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ASSESSMENT OF ONCHOCERCIASIS AND COMMUNITY TREATMENT-SEEKING BEHAVIOUR AFTER TWO DECADES OF IVERMECTIN ADMINISTRATION IN USHONGO LOCAL GOVERNMENT AREA

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ABSTRACT

Computer simulations have suggested that repeated Ivermectin treatment could suppress and subsequently interrupt transmission and has since been the main operational drug for the treatment and control of Onchocerciasis. In this study, the impact of Ivermectin on the prevalence of Clinical Onchocerciasis after two decades of mass drug administration was assessed. About 1014 Participants from 5 communities in Ushongo Local Government Area, who had received various rounds of Ivermectin were examined for Onchocercal depigmentation (Leopard skin), Onchodermatitis (Itching/Pruritis) and palpable nodules while ocular examination was carried out with illiterate e-chat and counting raised fingers at varying distances. Out of the 1014 volunteers, 219(21.6%) showed various symptoms of Onchocerciasis. A significant difference was observed (χ^2 = 45.33, $p < 0.05$) in the prevalence of Clinical Onchocerciasis between the 5 communities. Farmers were the occupation most infected with 129(58.9%), Participants of age group ≥60 years were the most infected 22(47.7%), while the 11-20 years old were the least infected 18(11.7%). There was a significant difference between the prevalence of infection within the age groups (χ^2 = 67.25, $p < 0.05$). 185 (84.5%) showed evidence of visual impairment, 170(79.8%) had Itching/Pruritis, 107(48.9%) had depigmentation /LS, 32(14.6%) had Onchocercal blindness and 59(26.9%) had Palpable nodules. Results obtained showed that there are significant reduction in the disease prevalence when compared to the REMO data prevalence of 48.58% after 20 years of Ivermectin chemotherapy. Ivermectin therefore remains an effective tool for the control of Onchocerciasis.

KEYWORD: Assessment, Ivermectin, Administration, Onchocerciasis, Community Treatment-seeking Behaviour, Ushongo.

INTRODUCTION

Onchocerciasis is a vector-borne filarial disease known as "river blindness," "Roble's disease," "craw-craw," or "sowda". It is the world's second leading cause of blindness, with trachoma being number one. This insidious disease is prevalent in about 37 countries of the world. Of all countries of the world, Nigeria has the highest persons with Onchocerciasis and highest number at risk accounting for over a third of global prevalence.[1] Estimate showed that 37 million people are infected at present with Onchocerciasis, some 30 million of them living in the great part of tropical Africa. Other endemic areas are the Yemen, Guatemala, Mexico, Venezuela and Columbia.[2] More than 250,000 blind and 500,000 persons have some degree of visual impairment.[3]

At present, Onchocerciasis constitutes a serious problem in 30 states of the country's 36 States as well as the Federal Capital Territory.[2] Over 120,000 cases of blindness in Nigeria are due to Onchocerciasis infection and an estimated 25 million people are at risk in the 35,219 Local Communities that are endemic.[1] *Onchocerca volvulus* is transmitted to humans who are the only known vertebrate host through the bite of an infected female blackfly of the genus *Simulium*, and in Nigeria, it is transmitted by *S. damnosum* complex.[4] The blackfly vector breeds in fast flowing and well oxygenated rivers and streams. This habitat preference of the vector limits and defines the distribution of Onchocerciasis.[5]

In the human body, the larva forms nodules in the subcutaneous tissue and matures into adult worms.[6] have indicated that the prevalence of infection and disease in a community is directly correlated to the proximity to riverine breeding sites of the blackflies with the highest burden of infection and disease in communities adjacent to rivers.[7]

The prevalence of Onchocerciasis is lowest in individuals aged below 10 years, and highest in those aged 20 – 30 years. The reason for the low prevalence in

children aged below 10 years, who are mostly school pupils, is largely because of reduced exposure to bites from black flies whose biting activity is greatest in the morning.[8] Comparatively the disease is generally highly prevalent in men than women.[2] This trend has partially been attributed to increased exposure of men to black fly bites, which are related to the occupational risk in farmers and fishermen.[7]

The presence of these microfilariae in the skin of infected individuals is responsible for the physical manifestations of Onchocerciasis. These manifestations include dermatitis, skin atrophy and inflammation of the eye, and over half of the infected people presenting with various skin diseases.[9] Onchocerciasis also causes troublesome itching and skin changes. A multi-country study showed that over 30% of the population in endemic areas had Onchocercal dermatitis.[10] In a survey of skin diseases in 7 endemic sites in 5 African countries, 40 – 50% of adults reported troublesome itching.[7] They also indicated that skin changes usually range from early reactive lesions such as acute papular onchodermatitis, chronic papular onchodermatitis and lichenified onchodermatitis ('Sowda') to late changes such as depigmentation and skin atrophy. Despite the high microfilarial loads in endemic areas, some patients present with subclinical or intermittent dermatitis corresponding to acute papular onchodermatitis, with little cellular attack against live microfilariae.[11]

