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Prevalence and Intensity of Onchocerca volvulus Infection in Kura L.G.A, Kano State, Nigeria: Implication for Elimination Efforts

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ABSTRACT

Background:

Onchocerciasis remains endemic in many rural communities in Nigeria despite decades of mass drug administration (MDA) with ivermectin. Accurate prevalence data at the community level are essential for tracking progress toward elimination. However, many endemic areas lack recent parasitological assessments.

Objective:

To determine the current prevalence and intensity of *Onchocerca volvulus* infection among residents of Kura LGA in Kano State, Nigeria, and to evaluate whether transmission persists at levels above the World Health Organization (WHO) elimination threshold.

Methodology:

This was a secondary analysis of cross-sectional survey data collected by the National Primary Health Care Development Agency (NPHCDA) in collaboration with the State Ministry of Health (MoH), and ESPEN from 2020 to 2024. Records of 400 participants aged ≥ 5 years from 10 onchocerciasis-endemic communities in Kura Local Government who are predominantly subsistence farmers were analysed. Microfilariae (Mf) prevalence and geometric mean intensity were determined from skin snip results. Prevalence was compared across age groups and sex using Chi-square tests.

Key Results:

A total of 400 de-identified individual records were extracted from the government dataset and included in this analysis, with participants (mean age 38.2 ± 15.4 years; 52% female) enrolled. The overall prevalence of *O. volvulus* microfilariae was 31.5% (95% Cl: 27.0-36.2). prevalence was highest among males (37.2%; 95% CI: 30.6 – 44.2) compared to females (26.3%; 95% CI: 20.8 – 32.7), with a difference of 10.9 percentage points, and in the age group 30-44 years (41.2%). Notably, 18.3% of children aged 5-14 years tested positive, indicating ongoing transmission. Only 62% of participants reported taking ivermectin within the last 12 months.

Conclusion:

Onchocerciasis prevalence in Kura LGA remains above the WHO elimination threshold (<1% in children). Suboptimal MDA coverage and persistent transmission in younger age groups call for enhanced community-directed treatment strategies and regular surveillance.

Keywords: Onchocerciasis, Kura LGA, Kano State, Microfilariae (Mf), Skin snips

INTRODUCTION

Onchocerciasis, commonly known as river blindness, is a neglected tropical disease (NTD) caused by the filarial parasite *Onchocerca volvulus* and transmitted to humans through the bite of infected blackflies of the genus *Simulium damnosum* complex [1, 2]. The disease is the world's second-leading infectious cause of blindness and causes severe skin disease, chronic itching, depigmentation (leopard skin), nodules, and permanent blindness [3], leading to social stigma and economic loss.

Globally, over 200 million people are currently at risk of the infection, with more than 99% of cases concentrated in many African countries [4,5]. Nigeria bears the highest onchocerciasis burden in Africa, particularly in areas where people live in areas near fast-flowing rivers which serves as breeding place of the vector [6, 15]. It is estimated that over 35 million people in Nigeria are at risk of infection, with approximately 5 million people already infected and nearly 350,000 suffering from blindness or visual impairment attributable to the disease [7].

The Nigerian government, in collaboration with the African Programme for Onchocerciasis Control (APOC) and its successor, the Expanded Special Project for Elimination of Neglected Tropical Diseases (ESPEN) designed by WHO Africa Regional Office (AFRO), to accelerate elimination towards 2030. This programme has implemented mass drug administration (MDA) with ivermectin since the late 1990s, which is delivered annually or biannually through community-directed treatment with ivermectin (CDTI) [8].

Considerable progress has been made, and two states in the federation have achieved elimination of onchocerciasis as a public health problem [14]. The World Health Organisation (WHO) elimination threshold requires that microfilarial prevalence in children aged 5-14 years falls below 1% and that new cases of onchocercal blindness or nodules are detected [9]. However, elimination efforts face persistent challenges: sub-optimal responses to ivermectin in some areas [10].

METHODOLOGY

Methods

Study Design and Data Source

This study is a secondary analysis of cross-sectional survey data originally collected by the National Primary Health Care Development Agency (NPHCDA) in collaboration with the State Ministry of Health (MoH), and Expanded Special Project for Elimination of Neglected Tropical Diseases (ESPEN) between June, 2020 to May, 2024. The original survey was conducted across 10 communities within Kura Local Government Area of Kano State, Nigeria, specifically targeting populations living in onchocerciasis-endemic riverine areas.

