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*Research Article*

# Post Evaluation of Mass Drug Administration Against Lymphatic Filariasis Transmission in Two Communities in Akwanga Local Government Area, Nasarawa State, Nigeria

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## ABSTRACT

**Background:** Lymphatic filariasis (LF) remains a significant neglected tropical disease in Nigeria, particularly in rural communities. Mass drug administration (MDA) is the primary elimination strategy, but posttreatment surveillance is critical to confirm transmission interruption and detect potential resurgence. Therefore, this study evaluated the impact of MDA after treatment on the prevalence, transmission and control of lymphatic filariasis in two selected communities in Akwanga Local Government Area (LGA) of Nasarawa State, Nigeria.

**Methodology:** A community-based cross-sectional study was conducted between July and November 2024. Capillary blood samples were collected from 97 participants (53 from Ungwan Zaria, 44 from Ungwan Habu). Thick and thin blood smears were stained with 10% Giemsa and microscopically examined for microfilariae. Hematological parameters including hematocrit (HCT), white blood cells (WBC), neutrophils, lymphocytes, monocytes, eosinophils, basophils, RBC and hemoglobin were analyzed.

**Results:** No microfilariae were detected in any participant (0.0% prevalence), indicating that there was no active transmission of LF after MDA. However, hematological abnormalities were observed: elevated lymphocytes (44.77-58.08% vs normal 20–40%), low neutrophils (20.25-22.59% vs 55-70%, reduced RBC (0.71-1.74 mil / mcl vs 3.92-5.65 mil / mcl) and low hemoglobin (1.20-13.24 g / dl vs 12-18 g / dl). In particular, eosinophil counts were elevated in Ungwan Habu (1.81±0.572% vs. normal 1 to 4%), suggesting possible persistent antigenic stimulation.

**Conclusion:** The implementation of MDA effectively interrupted the transmission of LF in both communities. However, persistent hematological abnormalities-particularly eosinophilia and lymphocytosis-may indicate ongoing immune activation or the risk of recurrence. Post-MDA hematological surveillance is recommended as a low-cost complementary tool to standard transmission evaluation surveys.

**Keywords:** Mass Drug Administration, Lymphatic filariasis, Elephantiasis, *Wuchereria bancrofti*, Transmission interruption, Post-evaluation, Hematological parameters, Biomarkers, Nasarawa State, Central Nigeria

## 1. Introduction

Filariasis, also called neglected tropical diseases (NTDs), is a disease caused by *Wuchereria bancrofti*[1,2]. Lymphatic Filariasis (LF), commonly known as 'elephantiasis,' is a parasitic disease that can remain asymptomatic for extended periods; however, even in its silent phase, it can cause significant damage to the lymphatic, renal and immune systems[2]. The infection is primarily caused by thread-like nematodes such as *Wuchereria bancrofti*, *Brugia malayi* and *Brugia timori* and *Wuchereria bancrofti* is responsible for approximately 90% of all cases[3,4]. Although lymphatic fibrosis rarely leads to death, it is recognized as the second leading cause of long-term disability worldwide[5]. Disease predominantly affects impoverished and marginalized populations in developing countries[6,7].

Adult worms live in the human lymphatic system and can cause permanent tissue damage, thus being considered the second most common parasitic disease (after malaria)[8]. Prolonged cases of nodule are becoming more and more common in male adults, resulting in severe lymphatic congestion and preventing it from flowing very well and it also causes lymph in the limb, breast and testicle of the bag. These manifestations cause severe distress, poor work performance and social stigmatization in afflicted people[5]. The disease also causes considerable physical and emotional suffering caused by deformation, hydrocoele, lymphangitis and elephantiasis. In some cases, patients experience lymphedema, an accumulation of fluid that causes swelling in the legs, arms and genital areas after long-term infection due to blocked or impaired lymphatic drainage. Fever, chills and leukocytosis (an excessive white blood cell count) are among the other symptoms of this disease. Globally, lymphatic fibrosis is the fourth most important and second largest contributor to chronic disability, causing substantial economic loss due to lost productivity and incapacitation of work[9,10]. Lymphatic filariasis can be diagnosed using night blood samples (blood is drawn at dusk and dawn) with the detection of mosquito-transmitted *Dirofilaria* parasites in blood smears by microscopy, IgG4 based immunoassay, polymerase chain reaction (PCR) for parasite DNA or Immuno-chromatographic card test for detection of circulating filarial antigen (CFA)[10].