The majority of skin dwelling microfilariae die in the tissue resulting to a complex array of immune-pathological reactions which in turn provokes several Onchocercal lesions. As a result, most of the tissue changes in Onchocerciasis that contribute to the development of clinical manifestations appear to be associated with death of microfilaria rather than the presence of adult worms[12]

The psychological stigmatization and rejection suffered by persons affected by troublesome itching and reactive onchodermatitis complications are far-reaching.[8] Okechukwu[13] observed that similar skin damage of the extremities in Onchocerciasis creates feelings of remorse, apathy, recrimination; resignation and even thought of suicide; and the desire to conceal the lesions perpetuate damage. The impact of stigmatization on individuals is a serious issue because it also results in fear of discrimination and low self-esteem.[13]

Onchocerca volvulus infection remains an important public health problem for many countries in Africa especially the sub-Saharan countries[14] including Nigeria. As a result of the devastating effect of this infection, Merck & Co. Inc. in 1987 took an unprecedented decision to donate Ivermectin (IVM) for as long as needed to eliminate this infection as a public health problem.[15] In Nigeria, mass drug administration (MDA) of Ivermectin started in 1993, and the general objective was to progressively reduce morbidity, disability, mortality and socio-economic burden directly or indirectly due to Onchocerciasis through strengthening of CDTI structures in Benue State.[16]

Inclusive in this research is the investigation of the Treatment-seeking behavior of Participants, numerous models are available, the framework by[17] used for this study was chosen because it was specifically designed for use in developing and transitional countries.

The study was conducted to assess the impact of Ivermectin MDA on the prevalence and distribution of Clinical Onchocerciasis and Community Treatment-seeking Behaviour in Ushongo Local Government of Benue State after two decades of Annual Ivermectin administration.

MATERIALS AND METHODS

Study Area

The study Area was Ushongo Local Government Area of Benue state (Figure 1). The area has its headquarters in the town of Lessel. It lies between longitude 8° 50'E and 9° 30'E and latitude 7°20'N and has an area of 1,228 km² and a population of 188,341 as at the 2006 census.[18] Ushongo Local Government Area lies in the guinea savanna vegetative belt. Water bodies that traverse parts of Ushongo Local Government Area include River Katsina-Ala which is the longest tributary of River Benue. Other minor streams that run through include Amile (Tamen and Kiliki) and River Dura from Buruku Local Government Area. Ushongo is made up of 11 council wards namely Atikyese, Ikyov, Lessel, Mbaaka, Mbanyam, Mbaawe, Mbagba, Mbagwaza, Mbakuha, Mbayegh and Utange. The inhabitants of Ushongo Local Government Area are mostly farmers who engage in subsistence agriculture. The rich alluvial soil due to the activities of River Benue forms the basis for agricultural activities in the area.

Ushongo Local Government Area belongs to the AW Koppen's classification of climate. Based on Koppen's Scheme of Classification, experiencing two distinct seasons, the wet/rainy season and the dry/summer season. The rainy season lasts from April to October with annual rainfall in the range of 100-200mm. The dry season begins in November and ends in March. Temperatures fluctuate between 23 - 37˚C in the year.

Figure 1: Map of Ushongo Local Government showing Study Communities[18]

3.2. Study Design

This research was based on the data obtained from a cross-sectional, correlational study along with a descriptive epidemiological survey conducted between September and December, 2016. Third inclusion criteria for enrolment of participants is; Below the ages 11yrs as they cannot be trusted to give reliable judgement

Inclusion criteria for enrolment of Participants

i. Living in the endemic area for Onchocerciasis.
ii. Willingness to participate in the study by signing or thumb-printing the Informed Consent Form (ICF).

Exclusion criteria for enrolment of Participants

i. Psychiatric disease that affects the ability of the participant to understand and cooperate with the study protocol.

3.2.1. Sample Size Determination

A sample size of 1014 persons, made up of 577 males and 437 females matched for ages, were randomly selected from five communities. The minimum sample size was determined using[19] method for calculating the sample size from a finite population.

$$\mathbf{n = \frac{N}{(1+ Ne^2)}}$$

Where n = desired sample size,
e = Maximum accepted margin of error (0.05),
N = Population of 188,341 persons (NPC 2006)
1 = Theoretical constant,

$$n = \frac{188{,}341}{(1+ 188{,}341 \times 0.05\times 0.05)} = \mathbf{399.998}$$

The minimum number of participants that will give a significant result is approximately 400. The sample size of 1014 was chosen to curtail selection bias and provide a reliable data as a large sample size is more representative of the population. The 1014 participants chosen for the study were interviewed in native Tiv language to obtain demographic information and to fill the questionnaire. This study mainly involved physical examinations and assessment of ocular, nodular and dermal manifestations of Onchocerciasis for all the 1014 participants.

