

Prevalence and Seasonality of Malaria Infection in Obi and Keffi LGAs, Nasarawa State, Nigeria

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Submitted: 12 February 2026 Accepted: 09 March 2026 Published: 16 March 2026

Citation: Luka, J., Maikenti, J. I., Ashigar, M. A., Ombugadu, A., Innocent, I. G., & Pam, V. A. (2026). Prevalence and Seasonality of Malaria Infection in Obi and Keffi LGAs, Nasarawa State, Nigeria. *J of Infec Dise and Vir Res*, 5(2), 01-06.

Abstract

Malaria remains a major public health concern in Nigeria, accounting for significant morbidity and mortality, especially among children. Therefore, this study investigated the prevalence and seasonal variation of malaria infection in Gwadenye and Angwan Alheri communities within Obi and Keffi Local Government Areas (LGAs) of Nasarawa state, Nigeria. Blood samples were collected from 879 individuals between March 2023 and February 2024 and tested using Rapid Diagnostic Tests (RDTs). Of the subjects screened, 317 (36%) tested positive out of the eight hundred and seventy-nine (879) subjects that were screened. A significantly ($P < 0.05$) higher malaria prevalence was recorded in wet season (39%) compared to the dry season (31%). Although infection was slightly higher in males (37%) than females (35%), the difference was not statistically significant ($P > 0.05$). Across age groups, children aged 0–10 years had a significantly higher prevalence (10%) than adults aged 21 and above, and differences varied significantly ($P < 0.05$). Geographically, Keffi LGA recorded a significantly ($P < 0.05$) higher infection rate (23.4%) than Obi LGA (12.3%). Monthly prevalence also varied significantly ($P < 0.05$), peaking in August and October and reaching its lowest in April and February in Keffi and Obi, respectively. Malaria remains an all-year-round public health burden in the study communities as such requires a corresponding all year-round malaria intervention with focus on seasonality and age.

Keywords: Malaria, Public Health, Infection, Seasonality, Keffi and Obi LGAs of Nasarawa State.

Introduction

Mosquitoes are small insect with short lifespans but capable of wreaking havoc on human lives ranging from their itchy bites to disease transmission which is sometimes deadly [1]. Malaria is preventable and curable but life-threatening disease that continues to be a significant threat to public health in Nigeria [2]. Though the disease is caused by protozoan parasites and mostly spread through the bites of infected female Anopheles mosquitoes, blood transfusion and contaminated needles may transmit malaria [3, 4]. It is endemic in much of the tropics and remains a global riddle with nearly half of population, mostly in Sub-Saharan countries, at risk in spite of all effort to control the disease [5]. Five *Plasmodium* (*P.*) species cause human malaria; *P. malariae*, *P. ovale*, *P. knowlesi*, *P. falciparum* and *P. vivax* [6]. *Plasmodium falciparum* and *P. vivax* pose the greatest threat

to humanity. While *Plasmodium falciparum* is the deadliest and the most prevalent on the African continent, *Plasmodium vivax* is the dominant malaria parasite in most countries outside of sub-Saharan Africa [7]. Malaria infection in human results in significant morbidity and mortality and places a profound burden on human productivity and development [8]. Nigeria has the highest burden of malaria globally and Nasarawa State accounts for 1.2% of malaria cases nationwide [9]. The disease is the leading cause of childhood illness and deaths in most communities across the state [10]. Prompt and accurate diagnosis is key to effective disease management and the urgency and importance of obtaining results quickly from the examination of blood samples from patients with suspected acute malaria render some of the more sensitive methods for malaria diagnosis impractical for routine laboratory use [11].

Materials and Methods

Description of the Study Area

Nasarawa State is located in the central region of Nigeria, within the North-Central geopolitical zone [12]. The state has a tropical climate with distinct wet and dry seasons, the rainy (wet) season typically lasts from April to October, while the dry season spans from November to March [13]. Though the State is known as the "Home of Solid Minerals" due to its rich deposits of minerals, tin, columbite, limestone, and bauxite, the economy of the State is primarily driven by agriculture [14]. This work was carried

out in Angwan Alheri, Rimi ward, in Keffi local government area and Gwadenye electoral ward in Zhemigili district, Obi local government area [15]. Keffi is a town located in the western part of the state and about 58 kilometers (36 miles) away from Abuja, the Federal Capital Territory and Obi are located in the southern part with an approximate geographic coordinate of 8.3500° N 8.6000° E and 8.8480° N and 7.8730° E, respectively, as shown in Figure 1. The economy of Keffi is diverse, with agriculture, trade, and education being the mainstays while agriculture and business are the main economy activities of Obi.