On a global scale, the World Health Organization (WHO) estimated that 120 million people are affected by it and among them, an estimated 40 million are considered to have clinically relevant manifestations and they not only greatly affect victims' health, but also pertain to an enormous socioeconomic encumbrance[11]. However, the World Health Organization noted that more than 856 million people in 52 countries around the world are at risk for contracting the disease. In Africa, the disease is endemic in 34 countries and Nigeria was ranked as the third most endemic country in the world after India and Indonesia[5]. 22.1% of the Nigerian population has been estimated to be infected, with 66% having a potential risk of infection (third only in India and Indonesia, closely followed by Guinea Papua), with prevalence in the northern central part of the northern part 8.2%, the northern-western region 7.8%, the south-east 7.1% and that morning the south-south had a prevalence rate of 2.5[12]. Nigeria is suspected to be the worst affected, with approximately 80-120 million people estimated to be at risk of infection[13]. The ongoing transmission of the disease in Nigeria was recently recorded[14] reporting a prevalence of 11.04% in Katsina state, while Elkanah, et al.[15] documented a prevalence of 32.64% in Taraba state, but lymphatic filariasis is also one of the six eradicable NTDs.

These arthropod-borne nematodes flourish in tropical and subtropical regions where mosquito populations are abundant, since mosquitoes serve as the main vector of transmission[7]. The infection spreads to humans through the bite of a mosquito that carries the infective larvae of the parasite. In Africa, *Anopheles* mosquitoes are the predominant vectors, while *Culex quinquefasciatus* is more common in the Americas and *Mansonia* and *Aedes* species are significant vectors in the Pacific and Asian regions[16]. Several mosquito species are involved in transmitting the disease, including: i) *Anopheles* species: *An. arabiensis*, *An. bancrofti*, *An. gambiae*, *An. melas*, *An. punctulatus*, *An.farauti*, *An. merus* and *An. wellcomei*; ii) *Culex* species: *C. quinquefasciatus*, *C. pipiens*, *C. annulirostris* and *C. bitaeniorhynchus*; iii) *Aedes* species: *A. bellator*, *A. aegypti*, *A. cooki*, *A. rotumae*, *A. darlingi*, *A. kochi*, *A. vigilax*, *A. scapularis* and *A. polynesiensis*; iv) *Mansonia* species: *M. uniformis* and *M. pseudotitillans*[16]. Although these mosquito species differ widely in their ecological preferences, biological characteristics and transmission efficiency, only *Anopheles funestus*, *Anopheles gambiae* and *Culex quinquefasciatus* are known to transmit *Wuchereria bancrofti* in sub-Saharan Africa[6].

Lymphatic filariasis elimination programs for neglected tropical diseases reduce the transmission and infection rate in an endemic area[1]. This is implemented by mass delivery of medications annually (Mass Drug Administration [MDA] preventive chemotherapy made from safe medicine), primary care for those who develop complications and reducing exposure to bites[1,17]. The global burden of vector-borne diseases is considered high and thus community mobilization, health education and vector control are key preventive measures[12]. Improving the level of consciousness among the public in endemic and non-endemic areas through information, education and communication (IEC) and behavior change communication (BCC), together with environmental management measures that include clearing vegetation, draining stagnant water and ensuring clean environments, may inversely cut the time of effective intervention efforts[3]. In 2018, the Pre-Transmission Assessment Survey (Pre-TAS) was carried out in the Abaji and Kuje Area Councils after they achieved the operational thresholds of five or more effective rounds of annual mass drug administration (MDA), with at least 65% therapeutic coverage and geographic coverage reaching all parts. The pre-TAS stage of both councils was cleared and therefore they were eligible for the first Transmission Assessment Survey (TAS 1). Pre-TAS was conducted in 2019 in one sentinel site and >1 spot-check sites within each council, indicating the prevalence of Lymphatic filariasis Ag <2% (0.00%-1.99%). The results of the TAS follow-up revealed that both evaluation units had reached the antigen threshold to stop MDA, indicating strong progress toward transmission interruption. Therefore, the FCT has achieved significant milestones in the elimination of lymphatic filariasis and is ready to stop treatment in two area councils. However, two more councils need another 2 years of sustained and effective MDA rounds before becoming eligible for further impact evaluations[3]. Interestingly, the Carter Center[19] reported a successful elimination of the parasite in the Plateau and Nasarawa states, respectively. To this end, this study was intended to evaluate the efficacy and sustainability