Ethical Consideration

Health authorities in Ushongo Local Government Area (LGA) were contacted and ethical clearance (Appendix I) was obtained before the actual 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 in each village, to the village heads and the elders, and their consent was obtained for the mobilization of the respective communities. During the parasitological and clinical survey, Health personnel (Onchocerciasis coordinator) were present to monitor safety standards.

Determining the Prevalence of Onchocerciasis in the Communities

Sensitization visits were made to the communities before the survey to intimate the Participants on the demands of the impending survey. All the communities were visited on a date that suited their economic engagements. Survey population was an open one, where all that come out for the survey were examined for Onchocerciasis.

The disease' visible symptoms such as Onchocercal blindness (OB), depigmentation/leopard skin (LS), Pruritis/Dermatitis/maculopapular rashes (MPR), palpable nodules and visual impairment[2,7] were used in assessing Onchocerciasis in the communities by palpation of nodules over area of bony prominences on the trunk, ribcage and groins of affected individuals to estimate size, consistency and texture of Onchocercal nodules as well as visually observing external manifestations like itch-dermatitis, lizard skin and leopard skin.

Recording of findings was done by scoring in pluses (+, ++, or multiple). The presence or absence of leopard skin, nodules were recorded. Participants visual acuity were examined by raising different number of fingers at varying distance to the examiner. Individuals who could not count the raised fingers at all distance and from five (5) metres were reported to have impairment[2]

Questionnaires were also administered to assess, the impact of Ivermectin MDA on the prevalence of Onchocerciasis, Epidemiological factors that influence prevalence of Onchocerciasis and Treatment Seeking Behaviour (TSB) of the disease. Data generated were subjected to simple percentages and chi-square analysis to determine the prevalence and distribution of infection among the villages, age groups, sexes and to assess the perception of the disease among the community members.

3.3 Data Analysis

Simple percentages were used to estimate the prevalence rate of various parameters in the subjects while chi square (χ^2) was used to determine the significant influence of sex and age, location, occupation on the prevalence of clinical manifestations among subjects using a p=0.05.

RESULTS

Assessment of Prevalence and Distribution of Onchocerciasis

The overall prevalence of the Onchocerciasis recorded in this study was 219 (21.6 %).

Prevalence and Distribution of Onchocerciasis within Study Communities

The highest prevalence of Onchocerciasis was observed in Participants from Ikov with 72(33.3%) while Lessel had the lowest prevalence of 21(10.9%) {Table 1}. There

was a significant difference in the prevalence of Onchocerciasis between the five study communities.

The manifestations of Onchocerciasis were predominantly dermal, nodular and ocular in character. Table 2 shows the Onchocercal Morbidity indicators observed during the period of investigation. Out of 1014 individuals examined, 219(21.6%) showed various indicators: 185(84.5%) had Visual impairment, 170(79.8%) had Itching/Pruritis, 107(48.9%) had depigmentation/Leopard Skin, 32(14.6%) had Onchocercal blindness and 59(26.9%) had Palpable nodules. There was also a significant difference in the distribution of OMI within the five study communities.

Table 1: Prevalence of Onchocerciasis within the Five Study Communities

Community	Number Examined	Number showing OMI	Prevalence Rate (%)
Mbakuha	183	21	11.5
Lessel	192	21	10.9
Utange	223	60	26.9
Ikov	216	72	33.3
Mbagwaza	200	45	22.5
Total	**1014**	**219 (21.6%)**	**100**

**OMI – Onchocercal Morbidity Indicators
($\chi^2 = 45.33$, $p < 0.05$

Table 2: Distribution of OMI within the Five Study Communities.

Community	Number Examined	Number Showing Onchocercal Morbidity Indicator				
		Visual Impairment	Itching/Pruritis	Depigmentation	Onchocercal Blindness	Palpable Nodules
Mbakuha	183	20	18	3	0	0
Lessel	192	20	20	0	0	0
Utange	223	46	30	16	9	6
Ikov	216	59	62	35	23	28
Mbagwaza	200	40	40	25	0	31
Total(%)	**1014**	**185(84.5%)**	**170(79.8)**	**107(48.9%)**	**32(14.6%)**	**65(29.7%)**

χ^2=34.27, df = 4, $p < 0.05$

4.3 Assessment of the impact of Ivermectin MDA on the prevalence of Onchocerciasis in Ushongo Local Government Area.

In Figure 2, the distribution of Participants shows that 49 (4.8%) of the 1014 Participants had not taken ivermectin treatment before. They also made up 20% of the infected population while the other 965 (95.2%) Participants had received Ivermectin treatments. The highest prevalence of OMI was observed in those who had taken Ivermectin treatment once 93 (42.5%).

