

## RE-ASSESSMENT OF THE PREVALENCE OF ONCHOCERCIASIS IN ADAMAWA STATE, NIGERIA AFTER MORE THAN TWENTY YEARS OF MASS DRUG ADMINISTRATION WITH IVERMECTIN

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### ABSTRACT

*Onchocerciasis is an eye and skin infection caused by a filarial worm (*Onchocerca volvulus*) transmitted by haematophagous female *Simulium* blackfly. The study was carried in four Local Government Area (LGA) of Adamawa State. Toungo, Yola-South, Song and Hong LGAs to assess the prevalence of onchocerciasis after more than twenty years of mass drug administration with Ivermectin drug. The technique employed was the use of Ov16 Rapid Diagnostic Test. 1311 blood samples were collected and examined for onchocerciasis from eight sentinel sites across four LGAs. 81 of those examined were positive for onchocerciasis giving prevalence of 6.18 %. The result showed higher prevalence in Bolki Community of Song LGA (8.77 %) and lowest in Ganzamanu in Toungo LGA (3.66 %). The prevalence in relation to sex was statistically not significant ( $p > 0.05$ ), though prevalence was higher among the males (6.80 %), compared to female (5.42 %). Infection was statistically significant ( $p < 0.05$ ) in relation to age with highest prevalence (27.84 %) observed in age group  $> 60$  years, while zero (0.00 %) prevalence was observed in age groups 5 – 20 years. Assessment of interruption of transmission among 486 children between the ages 5 – 9 years showed zero (0.00 %) prevalence in all the children in the sentinel communities. The continuous use of the microfilaricide drug over the years has interrupted the transmission of onchocerciasis. This implies that continuous distribution of the drugs will lead to elimination of the parasite and eventually the disease in Adamawa State, hence, distribution should be sustained.*

**Keywords:** Prevalence, Onchocerciasis, Ivermectin, Transmission, Interruption

### INTRODUCTION

Onchocerciasis, also known as river blindness, is a vector-borne parasitic disease caused by *Onchocerca volvulus* Bickel, 1982. The disease is second only to trachoma as the leading cause of blindness globally (WHO, 2011). The parasite is transmitted to humans through the bites of black fly of the genus *Simulium* Latreille, 1802 that breed in fast flowing rivers and streams. It remains a serious public health problem in many parts of tropical Africa. Approximately 123 million persons at risk of infection in 38 endemic countries, with 25.7 million infected, and one

million are blinded or have severe visual impairment (CDC, 2013). Other associated problems include skin diseases (leopard skin) and severe itching. People living around or working near blackfly breeding sites are most at risk of infection. Only members of the *Simulium damnosum* complex and *Simulium neavei* group are associated with transmission of onchocerciasis in Africa (Adeleke *et al.*, 2010; Crump *et al.*, 2012). However, member of the *S. neavei* complex has not been reported in Nigeria. Other species of black flies that occasionally bite humans in Nigeria is the

*Simulium bovis* and *Simulium vorax* (Adeleke *et al.*, 2010; Uzoigwe *et al.*, 2013).

The disease is a major obstacle to agricultural development of fertile river valleys with attended socioeconomic consequences in afflicted communities. The disease is targeted for elimination in several African countries by 2025 through community-directed mass drug administration (MDA) with Ivermectin, which is supported by donor agency such as Hellen Keller International (Zhang *et al.*, 2018). Ivermectin is the drug of choice worldwide for controlling both morbidity and parasite transmission (Crump and Omura, 2011). It is considered as a safe and effective microfilaricide. In addition it has the capacity to interrupt transmission of over time. The MDA with Ivermectin (IVM) is an effective strategy for interruption of disease transmission worldwide (Turner *et al.*, 2014). The criteria for determining interruption of transmission require a 5-year cumulative incidence of infection of < 0.1 % in children under five and untreated immigrants and assessing children 5 to 9 years in endemic communities with Ov16 Rapid Diagnostic Test Kits or Ov16 ELISA (WHO, 2001).

