Prevalence Studies on Onchocerciasis (River blindness) in some villages from three Senatorial Districts, Kano State, Nigeria.

A. Yahaya[1*], S. L. Kela[2], M. M. Suleiman[3] and A. B. Sama'ila[4].

[*1]Department of Biology, Faculty of Science, Kano University of Science and Technology, Wudil. P. M. B. 3244. Kano State, Nigeria

[2]Department of Biological Sciences, Federal University, Kashere. P. M. B. 0182, Gombe State, Nigeria

[3,4]Biological Sciences Programme, Abubakar Tafawa Balewa University, Bauchi. P. M. B. 0248. Bauchi State, Nigeria
*Corresponding Author's

ABSTRACT

Aim: The study determined the prevalence of onchocerciasis in some villages from three (3) senatorial districts of Kano State, from November 2013 to September 2017.
Study Design: Cross-sectional Survey.
Place and Duration of the Study: Some villages from three senatorial districts of Kano State, from November 2013 to September 2017.
Methodology: Parasitological examination for the presence of microfilariae of *Onchocerca volvulus* was done using standard skin-snip method.
Results: Out of 1,926 individuals sampled, 361 (18.7%) were infected with the disease. Onchocerciasis was higher in Kano South Senatorial District (36.4%) than Kano North Senatorial District (19.8%) and Kano Central (0.0%) and were categorized as mesoendemic, hypoendemic and sporadic respectively. The difference between the districts was statistically significant ($P<0.05$). The highest infection rate was observed among subjects of age range 30-39 in Kano South Senatorial District (54.1%) and Kano North Senatorial District (34.7%). Chi-square test revealed that the differences in the prevalence of the disease in relation to age were however not significant ($P>0.05$). Males had significantly higher onchocerciasis prevalence of 208 (40.5%) in Kano South and 96 (24.2%) in Kano North Senatorial Districts than their female counterpart (24.7%) and (7.9%), respectively ($P<0.05$). Prevalence of the disease was higher among fishermen (55.6%) compared to other occupational groups.
Conclusion: This study clearly reveals the existence and severity of onchocerciasis in many villages of Kano South and Kano North senatorial districts but absent in Kano central senatorial district and that the disease is still of public health importance in these parts of the State. Therefore, urgent and constant interventions using ivermectin treatment and inclusion of health education on how to protect the populace from the bite of the vector black fly among others are highly recommended in the study area.

Keywords: *Hypo-endemic; Kano State; Onchocerciasis; Prevalence; Senatorial district*

1. INTRODUCTION

Onchocerciasis, also known as river blindness is a disease caused by tissue-dwelling filarial nematode worms belonging to the genus *Onchocerca.* Of the 34 known species, only *Onchocerca volvulus* is anthropophilic while the other species are zoophilic. Onchocerciasis is the fourth most common cause of blindness and the second most common cause of preventable blindness in the Sub-Saharan Africa [1]. It may not directly cause death but it causes great social and economic consequences [2]. The disease is transmitted by the infective L3 larvae from blood sucking *Simulium* black flies which breed along the edges of fast flowing streams and rivers.

The global burden of disease as at 2017 estimated that there were 20.9 million cases of *Onchocerca volvulus* worldwide with 14. 6 million of the infected people had skin diseases and 1.5 million had vision loss [2]. The disease is found in 31 African countries, Yemen and South America with confirmed elimination in Mexico, Ecuador, Guatemala and Colombia [4]. Onchocerciasis is a serious health and socio-economic problem in Nigeria and other West African countries [3]. It primarily affects the rural population, particularly farmers, who produce the majority of food and industrial raw materials [3]. Nigeria ranks among those countries with the highest burden of the disease in the world, accounting for about a third of the global prevalence [5]. The worse endemic focus is found in the Taraba River valley in Northern Nigeria [6].

In Kano State, onchocerciasis occurs mainly in Tudun Wada area to the South where there is a fast flowing run-off from Tiga Dam. Studies have shown that since the construction of the dam, perennial breeding of *Simulium* flies has been occurring in the Kano River [7]. In Nigeria the current thrust in controlling onchocerciasis is by annual Mass Drug Administration (MDA) with Ivermectin or Mectizan® which started in 1988 [8], which later evolved into Community Directed Treatment (CDTI) of onchocerciasis with Ivermectin where communities in affected areas are encouraged to direct and manage their own treatment.

The World Health Organization's onchocerciasis control programme has successfully reduced onchocerciasis prevalence in recent years by interrupting parasite transmission and mass population treatment in at-risk locations. Mass distribution of Ivermectin and compliance in communities could reduce as symptom recedes, thus the goal of eliminating the disease in Kano State and other endemic areas is threatened. There is the need to document the distribution and prevalence of onchocerciasis in many areas in Kano State which had not been identified or studied in details. This will lead to evaluation of the long-term impact of large scale Ivermectin distribution by Community Directed treatment with Ivermectin (CDTI) in this part of Nigeria. In Kano State, the CDTI programme in between 1998 and 2000 identified some communities in only 18 targeted Local Government Areas of the State, with the goal of treating considerable number of rural population. However, there are still endemic or at risk communities in the present study in other Local Government Areas of the State that were not covered by the CDTI programme. Thus, this study would contribute significantly at establishing the current status on the epidemiology of the disease in Kano State, Nigeria. Therefore, this study is aimed at determining the number of people infected with onchocerciasis in some villages across the three senatorial districts of Kano State.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Kano, Kano State. The state has an estimated land area of 43,070 Km^2 and a population of 9,383,682 million people according to the 2006 census figures [11]. Kano State is situated between longitude 10^0 25' N to 13^0 53' N and latitude 7^0 10' E to 10^0 35' E, with an altitude range from 400m-800m above the sea level.