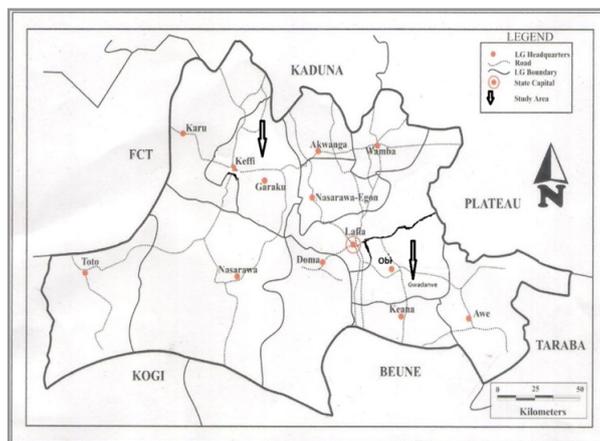


Figure 1: Map of Nasarawa State Showing the Two Selected Study Areas

Ethical Clearance

Ethical clearance was obtained from Health Research Ethical Committee (HREC) of Nasarawa State Ministry of Health, Lafia, with the approval number: HREC Protocol No. 18/06/2017, and verbal consent obtained from patients for malaria test.

Determination of Malaria Prevalence in the Study Area

Malaria infection rate among people in the study communities was determined using Rapid Diagnostic Test Protocol (RDT) [16]. The test was carried out by taking a drop of blood sample through pricking a finger of a patient with lancet after cleaning with alcohol swab. The collected blood was applied to the sample on the test strip using a pipette and two drops of a buffer solution were added. Blood-buffer mixture was allowed to flow for fifteen minutes (15 min) along the test strip containing antibodies that are specific to malaria antigen. The results were read on the appearance of coloured lines on the strip, two lines (the control line and the test line) indicated positive, presence of malaria antigens, a single (control) line indicated negative, no malaria antigens were detected and invalid when control line did not appear.

Data Analysis

Seasonal, sex and age prevalence of malaria in the two sampling sites were statistically analysed using Chi-square (χ^2) and student T-test at $P < 0.05$ level of significance. Monthly malaria prevalence was analyzed using One-Way ANOVA and significant differences that exist among the means were separated using Duncan Multiple Range Test at $P < 0.05$.

Results

Monthly Malaria Prevalence in the Study Areas

In the two study areas, Obi and Keffi, malaria infection occurred throughout the year and the infection was not uniform across the months in the study areas (Table 1). In Obi, more infection

occurred in the month of October 'a' and least in the month of January 'd' and was significantly different ($P < 0.05$) from other months 'b, bc, bcd and cd'. While in Keffi, malaria infection was more in the month of August and July 'a' and least in the month of March and April (Table 1). Months with highest infection was significantly different ($P < 0.05$) with other months except June and October and months with least infection (e)' was also significantly different ($P < 0.05$) with other months except January, February, May and December 'de' (Table 1).

Seasonal Malaria Infection Rate in the Study Areas

A total of eight hundred and seventy-nine (879) people were examined for malaria infection in both dry and rainy seasons, three hundred and seventeen (317 (36%)) were positive. The disease's prevalence in the rainy season was higher (31 and 44 %) than in the dry season (27 and 35%) in Obi and Keffi, respectively. (Table 2). Generally, higher infection (39%) significantly ($P < 0.05$) occurred in the rainy season than dry season (31%) (Table 2).

Sex and Age Malaria Infection Rate

Prevalence of malaria infection between males and females in the study areas indicated higher infection in males (30 and 42%) than females (28 and 41%) in Obi and Keffi, respectively (Table 3). Despite higher males (37%) than females (35%) malaria infection in the study area, there was no significant difference ($P > 0.05$) in the infection rate between males and females (Table 3). Age-related prevalence of malaria infection in the study areas indicated higher (10%) prevalence in younger age groups (1 - 5 and 6 - 10) followed by age group 11 - 15 (7%) while those above 15 years of age had lower infection rate (Table 4). The difference in the prevalence of malaria among the age groups was significant ($P < 0.05$).