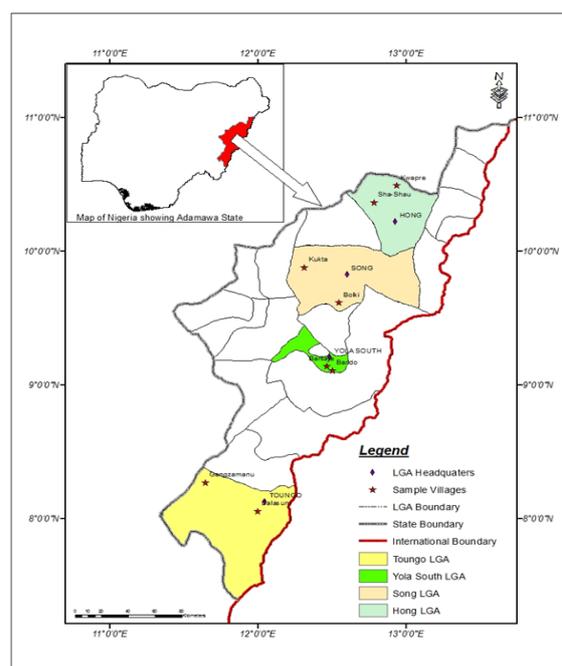
The goal of the onchocerciasis elimination agenda in Nigeria is to reduce transmission of *O. volvulus* infection through MDA by 2020. This research was therefore carried out to determine the extent to which this objective has been achieved in Adamawa State. Adamawa State has been an active participant in the implementation of the MDA and even has an Onchocerciasis Control Unit which is saddled with the responsibility of the distribution of Ivermectin in communities over the years. Hence, the objectives of this study were to assess the prevalence of onchocerciasis in the various communities as an indicator for the determination transmission interruption of onchocerciasis in the selected communities where MDA has been on-going over the years.

## MATERIALS AND METHODS

**Study Area:** Adamawa State is located on Latitude 9°19'60.00"N and Longitude 12°29'59.99"E. It has landmass of about 36,917 square kilometres (Tukur

*et al.*, 2004) with a projected population of 4,248,436 (Wikipedia, 2022). It is bordered by Borno State to the Northwest, Gombe State to the west and Taraba State to the Southwest. The eastern borders form the national eastern border with Cameroon. The area has a tropical climate, marked by dry and wet seasons. The wet season commences around May and ends in the middle or late October. The dry season starts in late October and ends in late April. Maximum temperature in Yola can reach 40°C or more around April, while minimum temperature could be as low as 18°C between December and early January. Relative humidity varies from 26 % in the month of January to 80 % in the month of August. Most inhabitants are civil servants, traders, fishermen, farmers and cattle rearers (Umar and Suleiman, 2020).

The study was conducted in four local Government Areas (LGAs) of Adamawa State namely, Song, Hong, Tongo and Yola South LGA (Figure 1).



**Figure 1: Map of Adamawa State showing the sentinel sites for the study (modified from Muhammed *et al.*, 2018)**

In each of the LGA, two sentinel sites were selected and the criteria for selecting sentinel sites was that the community must be an area where mass drug distribution of Ivermectin has been on-going over the years. The distribution of Ivermectin or mectizan tablet as is also called

commenced in Adamawa State in the 1995 under the programme then known as Community Directed Treatment with Ivermectin (CDTI). It was a programme supported by the African Programme for Control of Onchocerciasis (APOC) before it later metamorphosed into the current programme known as MDA with Ivermectin.

**Ethic:** The approval to conduct the research on prevalence of onchocerciasis in Adamawa State, Nigeria was obtained from Adamawa State Ministry of Health. The ethics for the conduct of research involving human subject was strictly adhered to (Kapp, 2006). Informed consent of all the subjects for the study was sort and obtained. The identities of all persons involved in the study were protected as no names were used during the data collection. Pre surveillance visit was made to Adamawa State Ministry of Health and to Primary health care authorities (PHCA) to inform and obtain permission to conduct the research. Thereafter similar visit was made to the traditional rulers and Ward heads in all the communities where the study was conducted to inform them on the significance of the work and outcome of the work will be made known to them. The resident health worker in the various communities especially the Local Government Neglected Tropical Diseases (LNTDs) officers in each of the local Government were used for mobilization and data collection during the formal surveillance.

**Research Design:** The study was conducted between 2019 and 2020 in four selected Local government areas of Adamawa State namely Tongo LGA, Yola South LGA, Hong LGA and Song LGA. In each of the Local Government Area, two communities were selected as the sentinel sites. Giving a total of eight sentinel sites for the study. The sentinel sites selected in the local government were as follows; Hong LGA 328 (Shashu 166 and Kwapre 162), Song LGA 336 (Bolki 171 and Kukta 165); Tongo LGA 319 (Dalasum 155 and Gangzamu 164) and Yola South LGA 328 (Bantage 166 and Bando 162). The criteria for the selection of a community as sentinel was that such a community must be

one of the communities where Ivermectin distribution was on-going for the past 10 years or more. A total of 1311 blood samples were collected from individuals 5 years and above across the 8 sentinel communities in the four LGAs of Adamawa State. Study subjects were categorized on the basis of sex and age, those between the ages 5 – 15 years were considered as children and above 15 years as adults.