of the Mass Drug Administration against lymphatic filariasis in the communities of Ungwan Zaria and Ungwan Habu in the Akwanga Local Government Area (LGA) of Nasarawa State, Nigeria.

## 2. Materials and Methods

### 2.1. Study area

The study was carried out in the areas of Ungwan Habu (latitude 8.936767, longitude 8.232139) and Ungwan Zaria (latitude 9.016064, longitude 8.293720) in Akwanga LGA of Nasarawa State, North Central Nigeria. Nasarawa State is snuggly located between the Federal Capital Territory (FCT) to the west and Plateau State to the south. Of the 36 states in Nigeria, Nasarawa ranks fifteenth in area and has a population of approximately 2.5 million people[18]. The state is predominantly in the tropical Guinean forest savanna mosaic ecoregion.

### 2.2. Ethical approval

Ethical approval was obtained from the Nasarawa State Ministry of Health, through the Human Research Ethics Committee Lafia, Nasarawa State. Permission was obtained from the Director of Primary Healthcare (PHC) of Nasarawa Local Government Area (NHREC PROTOCOL NO: 18/06/2017) and the Chief Medical Officer of the community clinic, while home owners were contacted and informed of the nature of the research work and also their request for consent before samples were collected.

### 2.3. Sample collection

A cross-sectional study was carried out in the two communities between July and November (2024). Samples were collected from Ungwan Habu and Ungwan Zaria in Akwanga Local Government Area of Nasarawa State. The samples were collected between July and November 2024. The target audience was not age-specific, while the collection site was determined by previous research on lymphatic filariasis infection within the two communities of study[19]. Blood samples were collected using a good standardization tool, which is key to maintaining the quality of the samples collected and transported. Whole blood capillary was obtained from a human host's finger[13].

### 2.3. Laboratory analysis of blood sample

The preparation and staining of the blood slides followed the standard procedures adopted by the World Health Organization[2] using 10% Giemsa staining at pH 7.2. The blood sample was obtained by aseptic technique from the subjects after swabbing their fingertips with 70% alcohol and drying for a while; then piercing (pricking) each adult subject's finger tips once using the order one sterile lancet order. Hematological parameters including hematocrit (HCT), white blood cell (WBC), neutrophils, lymphocytes, monocytes, eosinophils, basophils, red blood cell (RBC) and hemoglobin were analyzed.

### 2.4. Smear preparation

For the thin smear, a drop of blood was placed on a clean, dry, grease-free glass slide, which has been marked. The blood was spread with a 60° angle drilling spreader to smooth the tail of the stream. The smear was air dried and subsequently fixed with methanol for 1 to 2 minutes. Subsequently, the smear was washed with water for 2-5 seconds and stained with 10% Giemsa for a duration of 45 minutes and again washed followed by air drying. For the thick blood smear preparation, 2 drops of blood were used, smeared to a moderate thickness on a grease-free slide. The thick and thin film blood smears were stained with Giemsa and oil immersion was applied on the stained slides and the filarial worms and other blood parasites through 100× objective of the light microscope. Positive results indicate the presence of microfilaria, although the presence of white blood components such as eosinophil, basophil, neutrophil and lymphocytes with abnormal range could serve as an indicator of the presence of lymphatic filariasis [2].

### 2.5. Data analysis

A simple percentage was used to determine the prevalence of lymphatic filariasis in the study area. The hematological biomarkers of the subjects between two study areas were compared using one-way analysis of variance (ANOVA). The significance level was established at $P < 0.05$.