Prevalence of Malaria Between Obi and Keffi

In the two study areas, Obi and Keffi, malaria infection occurred

throughout the year (March, 2023 – February, 2024). Though more people were infected in Keffi than Obi, infection rate was higher in the months of March and April in Obi than Keffi (Figure 2). Highest malaria infections occurred in the months of Oc-

tober and August and least in the months of February and April in Obi and Keffi, respectively (Figure 2). There was a significance difference ($P < 0.05$) in malaria infection between Obi and Keffi (Figure 2).

Table 1: Monthly Malaria Infection Rate in Obi and Keffi Local Government Areas of Nasarawa State, Nigeria, between March 2023 and February 2024

Location	Months											
	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Obi	4.00± 0.00 ^b	3.00±1. 00 ^{bcd}	1.33± 0.58 ^{cd}	1.67± 0.58 ^{cd}	2.67±1 .53 ^{bcd}	4.00± 0.00 ^b	11.00± 1.73 ^a	6.33± 1.53 ^a	9.00± 2.00 ^{ab}	2.67±1. 53 ^{bcd}	1.00± 1.00 ^d	3.33± 1.15 ^{bc}
Keffi	1.67± 1.15 ^e	1.67± 2.08 ^e	3.67± 1.15 ^{de}	9.53± 1.53 ^{ab}	10.67± 2.52 ^a	11.00± 1.73 ^a	7.33± 0.58 ^{bc}	9.00± 2.00 ^{ab}	5.33± 0.58 ^{cd}	3.33± 1.15 ^{de}	3.00± 0.00 ^{de}	3.67± 0.58 ^{de}

^{abcde} Mean values followed by different superscript letters are statistically significantly different ($p < 0.05$) probability associated with the ANOVA test

Table 2: Seasonal Malaria Infection Rate in Obi and Keffi LGAs, Nasarawa State

Season	Locations					
	Obi LGA		Keffi LGA		Total	
	No Exam	No Inf (%)	No Exam	No Inf (%)	No Exam	No Inf (%)
Dry (Nov. - March)	168	45 (27)	146	51 (35)	314	96 (31)
Rainy (April - Oct.)	205	63 (31)	360	158 (44)	565	221 (39)
Total	373	108 (29)	506	209 (41)	879	317 (36)

No. Exam. = Number Examined, No. Inf. = Number infected and % = percentage prevalence. χ^2 calculated = 6.7; χ^2 tabulated = 3.84; df = 1

Table 3: Prevalence of Malaria Infection by Sex in Obi and Keffi LGAs, Nasarawa State

Sex	Locations					
	Obi LGA		Keffi LGA		Total	
	No Exam	No Inf (%)	No Exam	No Inf (%)	No Exam	No Inf (%)
Male	150	45(30)	218	92 (42)	368	137 (37)
Female	223	63(28)	288	117 (41)	511	180 (35)
Total	373	108(29)	506	209 (41)	879	317 (36)

No. Exam. = Number Examined, No. Inf. = Number infected and % = percentage prevalence. Note: χ^2 cal = 0.38; χ^2 tab = 3.84; df=1

Table 4: Prevalence of Malaria Parasite Infection by Age in Obi and Keffi LGAs

Age (Years)	Locations					
	Obi LGA		Keffi LGA		Total	
	No Exam	No Inf (%)	No Exam	No Inf (%)	No Exam	No Inf (%)
0-5	94	29 (8)	146	60(12)	240	89(10)
6-10	85	31 (8)	126	59(12)	211	90(10)
11-15	70	27 (7)	78	37(7)	148	64(7)
16-20	41	9(2)	58	25(5)	99	34(4)
21-25	31	4(1)	33	13(3)	64	17(2)
26-30	20	1(0.3)	43	9(2)	63	10(1)
≥31	32	7(2)	22	6(1)	54	13(1)
Total	373	108 (29)	506	209(41)	879	317(36)