#### **Collection of Blood Samples for Onchocerciasis Rapid Diagnostic Test (Ov16):**

The research was conducted using Ov16 Rapid Diagnostic Test kits. Laboratory procedure for blood sample collection was as described by Cheesbrough (2005). Subject whose blood samples were collected were arranged in serial order corresponding to number on each SD Bioline Onchocerciasis IgG4 Monoplex. The Ov16 rapid diagnostic test (Ov16 RDT) was performed according to the manufacturer protocol (SD Bioline Onchocerciasis IgG4 Rapid Test, Abbott Standard Diagnostics, Incorporated, Yongin, Republic of South Korea). The finger to be lanced was cleaned with alcohol swab and allowed to air dry before it was pricked on the lateral side with the aid of one use only disposable lancet. The Ov16 rapid test was performed as described per the product instructions. 10 µL of finger pricked capillary blood was transferred to the test cassette using a disposable capillary tube. There after buffer was added to the cassette, the test was allowed to run for 20 minutes and then results are recorded. The area marked 'C' indicates the control line, while the area marked 'T' designates the test line. Result was recorded negative when one purple line appears on the control region 'C'. However when two purple line appear in the 'C' and 'T' in the result window implies positive, while result was considered invalid when no line appear on the control 'C' or only 'T' line appeared. All invalid results were re-tested as recommended by Cheesbrough (2005).

**Data Analysis:** Data generated was analysed with SPSS version 20 using Chi-square test at P

= 0.05. The results obtained were presented in tabular forms (Tables 1 – 4).

## RESULTS

One thousand three hundred and eleven (1311) blood samples were examined for onchocerciasis from eight sentinel sites across four LGAs of Adamawa State. Eighty one (81) of those examined were positive for onchocerciasis giving prevalence of 6.18 %. Distribution of the studied subjects in relation to LGA and sentinel sites were as follows; Hong LGA (Shashau 166 and Kwapre 162), Song LGA (Bolki 171 and Kukta 165), Tongo LGA (Dalasum 155 and Gangzamanu 164) and Yola South LGA (Bantaje 166 and Bando 162).

Distribution of prevalence in relation to sentinel sites showed Bolki had the highest prevalence of 8.77 %, followed by Kwapre (8.03 %) and Dalasum (7.10 %), whereas Kukta, Bantaje and Bando had prevalence of 5.46, 5.42 and 4.94 % respectively. The community with the least prevalence was Gangzamanu (3.66 %). Analysis showed no significant association ( $p > 0.05$ ) between infection and location (Table 1).

Prevalence of onchocerciasis infection in relation to sex and sentinel sites showed that, males had the highest prevalence of 6.80 % compared to females with 5.42 %, although not statistically significant ( $p > 0.05$ ) (Table 2).

Prevalence of onchocerciasis in relation to age showed that those greater than 60 years had prevalence of 27.84 %, followed by those within the age range 41 – 60 years (15.80 %). Those within the age range 5 – 20 years had 0.00 % as no case was recorded (Table 3). There was a significant association between infection and age ( $p < 0.05$ ). Assessment of the interruption for transmission of onchocerciasis showed that in all the study participant that were between the age range 5 – 20 years in all the sentinel sites none tested positive for onchocerciasis.

This implied that transmission of onchocerciasis was interrupted among the studied subjects in the sentinel sites (Table 4).

**Table 1: Prevalence of onchocerciasis in some selected communities in Adamawa State, Nigeria after more than twenty years of mass drug administration with Ivermectin using Ov16 rapid diagnostic test**

LGA	Community	Number	
		Tested	Oncho-positive
Hong	Shashau	166	10(6.02)
	Kwapre	162	13(8.03)
Song	Bolki	171	15(8.77)
	Kukta	165	9(5.46)
Toungo	Dalasum	155	11(7.10)
	Gangzamanu	164	6(3.66)
Yola-South	Bantaje	166	9(5.42)
	Bando	162	8(4.94)
<b>Total</b>		1311	81(6.18)

$\chi^2 = 0.26$ ,  $df = 3$ ,  $p = 34.67$ , number in parenthesis = percentage prevalence

