:

Skin Snip Biopsy

The area to be skin snipped was first, carefully swabbed with methylated spirit (Botto *et al*, 1999) and two bloodless skin-snips were taken from each subject from the left iliac crest and shoulder with the aid of a corneo-sclera biopsy punch (2mm or 4mm bite), manufactured by surgitrac co. Ltd, 1902, Global trade center, 15, Wingkin Road, Kwai Chung, Hong Kong. This is because the iliac crest is recognized as having the greatest diagnostic potential for *0. volvulus* in Nigeria (Ufomadu *et al*, 1988).

The skin snips were separately placed in polystyrene microtitration plates with U-shaped wells (96 wells each) containing 3 drops of 0.95% physiological saline solution. The corneo-sclera punch was cleaned with cotton wool soaked with methylated spirit and allowed to dry before and after use to avoid transmission of other skin or blood infections. When filled, the wells were covered with cello tape to prevent evaporation and spilling of the contents in transit (Ufomadu *et al*, 1988).

Microscopic Examination

Skin snips collected in the field were incubated at room temperature before microscopic examination within 24 hours (Rahmah *et al*, 2001). 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 (Onwuliri*et al*, 1991). 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*. They were identified characteristically freeing themselves from the edge of the smear. Subjects were considered to be infected if more than 1 microfilariae 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 (Brown and Shannon, 1989).

Assessment of Impact of Human Onchocerciasis on the Infected

A questionnaire was developed to obtain information on demographic characteristics, disabilities, activities of daily living and impact of onchcerciasis on occupation. It also elicited information on the impact of the disease on social life, religious and leisure activities as well as interaction with family members, friends, work mates and the community. Feelings regarding illness and marital problems were also considered (Person *et al.*, 2006). The questionnaire was modified from previously validated survey instruments and pre-tested. The researcher and his team administered the questionnaire. Face validity of this instrument was assessed by an independent group to ascertain that the questionnaire detected psychological and socio-economic impact of onchocerciasis on the people.

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. Graphs and tables were applied to present different aspects of the results where necessary

RESULTS

Prevalence of Human Onchocerciasis in the study area

A total of forty one communities situated in three different but contiguous Local Government Areas of Delta State were studied for human onchocerciasis. Human onchocerciasis was reported in thirty one of these communities. The general prevalence of the disease in the three Local Government Areas of Delta State, Nigeria, is presented in Table 1. Out 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 infection rate was recorded in Aniocha North (12.5%), followed by Oshimili South (11.5%) and lastly Aniocha South (10.7%). Chi-square analysis indicates that the pattern of distribution of the disease was not significantly different ($p>0.05$) in the three Local Government Areas.

Table 2 showed the prevalence of human onchocerciasis in the eleven communities of Aniocha North Local Government Area. 344 persons were examined for the onchocercal parasites, of which 43 or 12.5% were positive. Eight communities in the samples were positive for the presence of onchecercal parasite, with Philip's camp (21.9%), Ugbodu (20.6%) and Ugboba (20%) recording among the highest while Idumugo, Obamkpa and Ukwu-Nzu had no infection. Infection rate was significantly different ($P<O.05$) among the sampled communities in Aniocha North Local Government Area.

Table 1: General Pattern of Distribution of Human Onchocerciasis in the Study area

LGA	No. of Communities Sampled	No. of Individuals Examined In each L.G.A	No. Infected with Onchocercal parasite	%(Prevalence) of Onchocercal parasite
Aniocha North	11	344	43	12.5
Aniocha South	15	432	46	10.6
Oshimili North	15	425	49	11.5
Total	41	1201	138	11.5

Table 2: Distribution of Human Onchocerciasis in Eleven Communities of Aniocha North L.G.A, Delta State

Communities	**Total No. examined**	**No. +v for mf**	**% Infection**
Aniofu	**28**	**2**	**7.1**
Idumuje – Ugboko	**33**	**5**	**15.2**
Idumugo	**31**	**0**	**0**
Issele – Azagba	**38**	**7**	**18.4**
Obamkpa	**32**	**0**	**0**
Okofia Camp	**31**	**5**	**16.1**
Philip's Camp	**32**	**7**	**21.9**
Uburubu	**28**	**4**	**14.3**
Ugboba	**30**	**6**	**20.0**
Ugbodu	**34**	**7**	**20.6**
Ukwu – Nzu	**27**	**0**	**0**
Total	**344**	**43**	**12.5**