The original data collection employed a **two-stage cluster sampling design**. In the first stage, communities were selected using probability proportional to population size. In the second stage, households within each community were randomly selected, and all eligible individuals aged ≥ 5 years were invited to participate. The dataset was retrieved from the State NTD repository in June 18, 2026 after obtaining formal written permission from the Executive Secretary, Primary Health Care Development Agency.

Study population and Eligibility

The original survey targeted all residents aged ≥ 5 years who had resided in the study communities for at least 12 months. For this secondary analysis, the study included all records with complete parasitological data (skin snip results) and demographic information. Records were excluded if they belonged to individuals who:

- Had received ivermectin within 6 months prior to the survey (as recorded in the dataset),
- Had missing data on age or sex, or
- Had inconclusive skin snip microscopy results.

Variables Extracted and Defined

The study extracted the following variables from the government dataset for the analysis:

- **Primary outcome:** *Onchocerciasis volvulus* infection status, defined as the presence of at least one microfilaria (Mf) on either of two skin snips (from the right and left iliac crests). Infection intensity was measured as arithmetic mean Mf count per skin snip among positive individuals.
- **Independent variables:** Age (recorded in years and categorized into 5-14, 15-29, 30-44, 45-59, and ≥ 60), sex (male/female), duration of residence (< 10 years versus ≥ 10 years), and self-reported ivermectin intake in the preceding 12 months (yes/no).

- **Clinical Variables:** Presence of onchocercal nodules, leopard skin, lizard skin, hanging groin, and chronic pruritus, as recorded by the original survey clinicians.

Data Management

The dataset was received in Microsoft Excel format with 520 individual records. I performed data cleaning using IBM SPSS Statistics version 25.0. I checked for duplicate entries, missing values, and out-of-range values (for example, Mf counts of >500 were verified against the original laboratory sheets). Records with critical missing data (age or sex) were excluded. The final dataset used for this analysis comprised 400 participants.

Statistical Analysis

Descriptive statistics were used to summarise participants' characteristics. Categorical variables were presented as frequencies and percentages. Continuous variables (for example, age, Mf counts) were assessed for normality using the Shapiro-Wilk test; Mf counts were normally distributed and were summarized as geometric mean intensity (GMI) with ranges.

The primary outcome of prevalence of onchocerciasis was calculated as the number of Mf-positive individuals divided by the total number of participants with valid skin snip results, with 95% confidence intervals (Cl) computed using the Wilson score method.

For inferential analysis, the Chi-square test was used to compare prevalence across categorical groups (for example, sex, age categories, ivermectin intake history). The independent t-test or Mann -Whitney U test was used to compare mean of Mf counts between two groups (for example, males versus females), and the Kruskal-Walli's test was used fir comparisons across more than two groups (for example, age categories). A two-sided p-value < 0.05 was considered statistically significant.

All analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Sampling weights, if provided by the original survey, were applied to account for the complex survey design.

Ethical Considerations

The original survey received ethical approval from the Kano State Health Research Ethics Committee approval number…. And the Nigerian National Health Research Ethics Committee approval number….

For this secondary analysis, I obtained a formal data access agreement from the Kano State Primary Health Care Development Agency. The dataset was fully anonymized prior to my receipt, with no personal identifiers (names, exact household addresses) included. In compliance with data protection guidelines, all data were stored on a password-protected computer accessible only to the researcher.

Data Availability Statement

The data that support the findings of this study were provided by the State National Primary Health Care Development Agency (SNPHCDA) and are publicly available. Request for data access should be directed to the Executive Secretary subject to the agency's standard data-sharing protocols.

RESULTS

A total of 400 individuals were enrolled in the original study, all of whom completed the questionnaire and underwent skin snip examination, giving a response rate of 100%. The mean age of participants was 38.2 ± 15.4 years (range: 5 – 82 years). The study population comprised of 209 (52.25%) females and 191 (47.75%) males. The majority of the participants, 313 (78.25) were subsistence farmers, while the remainder engaged in fishing, trading, and other domestic work. Over 90% (n = 360) had resided in the community for more than 10 years.

Table 1: Socio-demographic Characteristics of Study Population.