The main vegetation type is the Sudan Savannah and it has two major seasons: the dry season, which is between October to May and the wet season, which is between June to September. There are two main rivers, River Kano that runs from Tiga Dam to Wudil and River Chalawa running from Chalawa Gorge Dam to Wudil area of the State. There are also several reservoirs, earth dams, temporary pools and streams that are scattered all over the State. Flash flood, stormy discharges, and seasonality characterize the streams in the area [12].

The major ethnic groups in the State are the Hausa and Fulani tribes. Few other tribes also reside in the State. The inhabitants are predominantly Moslems, with considerable number of Christians and Pagans scattered within the State. The State is fertile and most inhabitants especially in the rural areas are mainly farmers, traders and minor hand crafters. Other occupations also exist in the State. The State has 44 Local Government Areas with 3 Senatorial Districts namely; Kano-South, Kano-Central and Kano-North Senatorial Districts.

2.2 Study Design

The study design is cross-sectional and involves the use of structured questioners' administered to the participating subjects for their personal bio-data (name, sex, age, etc). Seven Local Government Areas from each of the three Senatorial Zone (Kano-Central, Kano- North and Kano-South) were randomly selected for the study. Consequently, two villages from each of the seven Local Government Areas were also randomly selected to make a total of 42 villages; and these formed the sampling villages.

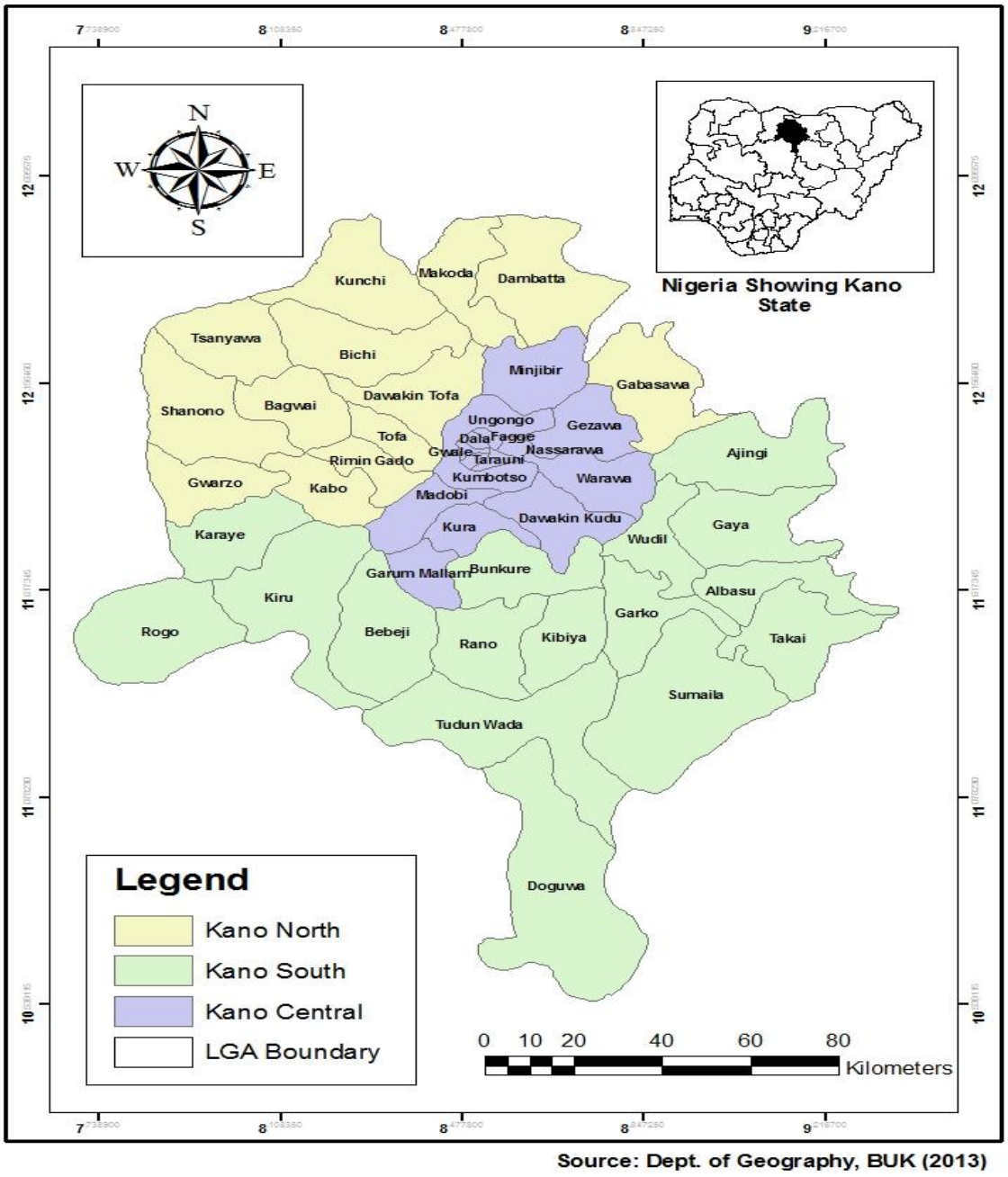


Fig. 1. Map of Kano showing three senatorial districts

2.3 Sample Size Determination

The sample size used for the study was determined using infinite population methods using the formula provided by [13]:
$n = N/ (1+ Ne^2)$,

Where n = desired sample size, e = Maximum accepted margin of error (0.05),

N = Population = 9,383,682 persons [11],

1 = Theoretical constant,

n = 9,383,682/ (1+ 9,383,682 x 0.05 x 0.05) = 399.983.
From the above, the maximum number of participants that will enroll in the study to give a significant result was approximately 400. With this information, the study used 1,926 subjects which were randomly selected and enrolled for the study. The 1,926 subjects who gave their consent were made up of both males and females and were also matched for their ages consisting of 695 from Kano- South, 545 from Kano- North and also 686 from Kano-Central Senatorial Districts (Fig. 1).