## 3. Results

A total of 97 subjects were tested for lymphatic filariasis in which none (0, 0.00%) were infected as shown in Table 1. Table 2 revealed the hematological parameters of the two study sites. HCT was higher in Ungwan Zaria 41% than in Ungwan Habu 32%, yet it fell below the respective normal range for men 42-50% and women 37-47%. The count of WBC in Ungwan Zaria 3417±358.36 was greater than in Ungwan Habu 2106.82±408.08 and interestingly, both counts were within the normal range of 1500-8000%. The neutrophils in Ungwan Habu had a more 22.59±2.57 than in Ungwan Zaria,20.25±2.299, however, both counts were below the normal range of 55-70%. The lymphocytes recorded in Ungwan Zaria had a high value of 58.98±4.52 than Ungwan Habu with a value of 44.77±4.76, but both counts were far higher than the normal range of 20-40%. Monocytes were higher in Ungwan Habu 3.45±0.785 than in Ungwan Zaria 0.98±0.45 but only subjects from Ungwan Habu were within the normal range of 2-8%. Ungwan Habu recorded a high Eosin count of 1.81±0.572 over Ungwan Zaria 0.57±0.348 and only Ungwan Habu subjects were in the normal range of 1-4%. The Basophils in Ungwan Habu were high 0.43±0.188 and low in Ungwan Zaria 0.19±0.101 yet the Ungwan Habu subjects screened were marginally within the normal range of 0.5-1%. The level of RBC in Ungwan Zaria more 1.74±0.160 than in Ungwan Habu 0.71±0.191 and yet the subjects in both communities were not within the normal range for men 4.35-5.65 mil/mcl and women 3.92-5.13 mil/mcl, respectively. The HGB count in Ungwan Zaria was dominant13.24±0.901 over that of Ungwan Habu 1.20±0.677 and remarkably none of the subjects in both communities were within the normal range for men 14-18 g/dl as well as women 12-16 g/dl.

**Table 1:** Prevalence of Lymphatic Filariasis in Ungwan Habu and Ungwan Zaira Communities, Akwanga LGA, Nasarawa State, Nigeria.

| Location | No. Examined | No. Infected (%) |
|---|---|---|
| Ungwan Zaria | 53 | 0(0.00) |
| Ungwan Habu | 44 | 0(0.00) |
| **Total (%)** | **97** | **0(0.00)** |

**Table 2:** Hematological Profile of Lymphatic Filariasis Post-MDA Populations in Ungwan Habu and Ungwan Zaira Communities, Akwanga LGA, Nasarawa State, Nigeria.

| Variable | Communities | | | F | P | LOS |
|---|---|---|---|---|---|---|
| | Normal Range | Ungwan Zaria | Ungwan Habu | | | |
| HCT | 42-50% | 41% | 32% | 14.50 | 0.000 | * |
| WBC | 1500-8000 | 3417±358.36 | 2106.82±408.08 | 5.861 | 0.017 | * |
| NEUT | 55-70 | 20.25±2.299 | 22.59±2.57 | 0.464 | 0.498 | ns |
| LYMPH | 20-40 | 58.98±4.52 | 44.77±4.76 | 4.652 | 0.034 | * |
| MONO | 2-8 | 0.98±0.45 | 3.45±0.785 | 8.115 | 0.005 | * |
| EOSIN | 1-4 | 0.57±0.348 | 1.81±0.572 | 3.763 | 0.06 | ns |
| BASO | 0.5-1 | 0.19±0.101 | 0.43±0.188 | 1.423 | 0.236 | ns |
| RBC | 4.35-5.65 mil/mcl | 1.74±0.160 | 0.71±0.191 | 17.204 | 0.001 | * |
| HGB | 14-18 g/dll | 13.24±0.901 | 1.20±0.677 | 106.599 | 0.001 | * |