Table 3 shows the prevalence of human onchocerciasis in fifteen communities of Aniocha South Local Government Area. A total of 432 persons were examined in the communities surveyed; with 46 (10.7%) being infected. The highest prevalence of 20.7% was observed at Ewulu followed by Umute with 20% while Olodu had as low as 4% but Azagba-Ogwashi, Ashama and Egbudu-Aka had the least prevalence of 0%. Chi-square calculated indicates that the pattern of distribution of human onchocerciasis differ significantly ($P<0.05$) between the communities of Aniocha South Local Government Areas.

Result of the survey in the fifteen sampled communities of Oshimili North Local Government Area is shown in Table 4. Out of the 425 people examined, 49 (11.5%) were infected. The highest prevalence rate was recorded at Aganike camp (23.3%), followed by Asoko (20%). The lowest prevalence rate of 12% and 12.9% were recorded at Iilah and Animwalo respectively while Azagba-Ogwashi, Ashama and Egbudu-Akah recorded zero. There was significant difference ($P<0.05$) in the pattern of distribution of human onchocerciasis between the communities of this local government area.

Table 3: Distribution of Human Onchocerciasis in Sixteen Communities of Aniocha South LGA, Delta State

Communities	Total No Examined	No +ve for mf	% Infection
Abugba	26	5	15.2
Azagba - Ogwashi	28	0	0
Adonta	25	3	12
Ashama	32	0	0
Egbudu - Akah	29	0	0
Ejeme - Aniogor	28	3	10.7
Ejeme – Unor	30	5	16.7
Ewulu	29	6	20.7
Isheagu	27	5	18.5
Nsukwa	33	3	9.1
Ogbu	30	4	13.3
Olodu	25	1	4
Otulu	29	3	10.4
Uku – Oba	31	2	6.5
Umute I	30	6	20
Umute II	30	3	10
Total	432	46	10.7

Table 4: Distribution of Human Onchocerciasis in fifteen Communities of Oshimili North LGA Delta State

Communities	Total No Examined	No +ve for mf	% Infection
Achala-Ibusa	28	4	14.3
Aganike Camp	30	7	23.3
Akwukwu – Igbo	26	0	0
Animwalo	31	4	12.9
Asoko	30	6	20
Atuma	30	4	13.3
Ebu	29	5	17.2
Ibusa	28	0	0
Illah	25	3	12
Ngegwu	30	4	13.3
Okpanam	26	0	0
Ubgolu	28	4	14.3
Ugwu – Ozala	28	4	
Ukala – Okpunor	29	0	
Ukala – Ukute	27	4	
Total	425	49	11.5

Gender-related Prevalence of Human Onchocerciasis in the Study area

Table 5 shows the general gender-related prevalence of human onchocerciasis in the study area of Delta State. A total of 1,201 persons were examined during the survey, out of which 826 (68.8%) were males and 375 (31.2%) were females. 101 (12.2%) and 37 (9.9%) of the males and females were infected respectively. Chi-square calculated indicates that there was no significant difference (P>0.05) in the gender-related prevalence of the disease in the studied area.

In Aniocha North Local Government Area, 201 males were examined, out of which 29 (14.4%) were infected while out of the 143 females examined 14 (9.8%) were infected. Gender-related infection rate recorded in Aniocha South Local Government Area showed that of the 296 males examined, 35 (11.8%) were infected while 11 (8.1%) females were infected out of the 136 of them that were examined. In Oshimili North Local Government Area, 329 males were examined of which 37 (11.3%) were infected while of the 96 females examined, 12 or 12.5% of them were infected. Analysis of the result using chi-square shows that there was no significant difference (P>0.05) between the three local government areas with respect to the gender-related prevalence of human onchocerciasis.

Table 5: General Gender-related Prevalence of Human Onchocerciasis in the study area

LGA	**Gender**	**Number examined**	**Number infected**	**% Infection**
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	22.2
	F	375	37	9.9

Skin manifestations in Humans infected with *Onchocerca volvulus* in relation to Gender and Age.