Characteristic	Category	Frequency (n)	Percentage (%)
Sex	Male	191	47.75

	Female	209	52.25
Age group (years)	5 – 14	71	17.8
	15 – 29	89	22.3
	30 – 44	112	28.0
	45 - 59	78	19.5
	≥ 60	50	12.5
Occupation	Farming	313	78.25
	Fishing	40	10
	Trading	28	7.0
	Others	20	5.0
Residence duration	≥ 10 years	365	91.25
	< 10 years	35	8.75

Prevalence of *Onchocerca volvulus* infection

Of the 400 participants examined, 126 were positive for microfilariae (Mf), yielding an overall prevalence of **31.5%** (95% Cl: 27.0 – 36.2).

Prevalence by Sex:

Males had a significantly higher prevalence of 37.2%; 95% CI: 30.6 – 44.2 (n = 71/191), compared to females 26.3%; 95% CI: 20.8 – 32.7 (n = 55/209)

Prevalence by Age Group:

Infection prevalence varied significantly across age groups (**X^2 = 12.36**, $p = 0.015$). The highest prevalence was observed in the 30 – 44 years age group at **41.2%**, while the lowest was in children aged 5 – 14 years at **18.3%** (n = 13/71).

Table 2: Prevalence of Onchocerca volvulus by Sex

Variable	**Category**	**No. examined**	**No. positive**	**Prevalence %**	**95% Cl**
Sex	Male	191	71	37.2	30.6 – 44.2
	Female	209	55	26.3	20.8 – 32.7
Total		**400**	**126**	**31.5**	

Table 3: Prevalence of Onchocerca volvulus by Age Group

Variable	**Category**	**No. examined**	**No. Positive**	**Prevalence %**	**95% Cl**
Age (years)	5 - 14	71	13	18.3	10.2 – 29.4
	15 - 29	89	25	28.1	19.1 – 38.6
	30 - 44	112	46	41.2	32.0 – 50.8
	45 – 59	78	28	35.9	25.4 – 47.3
	≥ 60	50	14	28.0	16.2 – 42.5
Total		**400**	**126**		

95% Confidence Intervals (CI) for each Group:

Using the Wilson score method, which is the most accurate and recommended method for binomial proportions, I calculate:

Table 4: 95% Confidence Intervals (CI):

Sex	**Prevalence (%)**	**95% Confidence Interval**
Males	37.2%	30.6% - 44.2%

Females	26.3%	20.8% - 32.7%

The intervals do not overlap, which visually suggests a statistically significant difference.

Chi-square (X^2) and p-value calculation:

To test if the difference between males and females is statistically significant, I use the Pearson Chi-square test for a 2x2 contingency table.

Table 5: Contingency table (Observed counts):

Sex	Positive	Negative	Total
Male	71	120 (191 - 71)	191
Female	55	154 (209 - 55)	209
Total	126	274	400

Expected counts (if there was no difference):

- Male Positive: (191 x 126) / 400 = 60.17
- Female Positive: (209 x 126) / 400 = 65.83
- Male Negative: (191 x 274) / 400 = 130.83
- Female Negative: (209 x 274) / 400 = 143.17

Chi-square (X^2) statistic:

$$X^2 = \boldsymbol{\Sigma \frac{(O - E)^2}{E} = 5.45}$$

(Degrees of freedom = 1)

p-value:

***p*= 0,020 (or *p* = 0.0195 exactly).**

The prevalence of Onchocerca volvulus infection was significantly higher among males (37.2%) compared to females (26.3%), with a difference of 10.9 % points. This association was statistically significant (X^2 = 5.45, df=1, p = 0.020).

Intensity of Infection

Among the 126 Mf-positive individuals, the geometric mean intensity (GMI) was **8.3 Mf per skin snip** (range: 1 - 47 Mf/snip). The highest geometric mean intensities were recorded in the 30 – 44 years age group (GMI = 10.1 Mf//snip), while children aged 5 – 14 years who were positive had a substantially lower GMI of 2.4 Mf /snip.

Prevalence of Children (Elimination Indicator)

Critically, **13 out of 71** children aged 5 – 14 years tested positive, giving a prevalence of **18.3%** (95% Cl: 10.2 – 29.4). This figure is substantially higher than the WHO elimination threshold of <1% prevalence in this age group.

Self-Reported Ivermectin Coverage

When asked about the last mass drug administration (MDA) round, only **248 (62.0%)** of all participants reported having taken ivermectin within the preceding 12 months. The remaining ***n = 152*** who gave their reasons for the non-uptake included: absence during the distribution day **(n = 52, 34.2%)**, fear of side effects **(n = 42, 27.6%)**, and lack of awareness of the distribution **(n = 28, 18.4%)**. Among the **126 positive individuals**, the treatment coverage was even lower at **54.8% (n = 69)**.