**Note:** M±S.E, * = Significant at $p < 0.05$, ns = Not significant, LOS = Level of Significance

## 4. Discussion

Mass drug administration (MDA) is a program designed to cure everyone at risk by providing treatment to all residents within a specific geographic location[20]. The result in this study indicates that there is no LF transmission after MDAs, which possibly suggests that transmission eradication has already occurred. Our finding is in line with the review carried out by Mohamed, et al.[21] that demonstrated more than 50% and possibly 100% reduction in LF indices after MDA in endemic populations of high prevalence. Mohamed, et al.[21], demonstrated that combination therapy was superior in reducing the transmission intensity index and the infectivity rate compared to single therapy, which could be explained by the beneficial impact of the combination of drugs. However, other studies show that stop MDA thresholds do not necessarily prevent interruption of transmission in every environment. Because investigations in American Samoa[22,23], Sri Lanka[24,25] and Zanzibar[26] indicated that when all or part of one or more transmission assessment surveys (TASs) are passed, the situation persists or even intensifies in terms of the transmission of *W. bancrofti*. Biritwum, et al.[27] reported that lymphatic filariasis infection has persisted in certain communities in Ghana even after more than 15 years of directly reported (theoretical but may not have invariably been adhered to by community drug distributors) MDA treatment, which is alleged to cover more than 65% of the endemic population. They opined that it was due to disparities in risk factors, treatment coverage, survey participation or a combination of any of these in adults and children who are the target population in transmission assessment surveys (TAS).

Follow-up measurements of hematologic parameters after mass drug administration (MDA) of lymphatic filariasis (LF) can provide valuable hints regarding the risk of relapse or continued infection. The results of the hematological parameters between the study communities show that the eosinophil in Ungwan Habu had a higher value (1.81±0.572%) than Ungwan Zaria, (0.57±0.348%) and a reference range (normal range) of 1.4%. The high level of eosinophils in Ungwan Habu over the normal eosinophil rate may suggest a possible future reoccurrence of the disease in the community, as the persistently high eosinophil count may suggest ongoing or recurrent infection. This is consistent with the results of Evans et al.[28], which found a strong predictive association between increased eosinophil blood counts and filariasis infection. Similarly, Debrah et al.[29] demonstrated that in chronic untreated infection, there is continued infiltration of eosinophils and macrophages leading to irreversible tissue damage, emphasizing the need for early detection and broad treatment. A study reported that an eosinophil counts exceeding 10% was present in 80% of filariasis patients, indicating its prevalence in active infections[30]. Also, another study observed that after diethylcarbamazine (DEC) treatment, there was marked activation and degranulation of eosinophils, indicating their participation in the immune response after treatment[31]. Riches et al.[32] reported research in Papua New Guinea where they found that filarial antigenemia remained in some individuals even after multiple rounds of MDA, suggesting that antigen levels can persist and may not always correlate with active infection. Eosinophils play an important role in parasitic infections, as persistent eosinophilia after MDA suggests ongoing immune stimulation by filarial antigens, even in the absence of detectable microfilariae. Bregani et al.[33] emphasized eosinophilia as a marker of parasitic activity.

The preponderance of white blood cell count (WBC) of 3417±358.36 in Ungwan Zaria than in Ungwan Habu 2106.82±408.08 and normal range of 1500-8000%, however, the WBC values of the two communities fall within the normal range value. Furthermore, a significant difference was observed in the WBC value between the two locations sampled. Reports have shown that chronic filariasis can lead to mild leukocytosis (elevated WBC count), especially during acute attacks (e.g., filarial adenolymphangitis), as this decrease after MDA indicates resolution while an elevated WBC could hint at persistent or secondary bacterial infection[34]. WBC counts, particularly differential counts (neutrophils, lymphocytes, monocytes), can provide information on the body's response to infection[34]. Our finding shows that neutrophils in Ungwan Habu were more 22.59±2.57% in comparison to Ungwan Zaria 20.25±2.299%, nevertheless, the neutrophil rate in both communities was still less than the normal range of 55-70%. The low neutrophil rate in this investigation suggests that the screened subjects are not a cause of concern nor indicate a common or serious neutrophil-related toxicity from ivermectin-albendazole MDA. This agrees with the study on PA-96 surveillance of hematological and biochemical changes after mass administration of ivermectin and albendazole for the control of lymphatic filariasis in endemic communities of Tanzania by Fimbo et al.[35] who opined that a low neutrophil level would require individual clinical evaluation. On the contrary, the work of Shenoy et al.[34] noted increased neutrophils during episodes of adenolymphangitis (ADL) in children with lymphatic filariasis, since elevated neutrophils after MDA have been shown to reflect acute inflammation, often seen

with lymphoedema or elephantiasis as a result of lymph damage. Similarly, Arndts et al.[36] reported a significantly higher level of neutrophils among microfilaria negative individuals compared to those who were microfilaria positive. This difference was attributed to homeostatic restoration of neutrophil activation after a short course of ivermectin (IVM) treatment, which helps normalize immune responses after parasite clearance[29].