Only 32(4.1%) Participants had taken more than 9 rounds of Ivermectin treatment and also showed no physical manifestations. It was observed therefore that as the number of rounds of Ivermectin treatment increased, the number of participants with no OMI increased.

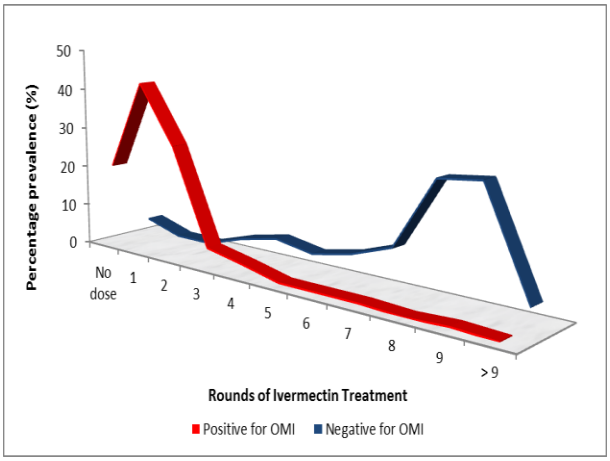


Figure 2: Number of rounds of Ivermectin Treatment against Prevalence of Onchocercal Morbidity Indicators.

Assessment of epidemiological factors that Influence Onchocercal Prevalence in Ushongo Local Government Area.

Prevalence of Onchocerciasis with respect to Occupation

The study area was one of the rural parts of the country where the main income of the area is dependent on subsistence farming and accordingly majority 621(61.2%) of the Participants were farmers and 38.2%

were students, Teachers and Civil Servants. In terms of occupation therefore, the farmers were the most infected 129(58.9%) while the retired and other were least infected 1(0.5%) [Figure 3]. There was a significant difference between the prevalence of infection and occupation of Participants ($\chi^2 = 28.6$, $p < 0.05$).

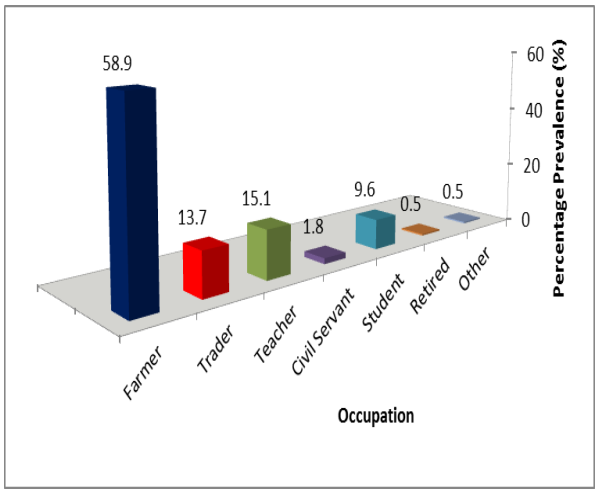
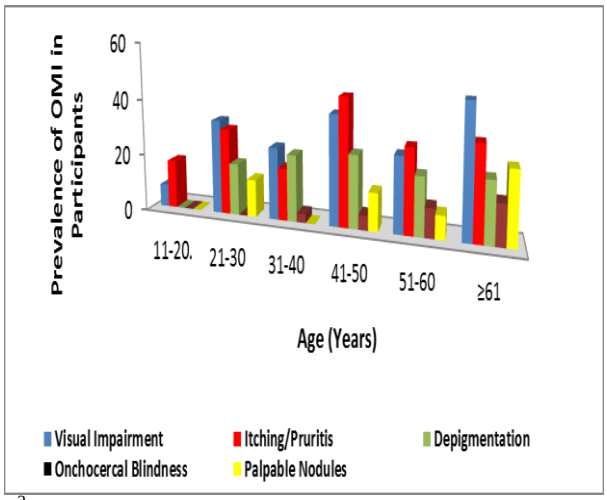


Figure 3: Prevalence of Onchocerciasis with respect to Occupation.

Prevalence of Onchocerciasis with respect to Age

Out of the 1014 Participants recruited, age ≥61 years old had the highest rate of infection 22 (47.7%), while those within the age range of 11-20 years were the least infected 18 (11.7%). There was a significant difference between the prevalence of infection among age groups (Figure 4).

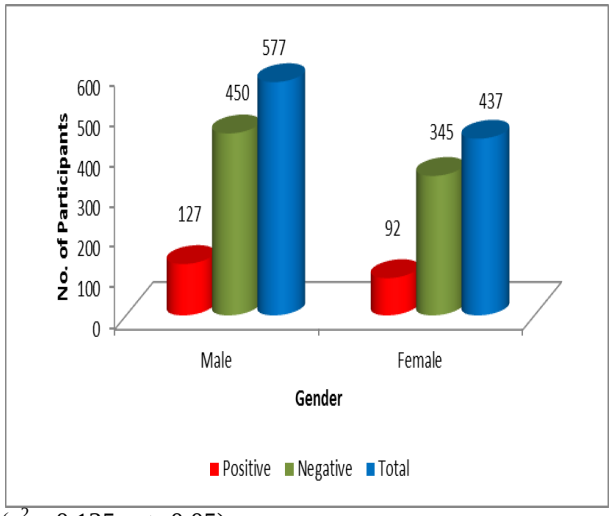


($\chi^2 = 67.25$, $p < 0.05$).