2.4 Parasitological Examination

Two bloodless skin snips were taken from either side of the iliac crest using a Holt-type corneo scleral punch (Storz Ltd, Japan) with a 2mm bite after cleaning the site with cotton swabs moistened with 70% ethanol. This cotton swab cleansing method of the corneo sclera punch was to prevent transmission of blood-borne infections like the Human Immuno Deficiency Virus (HIV), Hepatitis B virus, etc. The corneo scleral punch was then sterilized for re-use first with 95% absolute ethanol, then 3.5% sodium hypochlorite solution. Each skin snip was separately placed in a microtitre plate (flat-bottom, 96 wells) containing three drops of 0.85% solution of physiological saline as described by Anosike and Onwuliri [14]. In order to prevent spillage of the contents during transportation to the laboratory, the plates were covered with a Falcon 3073 pressure sensitive film plate sealer. The plates were then incubated for 24 hours at room temperature of 37^{o}C. The emerging microfilaria was each observed under X40 objectives of an inverted microscope and the identity noted.

2.5 Statistical Analysis

Data obtained was stratified by age and sex; and analyzed statistically using Chi-square ($x2$) on Statistical Analysis System (SAS) software 6.11 release. Chi-square values were considered to be significant when P is less than 0.05 and not significant when P is greater than 0.05.

3. RESULTS

The prevalence of onchocerciasis with regards to villages in Kano South Senatorial District is shown in table 1. From the data presented, Riruwai recorded the highest prevalence of onchocerciasis with an infection rate of 54.1% while Kaleku had the least with the rate of (21.2%). The prevalence falls in the mesoendemic and hypoendemic categories respectively. Chi-square test revealed that the difference in the prevalence rates of onchocerciasis is significant among the villages ($P<0.05$).

Table 2 show the prevalence of onchocerciasis in the various villages of Kano North Senatorial District. Gwanda village recorded the prevalence of 60.0% while Dugabau, Garo, Zaura, Madaci, Shuwaki and Yandadi recorded no infection. The 60% infection rate in Gwanda showed that the area is hyperendemic. There was significant ($P<0.05$) difference in the prevalence of onchocerciasis among the villages.

The result in fig 2 indicates that onchocerciasis was found to be higher (36.4%) in Kano South Senatorial District than in Kano North Senatorial District (19.8%). However, no infection was recorded in Kano Central Senatorial District (Table 3). The difference in the prevalence of onchocerciasis between the three (3) Senatorial Districts was significant ($P<0.05$). The overall prevalence of onchocerciasis in the study area was 18.7%, hypoendemic for onchocerciasis. All villages in the study area falls in varied onchocerciasis endemicity levels as depicted in fig. 3

Prevalence of onchocerciasis according to age from some villages in three senatorial districts of Kano State is shown in fig 4. People within the age group of 30-39 years had the highest prevalence (54.1%) and (34.7%) in Kano South and Kano North Senatorial Districts, respectively. While the least prevalence (11.1%) occurred within the age group 0-9 years in Kano South Senatorial District and within the age group 70 and above in Kano North Senatorial District recorded no infection. There was however, no significant ($P>0.05$) difference in the prevalence of the disease in relation to age group between the two Senatorial Districts.

The sex related prevalence of onchocerciasis in the three (3) Senatorial Districts of Kano State is presented in fig. 5. The result showed that males had significantly ($P<0.05$) higher onchocerciasis prevalence 208 (40.5%) in Kano South and 96 (24.2%) in Kano North Senatorial Districts than their female counterparts who recorded 45 (24.7%) and 12 (7.9%) in Kano South and Kano North Senatorial Districts, respectively.

Generally, in the study area, people that are engaged in fishing recorded the highest prevalence 23 (57.5%) while the least prevalence of onchocerciasis was recorded among indoor workers 4 (1.7%). There was however, no significant ($P>0.05$) difference in the prevalence of onchocerciasis among the various occupational groups (Fig. 6).

Table 1. Prevalence of onchocerciasis according to villages in Kano South Senatorial District

Village	No. Examined	No. (%) infected
Karefa	71	26 (36.6)
Yaryasa	68	33 (50.0)
Riruwai	74	40 (54.1)
Falgore	61	26 (42.6)
Toranke	50	18 (36.0)
Unguwarbai	52	19 (36.5)
Fulatan	40	12 (30.0)
Kaleku	33	7 (21.2)
Indabo	38	12 (31.6)
Wudil	36	11 (30.6)
Kumbugawa	41	14 (34.1)
Yola	36	11 (30.6)
Hamdullahi	45	12 (26.7)
Tsangaya	50	12 (24.0)
Total	**695**	**253 (36.4)**

Table 2. Prevalence of onchocerciasis according to villages in Kano North Senatorial District

Village	No. Examined	No. (%) infected
Gwanda	40	24 (60.0)
Fagwalawa	37	7 (18.9)
Kubarachi	40	18 (45.0)
Kauranmata	38	9 (23.7)
Wasai	42	12 (28.6)
Gurjiya	30	8 (26.7)
Dugabau	35	0 (30.0)
Garo	41	0 (21.2)
Zaura	45	0 (31.6)
Madaci	41	0 (30.6)
Shuwaki	40	0 (34.1)
Yandadi	35	0 (30.6)
Kutama	37	16 (26.7)
Mainika	44	14 (24.0)
Total	**545**	**108 (19.8)**