**Table 2: Prevalence of onchocerciasis in relation to sex of participants in some selected communities in Adamawa State, Nigeria after more than twenty years of mass drug administration with Ivermectin using Ov16 rapid diagnostic test**

Sex	Number	
	Examined by Ov16	Oncho-positive
Male	721	49(6.80)
Female	590	32(5.42)
<b>Total</b>	1311	81(6.18)

$\chi^2 = 0.31$ ,  $df = 1$ ,  $p = 1.05$ , number in parenthesis = percentage prevalence

**Table 3: Prevalence of onchocerciasis in relation to age of participants in some selected communities in Adamawa State, Nigeria after more than twenty years of mass drug administration with Ivermectin using Ov16 rapid diagnostic test**

Age group (Years)	Number	
	Examined by Ov16	Oncho-positive
5 – 20	637	0(0.00)
21 – 40	311	12(3.86)
41 – 60	266	42(15.80)
>60	97	27(27.84)
<b>Total</b>	1311	81(6.18)

$\chi^2 = 0.00$   $df = 3$ ,  $p = 165.71$ , number in parenthesis = percentage prevalence

**Table 4: Interruption of transmission among children 5 – 9 years in some selected communities in Adamawa State, Nigeria after more than twenty years of mass drug administration with Ivermectin using OV16 rapid diagnostic test**

LGA	Community	Number	
		Tested	Oncho-positive
Hong	Shashau	66	0(0.00)
	Kwapre	62	0(0.00)
Song	Bolki	71	0(0.00)
	Kukta	50	0(0.00)
Toungo	Dalasum	55	0(0.00)
	Gangzamanu	64	0(0.00)
Yola-South	Bantage	66	0(0.00)
	Bando	62	0(0.00)
<b>Total</b>		<b>496</b>	<b>0(0.00)</b>
		<b>(100)</b>	

$\chi^2 = 0.00$ ,  $df = 3$ ,  $p = 7.82$ , number in parenthesis = percentage prevalence

## DISCUSSION

Mass drug administration (MDA) with Ivermectin is the WHO-recommended strategy for the control of onchocerciasis among infected population and it is recommended that the drug should be taken at least once in a year. Turner *et al.* (2014) reported that MDA with Ivermectin is an effective strategy for interruption of helminthic disease transmission worldwide. The findings revealed an overall prevalence of 6 % onchocerciasis after 20 years of MDA. This finding was in tandem with studies conducted elsewhere in Southwest Ethiopia, Cameroun, Senegal and Equatorial Guinea (Hernández-González *et al.*, 2016; Njim and Aminde, 2017). The findings however differed from that of Kamalu and Uwakwe (2014) who recorded prevalence of 18.0, 29.2 and 32.8 % in communities in Okigwe, Nigeria. The low prevalence recorded among the study subject can be attributed to the sustained MDA in the area as reported by Turner *et al.* (2014).

The study showed that infection was irrespective of the sex, this implied that both male and female were equally exposed to being bitten by the blackfly vector. The sentinel sites are rural in nature and members are mainly farmers, some fishermen and their main sources

of water supply are the streams and rivers. This brings them in contact on daily basis with the blackfly vector. This finding was also similar to that of Adeyeba and Adegoke (2002), Wogu and Okaka (2008) and Afolabi *et al.* (2014) who recorded higher prevalence in males but not statistically significant.

However, males were more likely to be infected with onchocerciasis compared to females. This may be attributed to difference in socio-economic activities which predisposed the male more than the female. Culturally female behaviour of covering most part their body confer them with some level of protection against the bite of blackfly vector. The difference in prevalence between the males and females may also be attributed to occupational and travelling habit of males which put them more at risk of being bitten by infected blackfly. Males spend longer hours outdoors in those blackfly infested areas working either on their farms, fishing, hunting or other related activities, thereby making the males more vulnerable to be bitten by the blackfly vector. These findings were in agreement with studies done elsewhere (Rasheed, 2006; Dana *et al.*, 2015; Hernández-González *et al.*, 2016; Kamga *et al.*, 2016). These studies all attributed the high prevalence of onchocerciasis in males to their high frequency of involvement in outdoor activities, thus more at risk of being bitten by black flies. These findings were also in agreement with the reports of Adeyeba and Adegoke (2002), Wogu and Okaka (2008) and Afolabi *et al.* (2014) who reported that both male and female engage in socio-economic activities (such as fetching water from the breeding site, farming, fishing and hunting which are all risk factors for acquiring infection. However, Manyi *et al.* (2014) reported that there was no relationship between seroprevalence and sex, that both male and female were equally exposed to infection through farming, fishing and hunting which are the major socio-economic activities among patients attending the NKST Eye Care Programme, Mkar-Gboko, Benue State, Nigeria.