Differences in lymphocyte rate in this study were significantly different between subjects screened in the two communities in which Ungwan Zaria had a higher value (58.98±4.52%) than Ungwan Habu (44.77±4.76%) and interestingly, both values are more in the normal range of 20-40%. The high number of lymphocytes in this work indicates an active immune response that is reestablishing protective surveillance following the reduction of parasite burdens by widespread drug administration. This increase indicates that persistent infection no longer suppresses the host's immune system, which is successfully building a cellular defense against any remaining filarial antigens. Therefore, in lymphatic filariasis elimination programs, this immunological shift facilitates the transfer from mass medication administration to post-treatment surveillance phases and offers a quantifiable biomarker of treatment efficacy. This is consistent with the finding of Eigege et al.[37] who observed higher lymphocyte count among subjects screened in post-MDA communities in Plateau and Nasarawa States, Nigeria. Chronic lymphatic filariasis has been shown to result in suppression of T cells, altering lymphocyte counts and function. It shows that T cell anergy can persist in individuals with active or recurring infection. In addition, an alteration of the immune response can occur due to chronic exposure to antigens[20,38].

The strikingly high monocyte count in Ungwan Habu (3.45±0.785) over Ungwan Zaria (0.98±0.45) after LF MDA most plausibly signals different levels of underlying infection/ inflammation (including residual LF), not a primary toxicity signal of MDA drugs. Additionally, the monocyte reference range of 2-8% in which Ungwan Habu was observed to fall within, as well as the low count recorded in Ungwan Zaria, possibly implies that subjects with LF after MDA have a lower inflammatory burden which may be closer to the true postelimination state, but still needs standard confirmation of TAS / antigen / Mf. This agrees with the findings of recent studies in Nigeria's Federal Capital Territory, East New Britain Province, Papua-Neuve Guinea and Nepal, respectively[39-41]. On the other hand, high mean monocytes, above the reference range, connote ongoing antigenic stimulation (residual transmission of LF or other infections); community may be a post-MDA hotspot that needs increased surveillance and possibly additional rounds of MDA[41-43]. The Basophil count in Ungwan Habu shows a predominant count of 0.43±0.188 than in Ungwan Zaria 0.19±0.101 but relatively below the normal range of 0.5-1%. Basophils are involved in histamine-mediated responses, since elevated levels can indicate chronic immune activation or a persistent antigenic presence[44]. Charles and Blank[44] discussed basophil activation as a marker of filarial activity. Therefore, monitoring all these white blood cell counts (WBCs) can help detect inflammatory responses indicative of recurrence or complications of lymphatic filariasis.

The RBC value recorded in Ungwan Zaria and Ungwan Habuwas 1.74±0.160 and 0.71±0.191, respectively, differed significantly, but both were less than the normal range for men 4.35-5.65 mil/mcl and women 3.92-5.13 mil/mcl. Therefore, the differences in community-level RBC in this study are more likely to reflect background anemia and local factors or nondrug causes of anemia (e.g. nutritional deficiencies, other infections) than a major harmful effect of LF drugs, although low values still merit broader clinical and epidemiological evaluation. Our finding is consistent with other studies in the literature that found that in LF-endemic settings, ivermectin, albendazole and DEC-based MDA can cause small decreases in RBC and a proportion of values below reference, but these changes have been characterized as minor, transient and with minimal clinical safety concerns and large datasets have not shown consistent hematologic toxicity[35,45-47]. On the other hand, chronic lymphatic filariasis has been shown to lead to anemia of chronic disease, nutritional deficiency due to immune burden, secondary infections and inflammatory cytokine production. Persistent anemia or low PCV/RBC post-MDA may indicate underlying or recurrent infection, especially in resource-limited endemic settings[48].