Data on skin manifestations in individuals that tested positive for microfilariae of *Onchocerca volvulus* in the different gender and age groups are presented.

Cases of depigmentation or 'leopard skin' also referred to as 'aging scars' in some communities within the study area, are presented in Figure 1. This condition was not recorded in individuals of age 0 - 29 years. Only 1.8% infected males aged 30 – 39years, 25.8% (40 – 49 years), 27.8% (50 – 59 years) 13.2% (60 – 69 years) and 4.4% (70 years and above) had depigmentation. Among the infected females. 5.8% (40 – 49 years), 25.8% (50 – 59 years), 20% (60 – 69 years) and 11.5% (70 years and above) had depigmentation. Thus, there was a sharp rise in the percentage of the infected of both sexes suffering from depigmentation until a peak of 27.6% (males) and 25.8% (females) at age group 50-59 years. There was then an equally sharp drop in the number afterwards.

Eczematous skin, also featured among the infected in 1.5% males, 1% females of 10 – 19 years; 1.5% males of 20 – 29 years; 4.2% males, 1.9% females (40 – 49 years); 3.2% males, 6.5% females of 50 -59 years; 5.3% males, 8% females of 60 – 69 years and 2.2% males, 3.9% females (70 years and above). It was found in all the age groups and sexes (Figure 2).

Nodules or small swellings, was observed in 4.1% males (40 – 49 years); 2% males, 3.2% females (50 – 59 years) and 1% females (60 – 69 years). This condition was not observed from 0 - 30 years in both sexes (Figure 3).

Skin rash was observed in infected population accounted for 3% males, 1.8% females (of 10 - 19 years); 3.2% males, 7% females (20 – 29 years); 1.8% males, 2.1% females of 30 – 39 years); 2.1% males and 1.8% females of 40 – 49 years; 3.1% males and 6.5% females of 50 – 59 years and 1.3% males and 1% females of 60 – 69 years.. The peaks were 2.1% at 40-49 years for males, and females 6.5% at 50-59.

Severe itching among infected individuals was observed in 3.8% males, 3.2% females of 10 - 19 years; 3.2% males, 4.7% females of 20 – 29 years; 0.9% males, 2.1% females (30 – 39 years) 2.1% males, 1.8% females of 40 -49 years and 2% males of 50 – 59 years. The peak of 3.8% for males was at 10-19 years and that of the females 4.7% at 20 - 29 years. Scrotal swelling was confined to the males, featuring at the advance age of 60 years and above. The peak of 2.2% is at 70 years and above.

Visual acuity of Humans infected with *Onchocerca volvulus* in relation to Gender and Age

Figures 4 to 5 represent the data on visual acuity of individuals that tested positive for microfilariae of *Onchocerca volvulus* in the population sampled. Different types of ocular defects were observed in

individuals of 30 years and above, but were not found between ages 0 - 29. Between 30 and 39 years, males accounted for 1.8% and females 2.1%; between 50 and 59 years, 2% males and 3.2% females; between 60 and 69 years, 6.3% males and 12% females while 70 years and above accounted for 4.4% of males and 7.7% of infected females. The peaks were 5.3% and 7.7% at 60-69 and 70 years and above in males and females respectively.

Low vision was recorded in 2.1% males and 0.9% females of 30 – 39 tears; 3.2% males and 3.9% females of 40 – 49 years; 21.4% males and 9.7% females of 50 – 59 years; 9.2% males and 8% females of 60 – 69 years and 2.2% males and 3.9% females of 70 years and above. Its peaks of 22.14% (males) and 9.7% (females) were both at 50-59 years. No individuals from 0-29 years had low vision (Figure 5).

Similarly, reduced vision occurred in 2.1% males (30 – 39 years); 9.7% males, 2% females (40 -49 years); 21.4% males and 9.7% females of 50 – 59 years; 9.2% males and 8% females of 60 – 69 years and 2.2% males and 3.9% females of 70 years and above. B% males and females with peaks at 21.4% and 9.7% respectively were of 50 – 59 years.