Age Grp= Age group, No. Exam. = Number Examined, No. Inf.= Number infected and % = percentage prevalence. χ^2 cal = 25.8; χ^2 tab = 12.6; df = 6

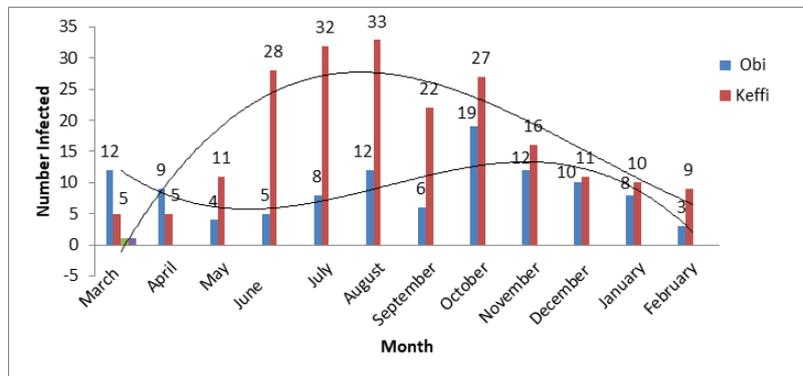


Figure 2: Comparison of Malaria Prevalence Between Obi and Keffi LGAs, Nasarawa State

Discussion

Malaria infection occurred throughout the year in this study and its prevalence significantly varied across months. Peak of malaria prevalence occurred in the months of August, and October while least infection occurred in the months of April and February in Keffi and Obi LGAs, respectively. This agrees with the report that malaria prevalence differed across different months among febrile patients attending a healthcare facility, more infection occurred in the rainy season especially the month of August [17]. Differences in the prevalence of malaria in different months could be as a result of variations in monthly weather conditions majorly being temperature, rainfall, and humidity, which together influences mosquito breeding and survival rates as well as the life cycle of the malaria parasite. However, the occurrence of malaria throughout the year and relatively higher in some months in the dry season could be as a result of agricultural practices and water storage system which create favourable conditions for mosquito breeding thereby affecting the seasonal abundance of mosquito populations and hence sustaining relatively similar malaria transmission trends throughout the year [18].

The result of this study shows that out of 879 people examined for malaria infection, 317 (36%) persons were positive. Findings from different research reported higher and lower prevalence of malaria in different localities in Nasarawa State compared to the result of this study [19, 20]. The difference in malaria prevalence with report of other studies could be as a result of diagnostic methods, intervention such as insecticide treated net (ITN) distribution and usage and awareness of malaria by the study population [21]. Malaria prevalence is significantly ($p < 0.05$) higher (39%) during the rainy season (April - October) than dry season (31%) (November - March). Differences in seasonal malaria prevalence (higher prevalence in rainy than in dry season) was also reported in Northern and South Eastern Nigeria [22, 23]. Higher rainy season malaria prevalence in this study could be as a result of favourable environmental conditions such as rainfall and higher relative humidity which enhance mosquito breeding, survival, biting rates and development of the *Plasmodium* parasite. Surge in mosquito population and consequent increase in outdoor and evening activities among humans enhance mosquito-human interactions, facilitating the spread of malaria [24, 25].

Both males and females were infected with malaria but the prevalence of the disease was higher in males (30% and 42%) than in females (28% and 41%) in Obi and Keffi LGAs, respectively. Though the disease prevalence was higher (37%) in males than

females (35%) possibly due to predisposing risk factors which could be attributed to outdoor activities: men engaging more in social activities outside the home during peak mosquito biting times, twilight and nighttime (dusk and dawn) and may sleep outdoors or in poorly protected structures, making them more susceptible to mosquito bites. Farming, one of the major occupations of the people in the study communities, mostly involved outdoor labour which can increase male exposure to infective bites of *Anopheles* vector thereby increasing their chances of malaria infection. Gender differences in immunity may be responsible for the higher malaria infection in males than females. Inherent biological differences in immune responses between males and females such as hormonal differences can influence the immune response to malaria infection, hormones such as testosterone in males suppresses type1 response while estrogen and progesterone in females enhance type2 response making females to develop more robust immune responses than males [26, 27]. Our finding is in line with the report of Eke et al. who reported higher prevalence of malaria among males than females in Nasarawa state. Similarly, Omoruyi and Awosolu reported higher prevalence of malaria in males than females in Edo and Ibadan, Oyo states, respectively [28-30]. Contrastingly, Musa et al. reported higher prevalence among females than males in Nasarawa State [31].