Figure 4: Prevalence of Onchocerciasis with respect to Age.

Prevalence of Onchocerciasis with respect to Gender

The overall prevalence of Onchocerciasis was found to be 219(21.6%). The infection was more prevalent in males 127(58.0%) than in females 92(42.0%) among study participants of the five Communities. There was no significant difference between male and female Participants (Figure 5).



($\chi^2 = 0.135$, $p > 0.05$)

Figure 5: Prevalence of Onchocerciasis with respect to Gender.

Epidemiological Factors influencing non-compliance to Ivermectin MDA in Ushongo Local Government Area

49 (4.8%) Participants examined had never taken Ivermectin despite the two decades of Ivermectin MDA. Figure 6 showed that Ivermectin non-compliance among male participants which was 25(51%) was higher than in females 24(49%).

Among the various age groups, Ivermectin non-compliance was also observed to be higher among the younger age groups with the highest percentage in Participants aged 11-20 years 46(93.9%) [Figure 7]. Ivermectin non-compliance was also observed to be highest among farmers 25(51%) followed by students 15(30.6%) [Figure 8].

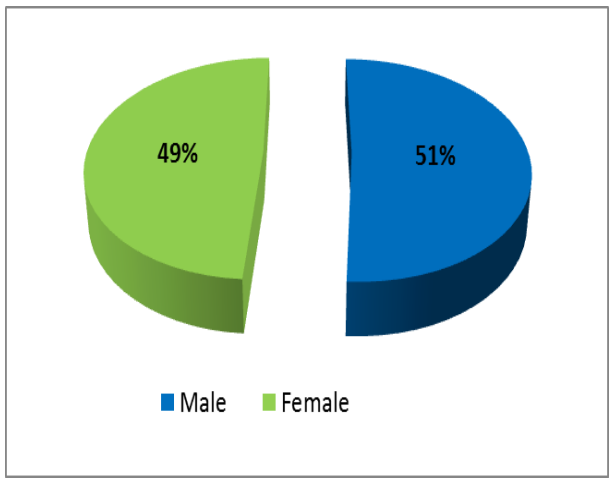


Figure 6: Ivermectin non-compliance with respect to Gender.

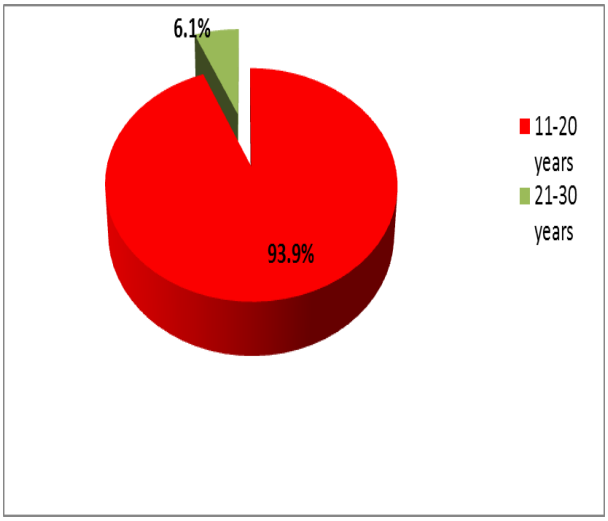


Figure 7: Ivermectin non-compliance with respect to Age.

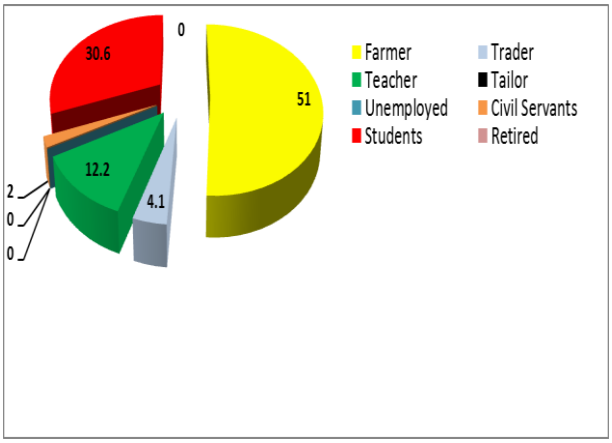


Figure 8: Ivermectin non-compliance with respect to Occupation Assessment of Community Treatment-Seeking Behaviour among Participants with Onchocerciasis.