Partial blindness featured in 3.2% females of 50 - 59 years; 2.6% and 2.2% males of 60 – 69 and 70 years and above respectively. Thus, occurring more in the males than females, 4% females of 60 – 69 years; 2.2% males and 7.7% females of 70 years and above were totally blindness. The peaks for both males (2.2%) and females (7.7%), occurred at 70 years and above (Figure 5).

Standard visual acuity was detected in 5.3% males and 3.2% females of 10 – 19 years; 6.5% males and 11.6% females (20 – 29 years); 5.3% males and 2.1% females (39 – 39 years); 3.2% and 2% males of 40 – 49 and 50 – 59 tears respectively. The peaks of 6.5% (males) and 11.6% (females) are located at age 20 - 29 years.

Other Symptomic manifestations in Human infected with *Onchacerca volvulus* according to Gender and Age

Persistent body pains occurred in 1.8% males, 2.3% females of 20 – 29 years; 5.3% males and 6.4% females of 30 – 39 years and 15.8% males, 13.5% females (40 – 49 tears). It was also observed in 31.8% males, 32.3% females (50 - 59 years); 14.5% males, 20% females (60 – 69 years) and 4.4% males 11.5% females of 70 years and above. A peak of 31.8% and 32.3% were respectively obtained at age group 50-59 years for both males and females.

Data on infected persons with frequent fever is presented. It accounted for 2.3% males, 1.8% females (10 – 19 years); 1.2% males, 4.7% females (20 – 29 years); 4.1% males and 4.3% females (30 – 39 years). It also occurred in 12.1% males and 5.8% females (40 – 49 years); 15.1% males, 19.4% females (50 – 59 years); 5.3% males, 8% females (60 – 69 years) and 2.2% males and 2.7% females (70 years and above). The males recorded a peak of 15.1% at 50-59 years while the females recorded 19.4% also at 50 - 59 years

Presentation of data on infected persons with malaise. This include 3.3% males, 1.8% females (10 – 19 years); 2.2% males and 4.7% females (20 – 29 years); 6.1% males and 6.5% females (30 – 39 years); 17.9% males and 11.5% females of 40 – 49 years. 28.5% males and 32.3% females (50 – 59years),

14.5% males, 20% females (60 – 69 years) and 4.4%, 11.5% females of 70 years and above also complained of general malaise. The peaks for malaise were 28.8% and 32.3% at 50-59 years for males and females respectively. Data on stomach pain shows that 1.8% males and 7% females (20 – 29 years); 3.5% males, 8.5% females (30 – 39 years); 7.4% males, 9.8% females (40 – 49 years). 12.2% males, 22.6% females (50 – 59 years); 9.2% males,12% females (60 – 69 years) and 2.2% males and 11.5% females, 70 years and above also had stomach pain. The peaks were 12.2% for males and 22.6% for females, both at 50-59 years.

Presentation of the data on infected persons that had waist pain. No person from 0-29 years had waist pain. It rather occurred in 0.9% males, 2.1% females (30 – 39 years); 17.9% males, 5.8% females (40 – 49 years); 20.4% males, 32.3% females (50 – 59 years as well as 13.2% males,20% females (60 – 69 years); and 4.4% males and 11.5 % females, 70 years and above. However, a peak of 20.4% for males and 32.3% for females was recorded at 50-59 years respectively.