Although HCT significantly varied between the two communities, Ungwan Zaria having 41% while Ungwan Habu had 32%, however, both were below the normal or reference ranges for both men (42-50%) and women (37-47%). Low HCT in the two post-MDA communities in this study may indicate mild anemia, but it does not, in itself, prove dangerous drug toxicity. Differences between communities could also reflect baseline nutrition, coinfections or sex/age structure, not just exposure to MDA. This is in line with the work of Fimbo et al.[35] who reported that HCT changes may occur after mass administration of Ivermectin and albendazole for control of lymphatic filariasis in Tanzania, but without significant changes in biochemical parameters. Additionally, another study shows that a persistent substantial hematocrit depression after MDA is not a typical or expected drug toxicity signal across diverse regions[49].

Similarly, hemoglobin (HGB) was high (13.24±0.901 g/dl) in Ungwan Zaria and low (1.20±0.677 g/dl) in Ungwan Habu, yet subjects in both communities were below the normal range for men (14-18 g/dl) and women 12-16 g/dl. The low variable HGB observed between the two post-MDA LF communities in this study is consistent with documented mild postMDA declines in hemoglobin, but current evidence argues against severe druginduced hematologic toxicity. Our finding should prompt the evaluation of broader determinants of anemia (nutrition, coinfections, sex distribution), not only focused on MDA exposure[35]. Osei-Atweneboana et al.[48] linked low HGB levels with chronic parasitic infections in community's endemic to lymphatic filariasis. Although specific studies on post-MDA HGB and level are limited, anemia remains a concern in areas endemic to lymphatic filariasis. The persistent low level of HGB after MDA may indicate ongoing disease activity or reinfection. Studies have reported lower hemoglobin levels in individuals with lymphatic filariasis, indicating the impact of the disease on red blood cell production. Furthermore, in a similar study by Rani and Shameem[50] hemoglobin parameter in 20 filariasis subjects, a reduction in their hemoglobin level was observed. Therefore, monitoring hemoglobin levels after MDA can help detect anemia, which may be a sign of ongoing infection or complications[48]. Krentel et al.[51] applied machine learning and a statistical model to predict the risk of lymphatic filaria using hematologicasl data. These models that use patterns in

eosinophil counts, differential WBC, hemoglobin levels, etc., to identify individuals likely to relapse or maintain infection have been proven to be very useful and cost-effective.

The findings and fluctuations in hematologic parameters in this study can be attributed to the complete absence or limited number of microfilariae in the bloodstream of participants in the two study communities, as the presence of microfilaria helps induce reactions and responses in the body. Although mass drug administration (MDA) has proven to be effective in reducing microfilaremia and transmission, post-MDA surveillance is critical for detecting persistent or reemerging infections. Conventional methods such as immunochromatographic card (ICT) tests and ultrasound detection are widely used but are often costly or logistically demanding in rural settings. Therefore, exploring hematological parameters as a low-cost and accessible predictive biomarker tool for reoccurrence offers significant public health value.

## 5. Conclusion

The findings of this study demonstrate that mass drug administration (MDA) has successfully interrupted lymphatic filariasis (LF) transmission in Ungwan Zaria and Ungwan Habu, Akwanga Local Government Area, Nasarawa State, Nigeria, as evidenced by the complete absence of microfilaria (0.0% prevalence) among the 97 participants screened. This outcome aligns with the Carter Center's report of successful LF elimination in the Plateau and Nasarawa states and underscores the effectiveness of annual MDA programs in endemic settings. However, the observed hematologic abnormalities, particularly elevated eosinophil counts in Ungwan Habu (1.81±0.572%) and persistent lymphocytosis in both communities, suggest ongoing immune stimulation by residual filarial antigens, even in the absence of detectable microfilariae. These findings highlight the necessity of sustained post-MDA surveillance to detect potential reemergence or residual hotspots of transmission. Although conventional methods such as immunochromatographic tests are valuable, their cost and logistical demands in rural settings limit accessibility. Therefore, integrating hematological parameters as low-cost predictive biomarkers into routine post-elimination monitoring frameworks offers a practical and cost-effective strategy. Continued health education, environmental management and periodic reassessments remain essential to sustain elimination gains and prevent a future resurgence of lymphatic filariasis in these communities.

## 6. Conflicts of Interest

The authors declare no conflict of interest.

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