Clinical Signs

Among the 126 positive participants, the most frequently observed clinical manifestations were:

- Chronic itching (pruritus): 78 (61.9%)
- Subcutaneous nodules: 41 (32.5%)
- Leopard skin (depigmentation): 27 (21.4%)
- Hanging groin: 4 (3.2%)

No cases of severe visual impairment or blindness attributable to onchocerciasis were recorded during this survey.

DISCUSSION

This community-based study revealed a persistent high prevalence of *Onchocerca volvulus* infection (31.5%) among residents of Kura LGA, with a geometric mean intensity of 8.3 microfilariae per skin snip among positive individuals. Critically, the prevalence of 18.3% observed in children aged 5 – 14 years far exceeds the WHO elimination threshold of <1%, indicating ongoing active transmission despite decades of mass drug administration (MDA) with ivermectin. These findings underscore significant programmatic gap that requires urgent remedial action.

The overall prevalence of 31.5% recorded in this study is comparable to reports from other persistent endemic foci in Nigeria. For instance, studies in parts of Kaduna and Taraba States have reported prevalence rates ranging from 20% to 45% in riverine communities to the extent of one community in Taraba recording 71.9% blindness rates among the riverine communities [11, 12]. In Kaduna riverine communities, out of 1,502 children aged 5-years examined, only 2 were found to be Sero-positive, but in the other age groups the prevalence was similar compared to Taraba State [13].

However, it is notably higher than the overall <5% prevalence reported in states that have successfully interrupted transmission, such as Plateau and Nasarawa, where sustained high-coverage MDA has been implemented for over 15 years [9]. This contrast suggests that Kura LGA community contrary what was claimed in Yahaya et al. (2021) remain a recalcitrant hotspot where elimination efforts have stagnated or regressed [18].

The most alarming finding is the 18.3% prevalence among children aged 5 – 14 years. In an elimination setting, this age group serves as a sentinel indicator because they have been born after the peak of MDA interventions and thus have minimal exposure to infective bites. The high positivity rate in this cohort points to ongoing transmission rather than merely residual infections from the pre-MDA era [10].

Several factors likely contribute to this. First, the self-reported ivermectin coverage in the preceding 12 months was only 62%, well below the recommended 80% community coverage threshold required to interrupt transmission [14]. Second, the proximity of the community to fast-flowing rivers ensures continuous blackfly breeding and human-vector contact, particularly during farming and fishing activities, which are the primary occupation s of 78% of participants.

The suboptimal MDA coverage of 62% in this study is a critical bottleneck. The reasons cited by non-participants absence during distribution of the drug (34.2%), fear of side effects (27.6%), and lack of awareness (18.4%) are consistent with barriers reported in other Nigerian and sub-Saharan African settings [17]. Absence on distribution days often reflects the timing of MDA campaigns, which may coincide with peak agricultural seasons when farmers migrate to farm settlements far from the distribution points. Fear of side effects, particularly the severe itching and oedema associated with the Mozzati reaction in heavily infected individuals, remains a powerful deterrent. This highlights the need for enhanced community health education that not only promotes uptake but also prepares communities for expected adverse events and manages them effectively at the primary care level.

With regard to infection intensity, the geometric mean of 8.3 Mf/snip, with a range of reaching 47 Mf/snip in some adults, is clinically significant. High microfilarial loads are directly correlated with the development of ocular lesions and consequent blindness [13]. The observation that the highest intensity occurred in the 30 – 44 years age group (10.1 Mf/snip) reflects cumulative exposure over decades of agricultural work near vector breeding sites. This age group also constitutes the most economically productive segment of the community,

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meaning the disease burden translates directly into lost workdays, reduced agricultural output, and household economic strain translating to a classic poverty -disease trap.

Clinically, the high prevalence of chronic pruritus (61.9%) and subcutaneous nodules (32.5%) among positive participants is noteworthy. While onchocerciasis is often associated with blindness in public health messaging, the dermatological burden is actually the most common and distressing manifestation [2, 11]. Chronic itching leads to sleep deprivation, skin excoriation, secondary bacterial infections, and profound social stigmatization, particularly for women with leopard skin depigmentation [10]. The fact that 21.4% of positive participants had leopard skin indicates long-standing, untreated infection, reinforcing the conclusion that MDA coverage has been historically insufficient in this locale.