Fig. 1: Leopard skin in the legs of infected Man

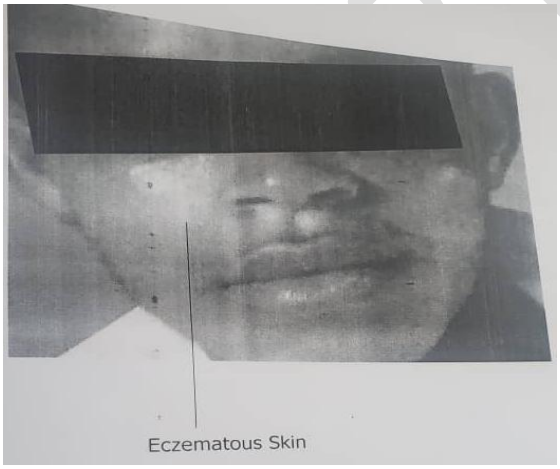

Fig. 2: Eczematous skin in the face of an infected Man

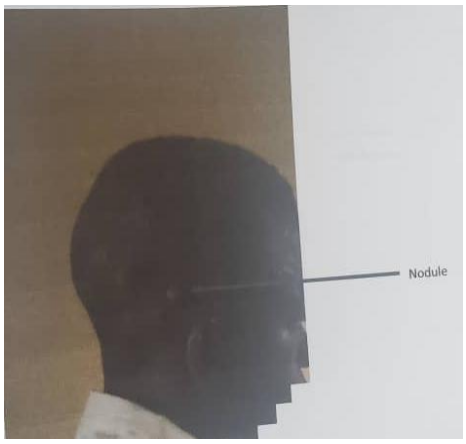

Fig. 3: A nodule and skin rashes on the head of an infected Man

Fig. 4: Microfilariae of Onchocerca volvolus that emerged from the skin snip of an infected individual

Fig. 5: Ocular defect in an infected Lady

Discussion

Prevalence of Human Onchocerciasis in the study areas

This study reveals that human onchocerciasis caused by *Onchocerca volvulus* infection existed in the study area, which comprised of three contiguous local government areas of Aniocha North, Aniocha South and Oshimili North in Delta State, Nigeria. Onchocerciasis has been reported to be widespread in Nigeria. All the states of the Federation are endemic for the disease, except Lagos State (Sam–Wobo *et al*, 2012). Other reported cases of the disease in Delta State include Nmorsi *et al.* (2002) and Emina and Okaka (2004).

The overall prevalence of human onchocerciasis in the study area was 11.5%. The pattern of distribution was not significantly different ($p>0.05$) in the three local government areas. Based on accepted epidemiological classifications of levels of outbreak as sporadic, hypoendemic, mesoendemic or hyperendemic, in relation to standardized microfilarial prevalence of less than 10%, 10% - 29%, 30% - 59%, 60% and above respectively (by Onchocerciasis Control Programme (OPC)); as adopted by Akinbo and Okaka (2010) in Ovia Local Government Area of Edo State, Nigeria, the area under study is hypoendemic. *Onchocerca volvulus* microfiliarial rate in the present study is lower than what was obtained in a rural farm settlement in Aniocha North Local Government Area in Delta state with a prevalence of 41.1% (Nmors *et al*, 2002) and a rural community of Okuetolo in Delta State, where infection rate was as high as 91.9% (Emina and Okaka, 2004).

Onchocerciasis is a focal disease that depends on the presence of a specific ecology, including among others, fast-flowing waters and the characteristics of the vectors involved in the transmission (De sole *et al.*, 1991; Nmorsi, 1996). Thus, the infection rate observed in the study area in Delta state is due to the presence of vector black fly and the fact that most endemic communities are located close to relatively fast flowing rivers (0.51 – 0.95m/s) such as Rivers Ohe, Namormai and Otor, as well as other tributaries which favour the breeding of *Simulium* vectors. In addition to this, is the presence of bushes made up of trees, herbs and shrubs near many homes, whose twigs and canopies provide desirable resting shades for the vector flies.

In Aniocha North Local Government Area, the general prevalence of human onchocerciasis was 12.5% (hypoendemic). The disease occurred in eight of the eleven communities that were sampled. Infection rates in Philip's camp, Ugbodu, Ugboba, Issele-Azagba, Okofia camp, Idumuje-Ugboko and Uburubu were hypoendemic (21.9%, 20.6%, 20%, 18.4%, 16.1%, 15.1% and 14.3%) respectively, while it was sporadic in the remaining communities.

In Aniocha South Local Government Area, the general prevalence of the disease was 10.7% (hypoendemic). It occurred in 12 of the 15 sampled communities. Infection rates in Ewulu, Umute, Isheagu, Ejeme-Unor, Abugba, Ogbu, Adonta, Ejeme-Aniogor and Otulu were hypoendemic (20.7%, 20% 18.5% 16.7% 15.2%, 13.3%, 12%, 10.7% and 10.4%) respectively, while it was sporadic in the remaining communities.