Table 3. Prevalence of onchocerciasis according to villages in Kano Central Senatorial District

Village	No. Examined	No. (%) infected
Sabon Gari	47	0 (0.0)
Gobirawa	42	0 (0.0)
Unguwar Abai	47	0 (0.0)
Jaen	41	0 (0.0)
Jajira	50	0 (0.0)
Ungoggo	48	0 (0.0)
Kutiyawa	46	0 (0.0)
Madobi	53	0.(0.0)
DanHassan	50	0 (0.0)
Karfi	49	0 (0.0
Fanido	51	0 (0.0)
Dusan	54	0 (0.0)
Zango	55	0 (0.0)
Abasawa	53	0 (0.0)
Total	**686**	**0 (0.0)**

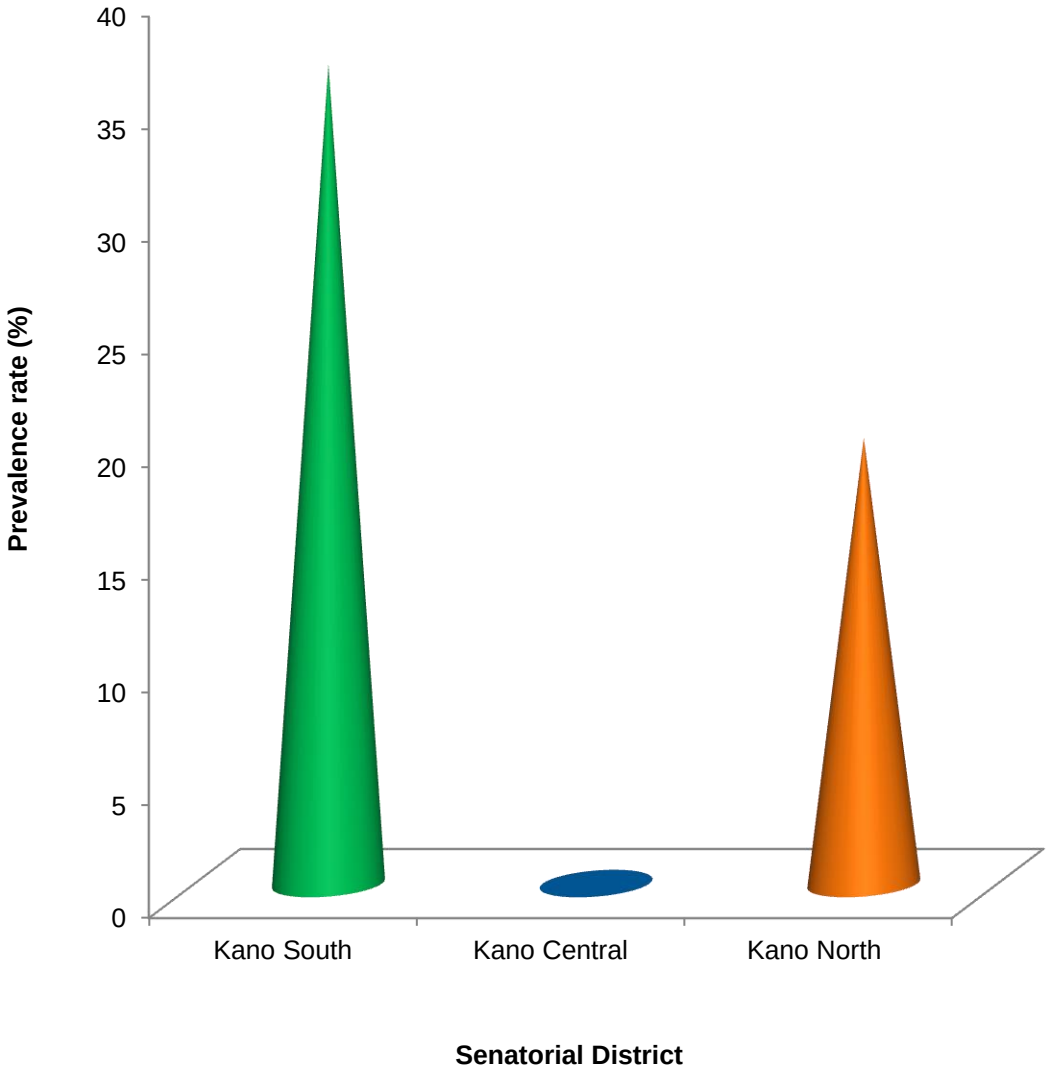
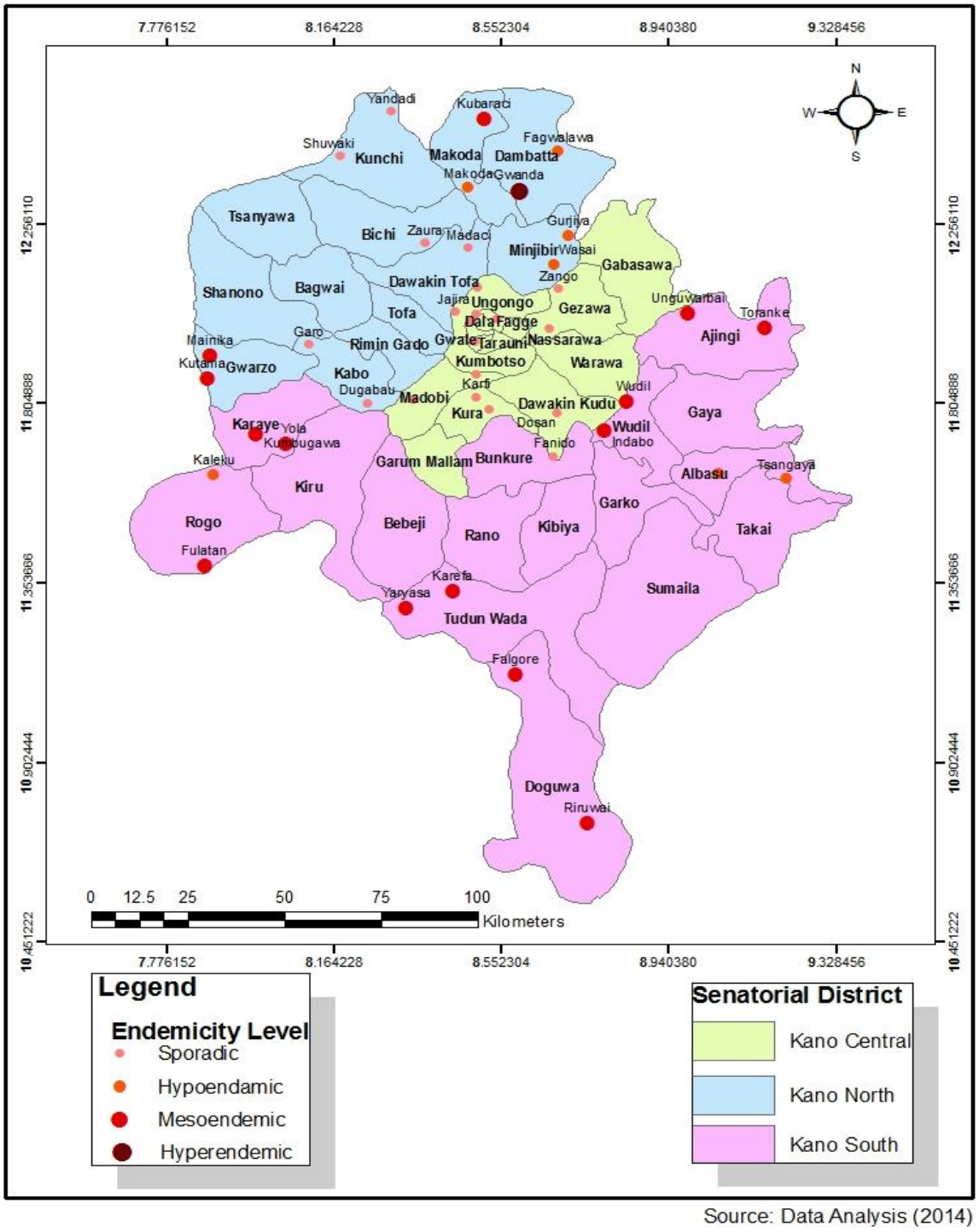