Choice of Healthcare Consultation

Figure 9 illustrates where households sought healthcare consultation from with respect to Onchocerciasis. 187 (85.4%) out of the 219 positive cases documented consulted a Health Centre, CDD or the Local Clinics in their Communities. The second most common consultations were provided by the Herbal Homes with 17 (7.8%).

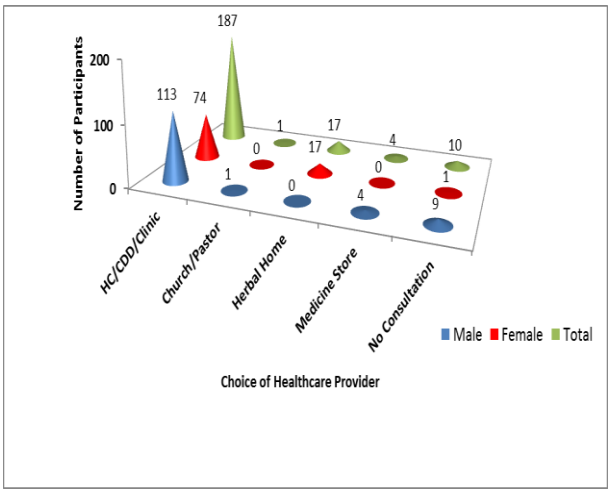


Figure 9: Choice of Healthcare Provider among Participants.

Factors affecting Choice of Healthcare Provider

Table 3 shows the responses to factors that influence participants choice of healthcare consultation, the ranking showed that Efficacy of Healthcare was the most influencing factor with 119(56.9%) followed by affordability with 59 (28.2%). Proximity was the least mentioned factor with 2(1%).

Table 3: Factors affecting Choice of Healthcare Provider.

Factor	Choice of Healthcare Provision				
	HC/CDD Clinic	Church/Pastor	Herbal Home	Medicine Store	Total
Convenience	29	0	0	0	29
Affordability	55	1	0	3	59
Efficacy	101	0	17	1	119
Proximity	2	0	0	0	2
Total(%)	**187(85.4)**	**1(0.5)**	**17(7.8)**	**4(2.0)**	**209**

DISCUSSION

This study describes the current situation of Onchocerciasis in these five communities of Ushongo Local Government by determining the prevalence of onchocercal morbidity indicators like visual impairment, Itching/Pruritis, Depigmentation/Leopard Skin, onchocercal blindness and Palpable nodules. Out of a total of 1014 Participants observed for onchocercal morbidity indicators in line with[20], An overall Prevalence of 219(21.6%) was observed. All the communities were observed to be hypoendemic for Onchocerciasis except Ikov with 33.3% which is mesoendemic for Onchocerciasis.

There have been several reports documenting improvement of some onchocercal symptoms after ivermectin treatment on onchocerciasis.[21] The most common onchocercal symptoms identified in this study amongst the 219 positive Participants were Visual impairment. The nodule rate of 29.7% is higher than the >20% nodule rate specified for definite CDTI areas[22,23] but however shows a decrease from the findings of[24] in

Ikov community. This is an indication that annual treatment with ivermectin is effective. The claim by a Participant that his nodules disappeared after several annual ivermectin treatments provides credence to the findings of some researchers that onchocercal nodules were gradually disappearing with repeated doses of ivermectin[25,26]

Significant geographically-related variation in patterns of OMI may be explained by nearness to breeding site of vectors. The average clinical prevalence observed in Ikov, Utange and Mbagwaza were significantly higher than those of Lessel and Mbakuha .This indicates that most of the inhabitants in Ikov, Utange and Mbagwaza Communities developed more physical manifestations compared to those in Utange and Mbakuha communities which means this infection was more endemic in Ikov, Utange and Mbagwaza compared to Lessel and Mbakuha communities. Ikov, Utange and Mbagwaza Communities are adjacent to each other and Ikov is transversed by Rivers 'Amile Ukiliki' and 'Amile U Tamen' and into the River Katsina-ala, Utange borders Ikov just on the south bank of River 'Amile Ukiliki' and on the south end also borders Mbagwaza with River Dura cutting across the two communities. Mbakuha and Lessel on the Other hand lie close to Gboko and while Lessel serves as Headquarter to Ushongo Local Government, Mbakuha which lies right next to her is just as Urban and they both have no waterbodies around the both communities.

The findings from this study therefore confirmed that this infection is more common in areas closest to rivers or streams that serves as breeding site of the blackflies with the highest burden of infection and disease in communities adjacent to rivers.[6]

In this study, Onchocerciasis was observed to be more prevalent in males than in females but there was no significant difference between both genders. The reason for the lack of differences between males and females may be that, both males and females in these communities are equally involved in farming and hence the levels of exposure to the black fly bites are similar.

In this study, Most of the male Participants were continually engaged in farming irrespective of their age and thus explains for the higher prevalence among males compared to females because of increased exposure to black fly bite in males.[27,28] have also attributed this trend to different pattern in sex-dependent exposure to black flies' bites, with men being more exposed.