In Oshimili North Local Government Area, the general prevalence of human onchocerciasis was 11.5% (hypoendemic). The disease occurred in eleven of the fifteen communities that were sampled. Infection rates in Aganike camp, Asoko, Ebu, Ukala-Ukute, Achala-Ibusa, Ugbolu, Ugwu-Ozala, Ngegwu and

Illah were hypooendemic (23.3%, 20%, 17.2%, 14.8%, 14.3%, 14.3%, 14.3%, 13.3%, and 12%) respectively, while it was sporadic in the remaining communities.

Gender-related Prevalence of Human Onchocerciasis in the study area

More of males volunteered to participate in this study than females. Males accounted for 68.8% while females 31.2% of the total population examined. Hence, it could be noted that the females were not fully disposed as the males to participate in this survey. 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 (2003) 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* (2010) where infection rate between males (38.9%) and females (26.7%) were not significantly different ($P>0.05$) among farmers in Ebonyi state. The finding of this study corroborate well with that of other researchers in other parts of Nigeria as referenced above in onchocercal gender-related infection, but at variance with the work recorded in Ovia North East Local Government Area of Edo State, Nigeria with 93% prevalence of onchocerciasis in females and 74.5% in males (Akinbo and Okaka, 2010).

Gender-related prevalence of the disease in Aniocha North Local Government Area showed similar result with that of the overall in the study area. Prevalence in males (14.4%) was higher than females (9.9%). In the communities of Aniocha North, prevalence in males was higher in Aniofu, Issele – Azagba, Okofia Camp, Philip's camp and Ugbodu. Females recorded higher prevalence in Idumuje-Ugboko, Obomkpa and Uburubu.

The general result of the gender-related prevalence of human onchocerciasis in Aniocha South Local Government Area is also similar to that of the overall in the study area and Aniocha North Local Government Area. Prevalence of the disease was higher in males (11.8%) than the females (8.1%). In the communities of Aniocha South, males also recorded higher prevalence in Abugba, Ejeme-Aniogor, Isheagu, Ogbu, Olodu, Ukwu-Oba and Umute; while females recorded higher prevalence in Adonta, Ejeme-Unor, EwuluOtulu and Nsukwa. The gender-related prevalence of onchocerciasis in Oshimili North Local Government Area differed from the overall and that of the other two local government areas under study. The females rather had a higher prevalence (12.5%) than the males (11.3%). In a similar survey, Biu and Bitrus (2009), also obtained a higher prevalence in females (92.9%) than males (85.8%) in 2002 in Borno State, Nigeria, when they reviewed clinical records of onchocerciasis between 2000 and 2006 in the state. Their results indicated that of the 1191 patients reviewed in the survey prevalence was generally higher in females 50.9% than males (49.1%). In the current survey, prevalence in females was higher in Aganike camp, Atuma, Illah, Ngegwu, Ugwu-Ozalla and Ukala-Ukute. Males recorded higher prevalence in only Achala-Ibusa and Ebu.

High infection rates of human onchocerciasis among communities near major breeding sites of blackflies have been recognized as feature of onchocercal nematodes. Some factors which have been identified to be responsible for high prevalence are transmission potential of vector flies and increased frequency of exposure of inhabitants to infective vector flies especially during outdoor activities such as fishing, farming or hunting (Rasheed, 2008, Adeleke *et al*, 2011 and Sam-Wobo *et al*, 2012). Idling / playing or waiting outdoors also predisposes individuals to bites of vector flies. Generally, in this study it was observed that frequent contact with infective flies also occurred when launderings, washing (of bikes or other vehicles) and bathing are done in water pools outdoors.

Manifestations of Human Onchocerciasis in the Infected in relation to Gender and Age

Generally, persons infected with *O. volvulus* in the study area showed certain manifestations which may be considered to be the signs and symptoms of onchocerciiasis. These signs and symptoms ranged from ocular defects through skin manifestations to many other abnormalities. Okoye and Onwuliri (2007) identified onchodermatitis as the usual first visible symptom of onchocerciasis. This they noted begins with intense itching, elephantous skin, ocular changes and depigmentation. According to them antigens released by micrifilariae and adult worms mediates and progress to a manifestation of irritating papular rashes known as craw craw in parts of Africa. Taylor *et al* (2005) listed some late changes in onchocerciasis to include odema, hanging groin and nodules.