In many resource-poor settings, the biannual community directed distribution of ivermectin has resulted in partial or total interruption of the disease (Plateau and Nasarawa States), and often leading to total elimination of onchocerciasis in some countries like Ecuador, Guatemala, and Colombia. While in some countries, elimination was achieved by combining WHO guidelines with the community guidelines by changing treatment frequency to quarterly as it occurred in Mexico in 2015 [14]. In some other areas, using larvicidal such as DDT along the channels that the river flows have been found to be effective in curbing the conducive breeding sites of the black fly (*S. damnosum* complex), particularly in high transmission areas where there is low rainfall [15].

Implications for Elimination

The finding that 18.3% of children harbour microfilariae is a red flag for the Nigerian onchocerciasis elimination programme. It demonstrates that, in this community (Kura LGA), the current MDA strategies have failed to interrupt transmission of the disease. The WHO in conjunction with the Federal Ministry of Health in Nigeria has set the elimination of onchocerciasis as a public health problem requiring that prevalence in children falls below 1% [16]. This study data shows that the country is far from that target, as such, the study recommends the following evidence-based interventions for Kura LGA community and other similar hotspots:

1. **Twice-yearly or Quarterly ivermectin distribution**
   Biannual MDA can be changed to quarterly instead of annual distribution, which has been shown to accelerate transmission interruption in hyper-endemic foci as observed in Mexico [14].
2. **Community-directed treatment with ivermectin (CDTI)**
   It should be revitalised with active involvement of community leaders, traditional rulers, NGOs, and women's group to address the "absence during distribution barriers" [18].
3. **Intensive health education**
   Campaigns to demystify adverse effects and emphasizing the long-term benefits of consistent drug intake should be directed toward the community, as well as instructing the people to avoid contact with water sources where chemicals were not applied [14].
4. **Integration with vector control**
   Where feasible, larviciding of Simulium breeding sites could supplement chemotherapy, particularly in riverine hotspots [14, 15].
5. **Regular post-MDA surveillance**
   Using the Ov-16 rapid diagnostic test often in combination with ELISA in children to monitor transmission trends without the invasiveness of skin snips [2, 19].

Strengths and Limitations

The strength of this study lies in its rigorous parasitological confirmation using the gold-standard skin snip method, which provides objective prevalence and intensity data, unlike rapid diagnostic tests that indicate exposure. The high response rate (100%) and double-reading of slides by trained microscopists enhance the reliability of our estimates. By focusing on the 5 – 14 years age group, the study has provided a direct, measurable indicator for the state elimination programme.

Nevertheless, several limitations must be acknowledged. First, the cross-sectional design precludes assessment of temporal trends or incidence, the author can only measure current prevalence. Second, skin snip microscopy, though specific, has reduced sensitivity in low-intensity settings (though it is not the case here). Third, this study was conducted in a single community, which limits the generalizability of the findings to other ecological zones in Nigeria. However, purposively selecting a known hyper-endemic community provides valuable "sentinel site" data for programme decision-making at the local level. Fourth, MDA coverage was assessed by self-report, which is subject to recall bias and may overestimate true intake. Fifth, the study did not perform vector studies (blackfly infectivity) to determine how infective it was, or the "molecular xeno-monitoring", which could have further confirmed ongoing transmission.

CONCLUSION

This study reveals that onchocerciasis remains highly endemic in Kura LGA, with an overall prevalence of 31.5% and, more critically, a prevalence of 18.3% among children aged 5 – 14 years, as against the prevalence of 0.0% in a study in Yahaya et al. (2021) in the whole Kano Central Senatorial District, Kura LGA inclusive, which is far exceeding the WHO elimination threshold of <1%. These findings in Kura LGA confirm the ongoing active transmission despite years of mass drug administration. Suboptimal ivermectin coverage (62%), driven by distribution timing, fear of side effects, and inadequate community awareness, appears to be the primary modifiable barrier. To avert continued morbidity and achieve national targets for elimination as observed in Miri et al. (2022), is to consider this study recommendations of urgent shift to quarterly MDA, revitalised community-directed treatment with robust health education, as well as intensifying the post-MDA surveillance, particularly in hard-to-reach riverine hotspots. Without these targeted interventions, this community will remain a reservoir of infection, perpetuating transmission and undermining Nigeria's broader elimination efforts.

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Competing interest

The author has no competing interests.

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