Prevalence in relation to age showed that there was a significant association between infection and age. It was observed that infection

was between the age groups 41 – 60 years and above 60 years. The findings revealed that those that were between the ages of 40 years and above were more likely to be positive for onchocerciasis infection compared to those that were between the ages of 5 – 20 years. This can be attributed to repeated exposure to the risk factors over time before the introduction of the mass drug distribution. Hence age was a factor in prevalence of onchocerciasis infection in the study area. These findings were in agreement with the studies of Kamalu and Uwakwe (2014), Dana *et al.* (2015), Wilson *et al.* (2016) and Kifle *et al.* (2019) that all reported age as a significant factor in the transmission of onchocerciasis. They were of the view that adults engaged more in outdoor activities, hence chances of being bitten by blackfly vector was more. In addition the long duration of the disease without cure might have contributed to the high prevalence of the disease among adults. Older people were exposed to the disease causing agent long before the introduction of MDA. Wilson *et al.* (2016) reported higher prevalence of onchocerciasis among persons above 50 years of age than those below 50 years of age in three Senegalese districts. The result of this study was at variance with the report of Umeh *et al.* (2010) who reported prevalence of 18.6, 18.6 and 20.7 % among age groups 15 – 24 years in Cross River, Taraba and Kogi states of Nigeria respectively. This disparity might be as a result of climatic differences between the forest and the savannah zones. In the northern part of the Nigeria which is characterized by savannah vegetation, the younger age groups are engaged more in farming than the older age groups.

Assessment of interruption of transmission after 20 years of MDA with IVM in the study area, showed that in all the sentinel sites none of the children between ages 5 – 20 years were positive for onchocerciasis. This implied that the sustained MDA with IVM has interrupted transmission among these age groups. This may be a pointer to the fact that sustained Ivermectin distribution will lead to elimination of onchocerciasis in these LGAs and Adamawa State in general. This result was in

agreement with the findings of Hernández-González *et al.* (2016) in Bioko Island, Equatorial Guinea and Surakat *et al.* (2018) in Ogun State Nigeria who recorded zero prevalence of onchocerciasis in Yewa North, Obafemi-Owode, Ewekoro and Ifo LGAs. Low value of Community Microfilaria Load (CMFL) observed in this study was in agreement with the findings of the study on (Sam-Wobo *et al.*, 2012). In contrast, Surakat *et al.* (2018) reported 4.0 % seroprevalence in Abeokuta North, 3.0 % seroprevalence in Abeokuta South, 13.0 % in Odeda LGAs in Ogun State Nigeria after ten years of MDA of Ivermectin in the LGAs. CDC (2013) reported that periodic, community wide mass drug administration (MDA) with Ivermectin prevents eye and skin disease and might interrupt transmission of the infection, depending on the coverage, duration, and frequency of MDA. This implied that interruption of onchocerciasis transmission requires more than 10 years of sustained drug distribution as it was the case in Adamawa to give the desired results.

**Conclusion:** The prevalence information in these LGAs served as a baseline data for future planning and epidemiological studies in Adamawa State Nigeria. The prevalence of onchocerciasis among studied communities is acceptably low as a result of the annual distribution of Ivermectin for the past 20 years in the state which is targeted towards the control and elimination of onchocerciasis in affected communities. The acceptance and compliance with Ivermectin treatment by persons in affected areas may have contributed to the drastic reduction of infection among the adults in this communities and interruption of transmission among the children. The zero prevalence or lack of infection recorded among children in all the LGAs indicates possible interruption of transmission among the study population. This implies that elimination of onchocerciasis is possible if the MDA with IVM is sustained and funded. The study identified age groups 41 – 60 years as the age group that was more susceptible to onchocerciasis while farming and hunting were identified as activities that highly predisposed individuals in these

communities to high risk of infection. Hence these age groups should be given more attention during MDA with IVM. The public enlightenment among these age groups especially those with the clinical symptoms will further educate them of the need to consistently take the drug in order to avoid permanent blindness. This study showed that the study area had low endemicity for onchocerciasis. Health education, sensitization, mobilization and advocacy should be sustained in areas so as to create awareness on the various ways of transmission in order to sustain these findings.

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