Though malaria infection occurred among all ages, the disease's prevalence was higher (10%) among younger age groups (0 - 5 and 6 - 10 years) than older age group (21 and above). The high prevalence of malaria infection amongst children in this study clearly shows the need for more attention as well as intervention towards them all year round. Related findings of higher prevalence of malaria among younger age group were reported in South West and Northern Nigeria [32, 33]. This study's result however contrasts the findings of Ali et al. who reported higher malaria infection rate in older than younger males in Akwanga LGA of Nasarawa state, Nigeria. Higher prevalence of malaria among younger age groups could be due to lack of acquired immunity [34-36]. Young children, especially infants and toddlers, have limited exposure to malaria compared to adults and over time, repeated exposure to malaria parasites makes adults develop partial immunity thereby reducing the frequency and severity of infections in adults. Also, young children rely on adults for protection against mosquito and are more likely than adults to be bitten by mosquitoes because of little or no knowledge of malaria transmission mode leading to inconsistent use of preventive measures.

The high significant variation of malaria infection in Keffi LGA over Obi LGA possibly suggests a greater number of malaria vectors breeding sites as well as favourable and more suitable environmental conditions in the area. Also, differences could be as a result of health seeking behaviour of the people in the study areas as well movement of people from high-transmission areas to low-transmission areas. Keffi is more of an urban area and mostly made up of civil servants and traders than Obi as a result people migrate into Keffi town for businesses. People in urban areas tend to seek medical care at slightest symptoms of ill health than rural population. Similarly, NMEP reported dissimilar prevalence of malaria in different geopolitical zones in Nigeria. Dissimilar prevalence was also reported in three (3) senatorial zones different localities within Akwanga, Nasarawa State.

Conclusion

Malaria infection occurred throughout the year though the disease's prevalence was not uniform across different months and also, more infection occurred in the rainy season than dry season in the two study localities. All age groups, most especially younger individuals, were susceptible to malaria infection which was higher among males than females. Keffi LGA, an urban area, had malaria prevalence that was almost twice the rate recorded in Obi LGA of Nasarawa state. Malaria vectors breeding grounds in the two LGAs should be cleared all year round and people should take advantage of sleeping under the ITNs given to them so as to prevent human-vectors contact thereby limiting malaria transmission.