Fig. 2. Overall Prevalence of Onchocerciasis in three Senatorial Districts of Kano State



Source: Data Analysis (2014)

Fig. 3. Map of Kano State showing the endemicity level of onchocerciasis from villages in three senatorial districts

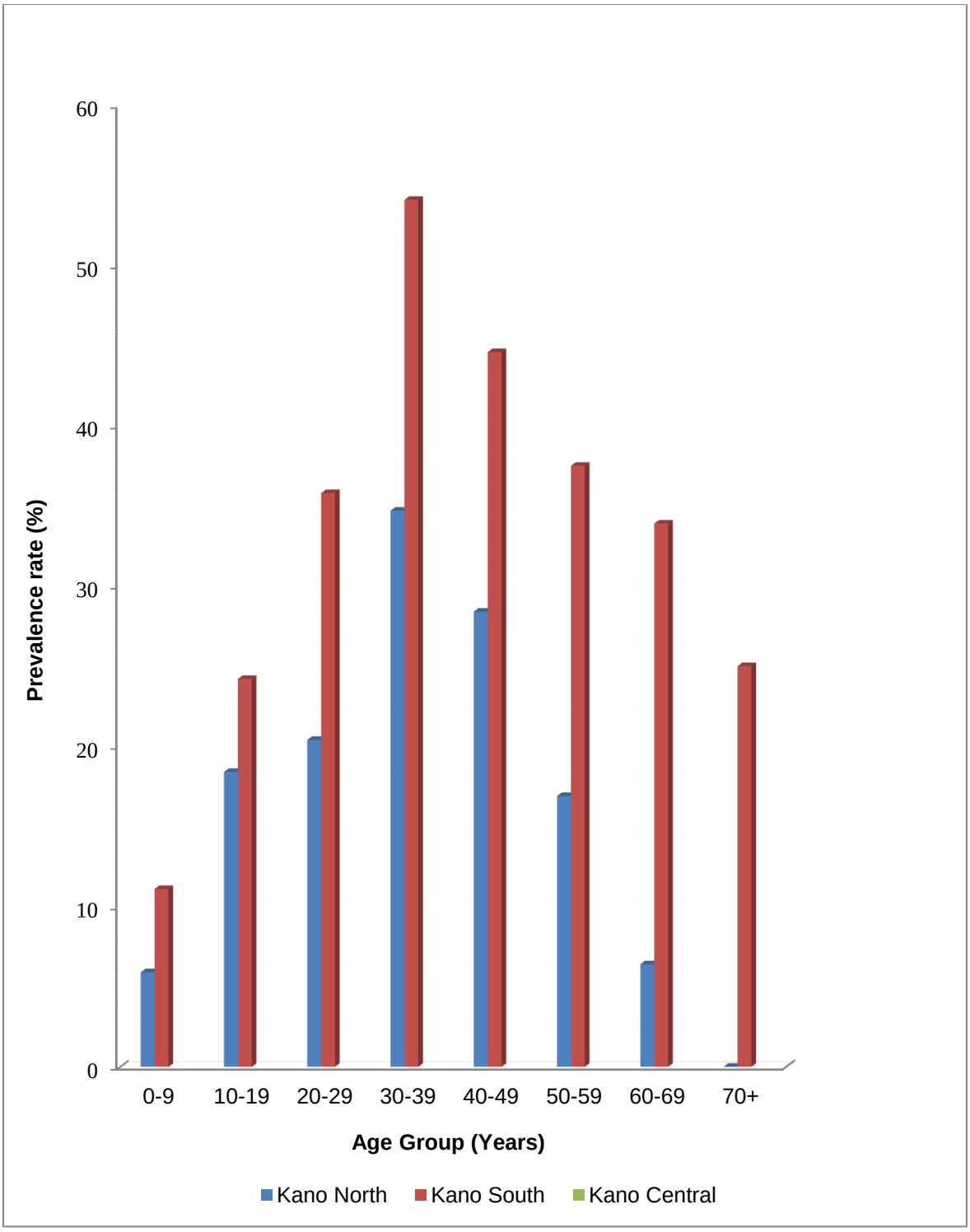


Fig. 4. Prevalence of onchocerciasis according to age in three senatorial districts of Kano State

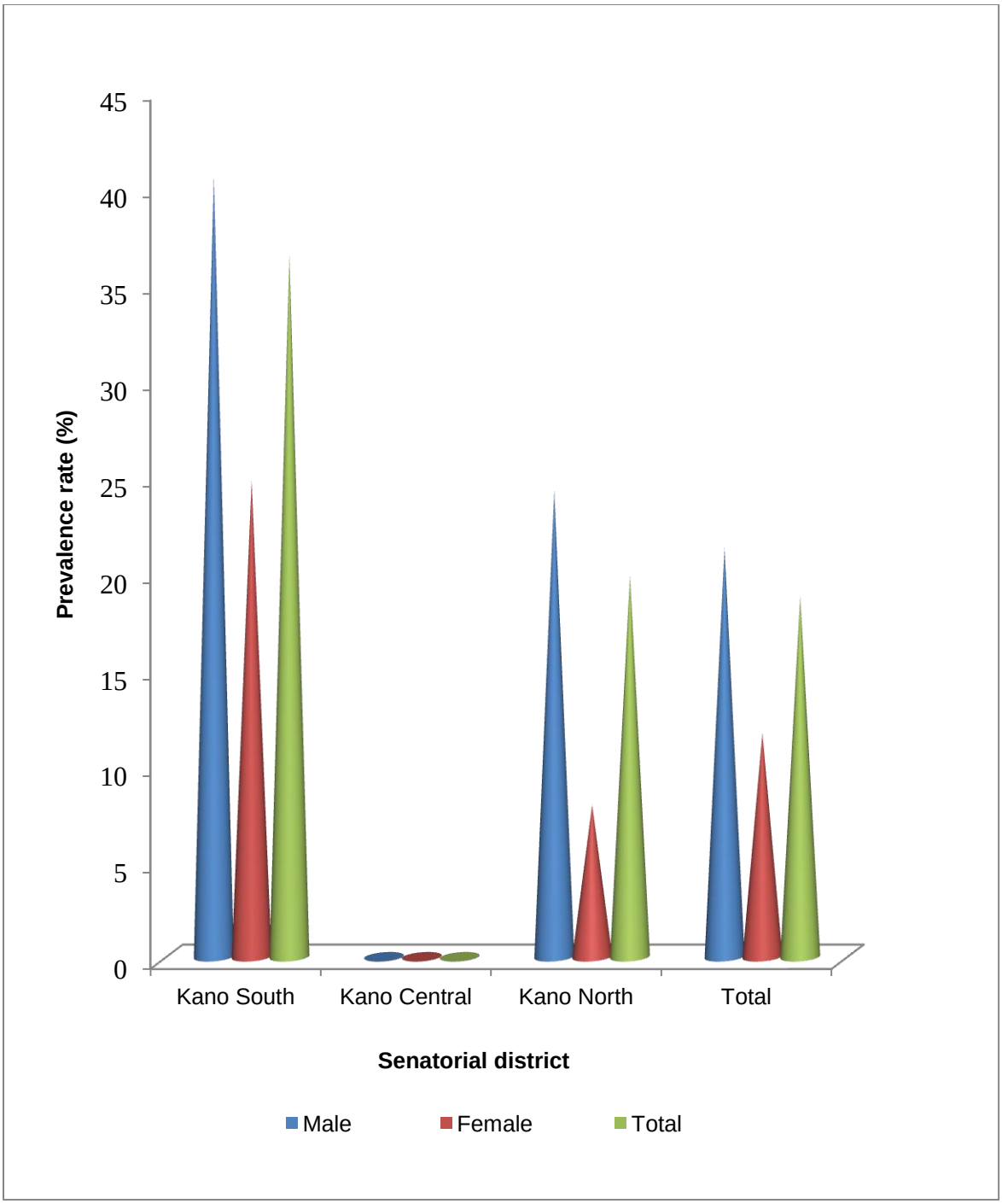


Fig. 5. Prevalence of onchocerciasis according to sex in three senatorial districts of Kano State