According to[29] host age and sex-heterogeneous exposure largely explains for local-specific infection patterns. The reason for this observation was that Participants of 21-30 age group to ≥61 years continually engaged in active farming activity while in the age group 11-20, there was a reduction in active farming hence the reduced exposure to blackfly bite in age group 11-20 years compared to the other age groups as observed also by.[27]

Exposure factors can be held largely responsible for this pattern of infection because the majority of the individuals in the localities studied were farmers and fishermen. Farming exposes people to an on-going risk of Simulium bites and *Onchocerca volvulus* transmission throughout their lives.

The relationship between man and his environment is symbiotic. Although, it is generally believed that the environment influences human activities, these activities in turn influence the nature of the environment. Physical, social and economic factors are very important factors that determine the severity of onchocerciasis in any given society[30] This study revealed significant difference between the prevalence of infection and the occupation. This agrees with[31] that Onchocerciasis is more common among farmers, fishermen, hunters, normads and others who are engaged in outdoor activities that bring them in constant contact with the *Simulium* fly.

The present prevalence rate of 21.6% shows a decline from mesoendemic status of 48.58% in 2005[16] to a hypo-endemic status. This could be due to the impact of Ivermectin MDA since there was no antivectorial control done in these areas for over 15 years. Ivermectin had significantly reduced the endemicity level of *O. volvulus* infection after 3 to 5 rounds of MDA (Figure 3). In Eastern Nigeria, it has been reported that, IVM also significantly reduced the Onchocerciasis prevalence from 69.3% to 39.3% after six years of MDA.[27] It is expected that with repeated rounds of MDA, this infection could be reduced to below transmissible levels.

Previous studies have indicated that Onchocerciasis infection (using microfilariae) peaks in individuals aged 20-30 years and is more common among males.[32] The study also showed that the prevalence of microfilariae was higher among males, increased also with age in both sexes but however peaked in Participants aged 31 to 40 years old. In the study, the difference in the peaking age group could be due to differences in patterns of exposure to blackfly bite and parasite acquisition, geographical location, occupational and immunological (acquired immunity) status of the locals[29] and also the MDA with IVM.

Ivermectin treatment has been shown to have minimum effect on the life of the adult worm[33] and as such to completely eliminate this infection there is also the need to develop a macrofilaricidal drug to complement the use of Ivermectin as demonstrated by.[34]

The overall finding from this study suggests the IVM mass drug administration may have reduced the intensity of *O. volvulus* infection in the study areas. This observation suggests that ivermectin treatment is still

effective as also suggested by[33,35] and could be the reason for the observed lower prevalence of infection. It is therefore assuring that when the MDA programme is sustained with improved distribution, access and coverage, *O. volvulus* infection could be controlled below transmissible level in Ushongo Local Government.

In order to interrupt the transmission of *O. volvulus* infection in Ushongo Local Government Area, there must be low and declining levels of these observed epidemiological indices (nodule prevalence, microfilarial prevalence and other OMIs) as outlined by the MoH strategic plan[16] Other studies have also asserted that, in order to achieve elimination of *O. volvulus* infection as a public health problem, Ivermectin has to be applied annually for 10 to 20 years or more.[36] According to[37] the prospect of eliminating onchocerciasis from Africa by mass treatment with Ivermectin has been rejuvenated following recent successes in certain foci in Mali and Senegal.

Findings from this present study shows that as the number of rounds of Ivermectin intake increased, the percentage of Participants with no Onchocercal morbidity indicators increased (Figure 3). Similar observations have been made by other studies[33,38] This suggests that ivermectin treatment suppresses reproduction by the adult worms responsible for morbidity indicators (Onchocercomas, Visual impairment, OB, etc.) with its effect rising with increasing rounds of IVM treatment. A significant observation in this study was that, there was a zero-prevalence in the positive line in Participants who have had more than 6 rounds of Ivermectin Treatment. The result from this study suggests that Ivermectin still remains an effective microfilaricide. Ivermectin is a broad spectrum anti-helminthic used currently for the treatment of human Onchocerciasis. It has been shown that even a single dose of ivermectin is able to reduce the winding and coiling motility of microfilaria.[39] According to[40] a 99% efficacy of microfilaricidal effect was achieved after each IVM dose and a reduction in mf production by fertile worms. It was evident in this present study that after one round of IVM treatment, there was drastic decline in mf density (Hence reduced Clinical manifestations) compared to Ivermectin non-compliant Participants. These observations indicate that Ivermectin has an effect on reproduction and motility of microfilariae of *O. volvulus* following administration to humans.[35]

According to the Onchocerciasis Coordinating Officer of Ushongo Local Government, communities in Ushongo were enrolled into the MDA programme in 1993 and had since been administered Ivermectin at annual treatment intervals. Before this study, there had been at least 20 rounds of Ivermectin treatment in all five communities.