References

- Ann, P. (2022). Mosquito Bite: Symptoms and Treatments. <https://www.healthline.com/health/mosquito-bites>.
- Ombugadu, A., Kasimu, H. L., Raphael, A., James, I. M., Joshua, A. I., Innocent, A. P., Jeremiah, I., Hasley, L. N., Victoria, A. P., & Mwansat, G. S. (2025). Mosquitoes Composition and *Plasmodium* Infection Status in Malaria Vectors in an Urban Community in Lafia Metropolis, Nasarawa State, Nigeria. *International Journal of Current Research in Science, Engineering & Technology*, 8(2). DOI: doi.org/10.30967/IJCRSET/Akwashiki-Ombugadu/184.
- Djihinto, O., Medjigbodo, A., Gangbadja, A., Saizonou, H., Lagnika, H., Nanmede, D., & Djogbénou, L. (2022). Malaria-Transmitting Vectors Microbiota: Overview and Interactions with *Anopheles* Mosquito Biology. *Frontiers in Microbiology*. doi.10.3389/fmicb.2022.891573.
- WHO (2022). Malaria. Retrieved May 2023 from https://www.who.int/health-topics/malaria#tab=tab_1
- Ebuka, K. E., Chukwudi, M. E., Chikaodili B. U., Udoka, C. N., Cosmas, O. O., Paschal, C. A., ... & Emmanuel O. O. (2020). The Impact of Human and Socio-cultural behavior on malaria transmission in a rural community of Nigeria: The Nyumagbagh Experience. *New York Science Journal*, 13(12), 86-99.
- Singh, B., & Daneshvar, C. (2013). Human infections and detection of *Plasmodium knowlesi*. *Clinical Microbiology Rev.*, 26(2),165-84.
- Sato, S. (2021). *Plasmodium*—a brief introduction to the parasites causing human malaria and their basic biology. *Journal of Physiological Anthropology*, 40. doi.10.1186/s40101-020-00251-9.
- Smanski, M. (2021). Spotlight on Genetic Design in a Spotted Wing Crop Killer. *The CRISPR Journal*, 4(5), 628-630.
- WHO African Region (2022). Report on malaria in Nigeria. <https://www.afro.who.int/countries/nigeria/publication/report-malaria-nigeria-2022>.
- Ahmed, Y. (2023). Nasarawa State Steps Up Efforts to Achieve Zero Malaria. <https://von.gov.ng/nasarawa-state-steps-up-efforts-to-achieve-zero-malaria/>
- Moody, A. (2002). Rapid Diagnostic Tests for Malaria Parasites. *Journal of clinical microbiology reviews*. /doi.org/10.1128/cmr.15.1.66-78.2002.
- Babatunde, J. J. (2021). Geography and Insecurity in Northern Nigeria. *International Journal of Research in Geography*, 6(3) 43-51.
- Sufiyan, I., Mohammed, K., Bello, D., & Zaharadeen, I. (2020). Impact of harmattan season on human health in Keffi, Nasarawa State, Nigeria. *Matrix Science Medica*, 4, 44-50.
- Abubakar, U., Mohammed, U., Tanko, L., & Adebayo, C. (2023). Analysis of Risk Attitude of Cereal/Legume Farmers in Nasarawa State, Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology*. doi.10.33003/jaat.2023.0901.03.
- Eduweb (2024). Obi LGA wards new and existing polling unit. <https://www.eduweb.com.ng/obi-lga-wards-new-and-existing-polling-unit/>
- WHO (2021). How malaria RDTs work <https://www.who.int/teams/global-malaria-programme/case-management/diagnosis/rapid-diagnostic-tests/how-malaria-rdts>
- Zakari, H., Samuel, B. I., Sabina, C. E., Suleiman, Z., Celestine, O. O., Blessing, O. A., ... & Oludare, A. (2024). A Cross-Sectional Study of Malaria Burden among Febrile Patients Attending a Healthcare Facility in Nassarawa State, Nigeria. *Translational Biomedicine*, 15(1:001) <https://www.itmedicalteam.pl/>
- Garba, Y. (2023). Distribution of the African Malaria Vectors (Anopheline Mosquitoes) in Kontagora, North Central Nigeria. *Journal of Applied Sciences and Environmental Management*. doi.10.4314/jasem.v27i4.21.
- Oyibo, W., Godwin, N., Perpetua, U., Olusola, O., Nnenna, O., Olufemi, A., ... & David, C. (2021). Geographical and temporal variation in reduction of malaria infection among children under 5 years of age throughout Nigeria. *British Medical Journal of Global Health*. doi 10.1136/bmjgh-2020-004250.
- Shamsudeen A., & Akeyede, I. (2023). Prevalence and Factors Responsible for Asymptomatic Malaria Reservoir of *Plasmodium falciparum* Among Adults in Nasarawa State, Nigeria. doi 10.21522/TIJPH.2013.12.01.Art033.
- National Malaria Elimination Programme (NMEP) (2022). Nigeria Malaria Indicator Survey 2021, Final Report. <https://dhsprogram.com/pubs/pdf/MIS41/MIS41.pdf>
- Ibrahim, O. R., Lugga, A. S., Ibrahim, N., Aladesua, O., Lawal M.I., Suleiman, B. A., & Bello, M. S. (2021). Impact of climatic variables on childhood severe malaria in a tertiary health facility in northern Nigeria. *Sudanese Journal of Paediatrics*, 21(2), 173–181.
- Anumudu, I. C., Dozie, I. N., Iwuala, C. C., Iwuoha, G., & Ede, A. O. (2019). Seasonal variation and the Prevalence of Malaria in Imo State, Nigeria. *Journal of Nursing and Health Science*, 8(6), 4-10.
- Coetzee, M. (2022). Literature review of the systematics,