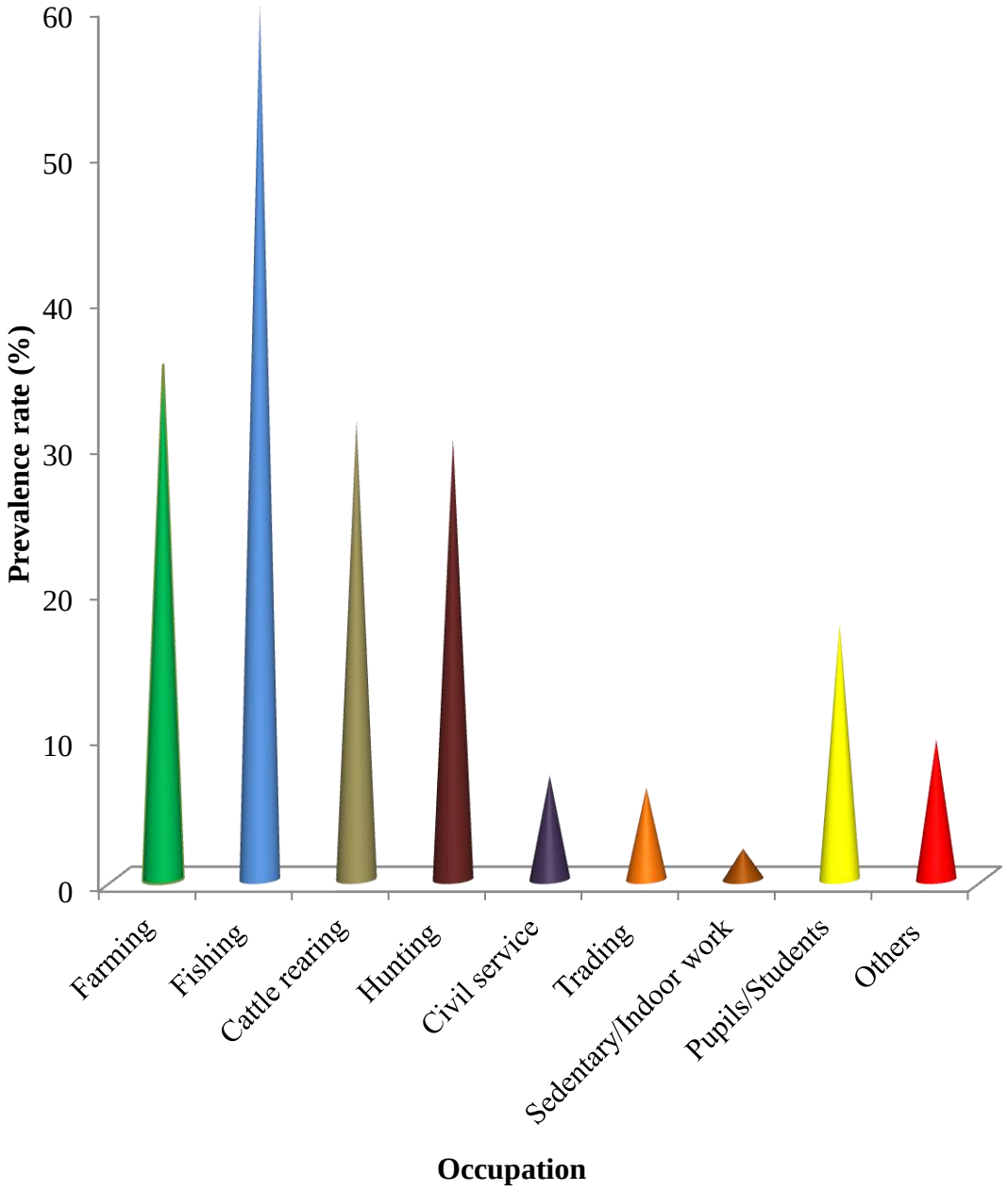


Fig. 6. Overall distribution of onchocerciasis according to occupation in selected villages of Kano State

DISCUSSION

Human onchocerciasis is endemic in some of the villages from two of the three senatorial districts surveyed in Kano State, Nigeria, in varying degrees ranging from low to high rates. The overall prevalence rate of 18.7% recorded in this study is an indication that the disease is actually transmitted in the area. This agrees with the findings of Abdullahi and Oyeyi [15] who observed a prevalence of 31.5% in Tudun Wada and Doguwa L.G.As Kano State, Nigeria. The presence of onchocerciasis in these villages could be due to the fact that most of the populations are largely farmers who are in close contact with the breeding sites of the *Simulium* vectors and are invariably more exposed to bites by the flies that lead to transmission of onchocerciasis.

According to [16], the rate and intensity of onchocerciasis infection is related to the distance from the nearest breeding site. Report of [17] shows that the occurrence of onchocerciasis varies from one geographical region to another and these zones belong to the same region. In Nigeria, the prevalence of onchocerciasis varies significantly by village, with villages near vector breeding sites having a higher infection rate [16]. The prevalence of onchocerciasis has been established in different parts of Nigeria by various researchers [18; 19; 20] among others. Its rates of occurrence as reported by those researchers vary from one geographical area to another.

The prevalence of onchocerciasis was reported as 36.4%, 19.8% and 0.0% in Kano South, Kano North and Kano Central Senatorial Districts respectively. Adopting the endemic rates classification of the World Health Organization, these districts can be regarded as mesoendemic, hypoendemic and sporadic for onchocerciasis. The overall prevalence observed in this study was lower than the reports from some parts of the country. For instance, [21] between 1999 and 2000 reported a prevalence of 41.1% in a rural farm settlement in Aniocha North L.G.A in Delta State and [22] in 2004 observed much a higher prevalence rate of 91.9% in a rural community of Okuetolo in Delta State.

The disparity in the prevalence of onchocerciasis observed in this study could be explained by the fact that the focal nature of the disease depends on the presence of a specific ecology, including but not limited to fast flowing waters and the characteristics of the vectors involved in the transmission. In all the senatorial districts, the age related prevalence increased progressively with age with a slight decline from 60 years to 70 years and above. Generally, the main working population in the study is from 30 years and above and the result showed highest prevalence of the disease. These groups were the ones who go out to farms or other places of work very early in the morning and stayed till late in the evening. This exposed them to more frequent bites of black flies, thus predispose them to infection. This observation is in line with existing reports on human onchocerciasis. For instance, [23] explained that this was due to steadily build up of infection as a result of early human-vector contact which is sustained throughout the period of existence. Similar observation was made by Akinboye *et al*. [17] in Ibarapa L.G.A of Oyo State, Nigeria that infection rates increase with age.