Skin manifestations in persons infected with the onchocercal parasites in the study area were quite profound. Okoye and Onwuliri (2007) explained that the rate of onchocercal skin disease increased with age for both sexes. 58 (6.8%) of infected males and 19 (5.1%) of females had depigmentation (leopard skin) also known as 'aging scars' in some of the communities; which appeared at the anterior lower leg. Nwoke *et al* (1994) and Okoye and Onwuliri (2007) noted that depigmentation was an advanced stage of onchocercal infection and was characterized by loss of skin elasticity and skin atrophy. Wagbatsoma and Aisien (2003) pointed out that depigmentation was a characteristic feature in elderly subjects infected with onchocerciasis and it was often at the pretibial region of their lower limb. Other skin manifestations encountered in this survey were eczematious skin, nodules, skin rashes and scrotal swelling. Eczematious skin in infected was characterized by itchy red skin. Nodules (small swellings) likely due to aggregation of cells, though not common, was observed in some of the infected. These conditions have previously been documented as features of the disease by other workers like Okoye and Onwuliri (2007) and Emina and Okaka (2004).

Dying microfilariae have been reported to release *Wolbachia*s' surface protein that triggers innate immune responses and produce the inflammation and its associated morbidity.*Wolbachia* species have been found to be endosymbionts of *O. volvulus* adults and microfilariae, and are thought to be the driving force behind most of *O. volvulus* morbidity. Taylor *et al* (2005) observed that dying microfilariae have been discovered to release *Wolbachia*-derived antigens that trigger innate immune responses and produce inflammation and its associated morbidity. The severity of illness is directly proportional to the number of infected microfilariae and the power of the resultant inflammatory response (Okoye and Onwuliri, 2007). Similarly, onchocerciasis has long been known to be

characterized by visual acuity problems, blindness being the cause of morbidity of the disease and source of immense burden to sufferers (Nmorsi, 1996). To further buttress this, Hopkins *et al* (2005) explained that infection with vector borne filarial parasite *Onchoerca volvulus,* causes eye lesions, often progressing to blindness, and imposing immense burden on affected populations.

In this study visual acuity problems were age-related to a large extent. Onchocercal ocular morbidity increased with age in relation to microfilarial prevalence and intensity of infection. Total blindness had similar trend with the partial blindness, because it featured more among the aged. However, more females were found to be totally blind than males. Standard visual acuity was higher in the younger age groups, and was absent in the older ages of 60 years and above. Low vision occurred in 33 (4%) males and 9 (2.4%) females. Partial blindness in 3 (0.8%) males and 1 (0.3%) females. 1 or 0.3% males and 3 or 0.8% females were totally blind.

Ocular involvement is as a result of migration of microfilariae to the surface of the cornea as infection build up (Nmorsi, 1996). However, as no detailed ophthalmologic examination using pen touch, slit lamp and ophthalmoscope was carried out, the researcher could not ascertain the exact ocular defects presented by the infected. However, some of the visble ocular conditions resembled cataract, pterigium, red eyes and uveitis that have been reported by other workers (Emina and Okaka, 2004). Other complaints of the infected in the course of the study were body pains, fever, headache and general malaise. Many individuals that were infected by *Onchocerca volvulus* complained of body pains, fever and malaise. These were observed in all the infected age groups. Although, elephantious skin, hanging groin, breast swelling and chyluria had been reported in literature as signs of the disease (Emina and Okaka, 2004) they were not encountered in this study.

Conclusion

The study of the pathological impact and disease burden of persons infected with human onchocerciasis in the study area suggest that much more need to be done to ameliorate the plight of the infected. It is therefore recommended that comprehensive epidemiological surveys of onchocerciasis in remote areas be carried out a\\d all the affected population treated with ivermectin. This will prevent possible re-infection of already treated nearby communities. The Community Delivery Treatment with Ivermecti (CDTI) programme of APOC to inhabitants of the area should still is sustained and compliance with drug usage be properly monitored.

It is necessary to adopt a holistic medical approach that will beside the above stated measures, offer palliating assistance to the infected. This will minimize the psychosocial and economic impacts of onchocerciasis on the infected. Psychosocial needs may be addressed through counseling, but economic needs require that patients who are physically challenged, be rehabilitated and offered mild or sedentary jobs; so as to minimize their economic problems and give them feeling of independence.

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