- biology and role in malaria transmission of species in the Afrotropical *Anopheles* subgenus *Anopheles* (Diptera: Culicidae). *Zootaxa*, 5133(2), 182-200.
25. Babale, S., Salim, H., Yakudima, I., Kabir, B., Mamman, R., Chiroma, U., & Ibrahim, S. (2023). Seasonal assessment of pupal habitat productivity of malaria vector: *Anopheles gambiae* s. l. as influence by physico-chemical conditions at selected breeding habitats in Niger, Nigeria. *EUREKA: Life Sciences*. doi.10.21303/2504-5695.2023.002841.
 26. Roved, J., Wester Dahl, H., & Hasselquist, D. 2017. Sex differences in immune responses: Hormonal effects, antagonistic selection, and evolutionary consequences. *Hormones and Behavior*, 88, 95-105.
 27. Cervantes, C. L., Aguilar, C. J., Buendía, G.F., Fernández, R. O., Nolasco, P.T., López, P. M., ... & Legorreta, H. M. (2021). 17β-Estradiol Is Involved in the Sexual Dimorphism of the Immune Response to Malaria. *Frontiers in Endocrinology*, doi.10.3389/fendo.2021.643851.
 28. Eke, S. S., Mumuney, K., Temitope, M., Nancy, E., Shehu A.B., Onojafe, J., ... & Ismaila, R. O. (2022). Intestinal and Malaria Parasitic Infections among School-Aged Children in Selected Rural Communities in Nasarawa State, Nigeria. *Journal of Infectious Disease and Preventive medicine*. doi 10.35841/2329-8731.22.10.259.
 29. Omoruyi, Z. & Oni, O. L. (2024). Malaria Infection Among Psychiatric Patients Attending Federal Neuropsychiatric Hospital, Edo State. *Sokoto Journal of Medical Laboratory Science*, 9(1), 195–202.
 30. Awosolu, O. B., Zary, S. Y., & Meor, T. F. H. (2021). Prevalence, Parasite Density and Determinants of Falciparum Malaria Among Febrile Children in Some Peri-Urban Communities in Southwestern Nigeria: A Cross-Sectional Study. *Journal of Infection and Drug Resistance*, 14, 3219–3232.
 31. Musa, A., Uzoigwe, N. R., Pam, V. A., Ombugadu, A., Maikenti, J. I., Adejoh, V. A., & Ahmed, H. O. (2023). Study of *Plasmodium* Infection among Primary School Children in Lafia Local Government Area, Nasarawa State, Nigeria. *Austin Journal of Infectious Diseases*, 10(2), 1081-1084.
 32. Ibrahim, A. O., Bello, I. S., Shabi, O. M., Adejumo, O. O., Abayomi, A., & Babatunde, A. A. (2022). Malaria infection and its association with socio-demographics, preventive measures, and co-morbid ailments among adult febrile patients in rural Southwestern Nigeria: A cross-sectional study. *Epidemiology of Infectious Diseases*. Doi 10.1177/20503121221117853.
 33. Ambe, J. P., Balogun, S. T., Waziri, M. B., Nglass, I. N., & Saddiq, A. (2020). Impacts of seasonal Malaria Chemoprevention on Malaria Burden among under Five-Year-Old Children in Borno State, Nigeria. *Journal of Tropical medicine*. doi: 10.1155/2020/9372457
 34. Ali, A. A., Pam, V. A., Ombugadu, A., Uzoigwe, N. C., & Uzoigwe, N. R. (2023). Haemoparasites Infection in Rural Agrarian Communities in Akwanga LGA of Nasarawa State, Nigeria. *Acta Scientific Clinical Case Reports*, 4(4), 26-30.
 35. Nziza, N., Tran, T., DeRiso, E., Dolatshahi, S., Herman, J., Lacerda, L., ... & Alter, G. (2023). Accumulation of Neutrophil Phagocytic Antibody Features Tracks with Naturally Acquired Immunity Against Malaria in Children. *The Journal of infectious diseases*, 15,228 (6), 759-768.
 36. Qu, Z., Patterson, D., Childs, L., Edholm, C., Ponce, J., Prosper, O., & Zhao, L. (2023). Modeling Immunity to Malaria with an Age-Structured PDE Framework. *SIAM Journal on apply mathematic*, 83(3), 1098-1125.