It's worth mentioning that a variety of factors contribute to the differences in infection rates between age groups. This could be related to the amount of time spent in the location and the disease's re-infection caused by repeated bites by infected vectors. This suggests that infection rate is not necessarily determined by age but by the degree of exposure to infection. Although, these findings are contrary to [24] who reported prevalence of 18.6% and 20.7% as the highest age prevalence in age group 15-24 years in Cross River, Taraba and Kogi States, respectively. The lower prevalence observed in the age group 0-9 years could be attributed to the fact that this age group is mostly made up of schoolchildren, who have little exposure to black fly breeding sites because they are not actively engaged in activities that can easily predispose them to the disease, though a few who are positive became exposed possibly when children visit streams to swim, fetch water for domestic use, or for other purposes.

The significantly higher prevalence of onchocerciasis in male subjects in all the villages of the two (2) senatorial districts is in accordance with the findings of [25] in Ovia North East L.G.A of Edo State, Nigeria, as well as that of [15] in Tudun Wada and Doguwa L.G.A's of Kano State, which are areas that are predominantly muslims where traditional restrictions imposed on women result in less exposure and thereby in lower prevalence than in men. The study findings also support the works of other researchers in onchocerciasis gender infection [19; 26] among others in different parts of Nigeria. These findings do not agree however, with the results from mesoendemic areas of Ezeagu and Oji River Basin and Uzo-Uwani in Enugu State [27] as well as in Ovia North East Local Government Areas of Edo State with 93%

onchocerciasis prevalence in female and 74.5% in males [25]. It is also contrary to the observation of [29] who suggested that as both sexes are equally exposed to the bites of the *S*. *damnosum* in Ini L. G. A. of Akwa Ibom State. The differences in the infection rate based on gender may be due to endemicity [30], occupational exposure [16] and susceptibility of individual [29]. In the study area, male subjects are mostly farmers and fishermen who normally stay outdoors mostly in the farms and by the streams/ rivers and hence have a greater exposure to bites by *Simulium* black flies. The lower prevalence rate in females may as well be due to unexplained hormonal effects [31].

Occupation is clearly a risk factor in onchocerciasis [17] and these explains the higher prevalence in farmers and fishermen than other occupational groups. The prevalence of human onchocerciasis among the various occupational groups in Kano State shows that the disease is related to occupation. That is, the occupational groups that carries out most of their activities outdoors, especially with most part of their bodies exposed are more susceptible to onchocerciasis. Occupations of the inhabitants have some effect on the pattern of distribution and prevalence of onchocerciasis infection. In all the villages surveyed, results of the occupational-related prevalence indicate that infection rates were more prevalent among fishermen, farmers, cattle rearers and hunters followed by pupils, civil servants and traders. This variation in prevalence rates is attributed to vectoral capacity or degree of human-vector contact. The observed association between prevalence and occupation is in line with report on onchocerciasis elsewhere [32]. This may be as a result of higher frequency of contact of these occupational groups with the infected vectors. Other vulnerable groups were the school aged children (5 years and above). These groups are often sent to fetch water from nearby streams and many whom take pleasure in washing, bathing or doing their laundries in the streams. Poor living conditions among some rural dwellers often deny most school aged children from going to school, following parents to farms and watersides. It is pertinent to indicate that people whose daily activities and engagements frequently bring them in close proximity to infected black fly are the most vulnerable groups in endemic areas.

5. CONCLUSION

This study clearly reveals the existence and severity of onchocerciasis in many villages of Kano State, particularly the southern parts, affecting a large proportion of the inhabitants. The findings obtained from this work suggested that Kano State is hypoendemic for onchocerciasis with Kano South ((36.4%)), Kano North (19.8%) and Kano Central (0.0%) Senatorial Districts being mesoendemic, hypoendemic and sporadic respectively. Prevalence of onchocerciasis was higher in males than females and was found to be more common in adults of middle age groups than other age groups. The presence of the disease is associated with activities like farming, fishing, cattle rearing, hunting, e. t c, which exposes individuals to the vector black fly. The findings also revealed that the disease is still of public health importance in this part of the State.

This study clearly underpins the need for immediate and full implementation of the African Programme for Onchocerciasis Control or Onchocerciasis Control Programme in all endemic villages of Kano State to prevent continuous spread the disease and to reduce the morbidity related to this infection. It also provides sufficient information for the development of other intervention strategies and public health policies that are acceptable to communities at risk of onchocerciasis, compatible with their lifestyles, and sustainable.

In view of the findings of this study, it is recommended that Government should urgently make Ivermectin drug constantly available and accessible to the people, particularly in Kano south senatorial district. The populace needs to be educated and encouraged about how to protect themselves from the bite of the vector as well as encouraged the use of protective clothing (for people whose occupation exposes them to vector bite). This study also underscores the need for routine epidemiological surveys to monitor the disease in its hypo-endemic state.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Authors AY, SLK, MMS and ABS designed the present study. AY conducted the survey, wrote the manuscript, *did the statistical analysis and* discussed the results. *SLK, MMS and ABS* supervised the overall implementation of investigation. *All authors read and approved the final manuscript.*

CONSENT

In each village, written consent was sought from each subject after explaining the purpose of the study to them before sample collection.

ETHICAL APPROVAL AND MOBILIZATION

Prior to commencement of data collection, ethical clearance was obtained from the Local Government Area Health Departments, the village heads and elders. Community mobilization was also conducted to seek support and cooperation.

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