The observed effect of Ivermectin in this study is consistent with previous studies that were undertaken when Ivermectin was introduced for onchocerciasis control.[41,42] Repeated rounds of treatments showed that Ivermectin is still a highly effective microfilaricide.[33] It is therefore very important to sustain Ivermectin MDA and increase coverage to ensure *O. volvulus* infection is completely eliminated as a public health problem.

According to the Ministry of Health Annual Plan of Action for National Neglected Tropical Diseases Programmes report in 2015, Ushongo Local Government recorded ivermectin coverage of 79.7%. Despite the reported coverage, this study showed that about 49 (4.8%) of study Participants remain non-compliant to Ivermectin MDA (said they had never taken Ivermectin).

A recent IVM compliance study reported that 6% had never taken IVM despite 8 rounds of MDA in Cameroon and Nigeria.[43] These Ivermectin-non-compliant Participants remain an essential group for re-transmission of this infection. Two major reasons have been assigned to this difference between the coverage reported by Ministry of Health and what was observed in this study; systemic and personal reasons. Among the systemic reasons, the first one is that the Ministry of Health reports were based on the mode of drug distribution. The distribution of Ivermectin was based on house-hold rather than individual treatment. As a result of this, although the drug may have been distributed, there was no follow-up to know that the treatments were taken by the individuals. Compared to the Polio Eradication Programme, the Direct Observed Treatment (DOT) has higher efficiency because it is based on individual treatment.

The second reason is with the selection of Community-Directed Distributors (CDD). The CDD personnels in these communities were mostly non-health workers. As a result they are often unable to explain to the local folks the reasons and importance of taking the IVM treatment.

The third challenge is with the allocation of CDDs to communities. In most of the small communities, no CDD is assigned to them. As a result they rely on the bigger communities for their drug supply. Most often it is difficult for the CDDs to effectively distribute the drugs limiting accessibility of the drugs to inhabitants in smaller communities. The efficiency of the MDA can be heightened when CDDs are assigned to every community irrespective of its size. Also, the current study observed the CDDs are not paid any form of remuneration; this is prone to reduce their motivation to distribute the drug effectively.

Personal reasons have also been given by the community folks, which include lack of understanding on why they need to take the ivermectin treatment. This challenge can be addressed by training well-informed CDDs. When

well-informed CDDs are selected they will be able to comprehensively explain the need for the treatment.

Secondly, fear and rumours about developing adverse effects (AE) has been cited as one of the reasons. The mode of action of Ivermectin is often not explained to them, as a result there is panic among those who have never taken Ivermectin. There is the fear that taking the MDA drug will 'expose their hidden ailments'.

The third reason is the lack of interventions for AEs occurence. People who usually develop AEs after the first drug intake stay away from taking subsequent rounds of IVM treatment because of fear of developing AEs again. This can be addressed when community nurses are deployed as CDDs, in that way the community people can be well attended to when they develop AEs and this will reduce fallouts after initial treatment round.

Another challenge is the lack of understanding to why they must take the IVM treatment. Because the people do not understand the need to take the ivermectin treatment, they stay away from participating in the MDA treatment programme and there is no urgency among them to take the treatment. Education is essential in sensitizing them about the need for treatment. In contrast to other evidences from North-Eastern Nigeria by[44] most Study Participants (85.4%) sought healthcare consultation from formal providers (CDD, Health centres and Clinics. Utilization of Health services is a complex phenomenon influenced by such factors as availability, affordability, efficacy and Proximity. The high percentage of informed and compliant Participants in this study can be attributed to the CDTI approach adopted. Nevertheless the present study has identified that 14.6% of Participants showing clinical manifestations were either ignorant or still harboured reservations toward IVM treatment. It is therefore such enabling and hindering social factors in these communities that when socially engineered in health education material that will help to diffuse and change the age-long perception and beliefs.

Health education is a key factor in erasing negative beliefs, cultural practices as well as behavioural patterns, which may jeopardize patients and community acceptance and compliance to prevention and control measures.[45]

CONCLUSION

The APOC goal of eliminating Onchocerciasis as a public health problem (EPHP) is not quantitatively defined. The EPHP goal was logically defined as when prevalence is driven below the original baseline threshold required to launch the mass Ivermectin treatment program, which is an Onchocercal nodule rate ≥20% or an mf rate ≥40%.[46] Achieving EPHP at these levels does not necessarily indicate that transmission has been interrupted. In the case that it has not, halting mass treatment can result in a return of transmission to pretreatment levels and disease recrudescence.

Available evidence from this study shows that the government is often unable to provide adequate financial resources to their Onchocerciasis projects. However, financial responsibility for sustaining mass treatment is increasingly falling on the governments of Nigeria and their non-governmental organization (NGO) partners.

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