



Vol. 10(1), Pp. 91-98, March 2025,

Author(s) retain the copyright of this article

This article is published under the terms of the
Creative Commons Attribution License 4.0.

<https://journals.directresearchpublisher.org/index.php/drjphet>

Research Article
ISSN: 2734-2182

Assessment of malaria infection and associated risk factors among human populations in Qua'an-Pan Local Government Area of Plateau State, Nigeria

Yakop D. Dakum^{1, 2*}, James I. Maikenti², Akwashiki Ombugadu², Mohammed A. Ashigar², Pangwa M. Lapang³, Innocent C. J. Omalu⁴, and Victoria A. Pam²

¹Department of Zoology, Faculty of Science, Federal University Lokoja, Lokoja, Kogi State, Nigeria.

²Department of Zoology, Faculty of Science, Federal University of Lafia, Lafia, Nasarawa State, Nigeria.

³Department of Zoology, Faculty of Natural Sciences, University of Jos, Jos, Plateau State, Nigeria.

⁴Department of Biological Sciences, Federal University of Technology, Minna, Nigeria.

Corresponding Author email: yakop.dakum@fulokoja.edu.ng; Tel: +2347036042451.

ABSTRACT

Malaria remains a global public health disease especially in rural communities where agriculture is the major occupation. The aim of the study was to assess the prevalence of malaria among human populations in some parts of Qua'an-Pan Local Government Area of Plateau State. A longitudinal survey was conducted in four selected districts in the study locality from January to December, 2021. Microscopy was used to examine malaria parasites. Structured questionnaire was administered to gather information from participants on possession and utilization of insecticide-treated bed nets (ITNs). A total of 814 people were examined for malaria parasites across four districts in Qua'an-Pan LGA. Out of which, 635 (78%) people were found to be positive of the parasites. Female participants recorded higher malaria parasites infection 301 (78.2%) than the male participants 334 (77.9%) with significant difference ($P < 0.05$). Malaria parasites infection was significantly ($P < 0.05$) higher among students (80.1%) than other occupational groups. Parasites infection was higher (88.6%) among the ages ≥ 31 . Early dry season (81.8%) recorded the highest parasites infection rates with the least during late dry season (71.3%), but was not significant ($P > 0.05$). Majority of the respondents didn't have ITNs and usage was low among those that possess the ITNs. In conclusion, malaria remains a public health concern in the study area with high prevalence of 78% and low ITN ownership and usage. Hence, there is a crucial need for increased health education in the study area about malaria infection and the importance of owning and using ITNs.

Keywords: Malaria, Prevalence, Insecticide-treated bed nets (ITNs), Seasonality, Risk factors, Qua'an-Pan LGA, Plateau State

Article information

Received 2 February 2025

Accepted 7 March 2025

Published 10 March 2025

DOI: <https://doi.org/10.26765/DRJPHET427030352>

Citation: Dakum, Y. D., Maikenti, J. I., Ombugadu, A., Ashigar, M. A., Lapang, P. M., Omalu, I. C. J., and Pam, V. A. (2025). Assessment of malaria infection and associated risk factors among human populations in Qua'an-Pan local government area of Plateau state, Nigeria. Direct Research Journal of Public Health and Environmental Technology. Vol. 10(1), Pp. 91-98. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Malaria is a life threatening disease that is preventable and curable, caused by *Plasmodium* parasites and transmitted through infected female *Anopheles* mosquitoes (WHO, 2022a). According to Awosolu *et al.* (2021), *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae* and *Plasmodium ovale* are the four primary malaria parasites that caused malaria in human whereas *Plasmodium knowlesi* is a zoonotic species prevalent in Southeast Asia. The *Anopheles* species responsible for the transmission these parasites year round in Nigeria are *Anopheles*

gambiae, *Anopheles funestus*, *Anopheles arabiensis*, and *Anopheles moucheti* (Oguntade *et al.*, 2022). Progress has been made worldwide in combating malaria in the past two decades due to increased usage of long-lasting insecticidal nets and application of indoor residual spraying in large scale (WHO, 2021). However, the progress achieved and possible future successes are threatened by widespread insecticide resistance in malaria-endemic areas (Ochomo *et al.*, 2013). Malaria is a global public health and socio-economic concern,

Blood sample collection, films preparation and processing

The blood sample collection and processing was done as described by Abossie *et al.* (2020). Capillary blood specimen was collected from finger prick using sterile blood lancet to prepare thick and thin blood film smears. The smears were air dried and the films were fixed with methanol, and were stained with 10% Giemsa stain for 15 minutes. All dried slides placed in slides boxes and were examined by laboratory technologist at the Plateau Specialist Hospital, Jos. The films were examined under microscope using x100 Objective lens, (Oil immersion). Positive results were indicated by the presence of ring forms of *Plasmodium* trophozoites, schizont or gametocytes. The presence of malaria parasite was observed using the thick blood films while the identification of the species was determined using the thin blood films. A slide was scored as parasite not seen when 100 per high power fields had been examined without seeing any malaria parasite. To assure quality of the microscopic examinations, all positive and 10% of the negative slides were reexamined by a third reader to remove discrepant result.

Questionnaire administration

A well-structured questionnaire was administered to the participants. The questionnaire was used to gather information from respondents' on ownership and utilization of insecticide-treated net (ITNs).

Statistical analysis

Data obtained was analyzed using Minitap statistical software (version 21.2). Pearson's Chi-square test was used to check significant variations of malaria prevalence across districts, occupation, age group, gender, marital status, and seasons, respectively. Chi-square test was also carried out to check significant variations in the ownership and usage of insecticide treated bed nets in the study area. Percentages were calculated to determine the percentage prevalence of each of the variables. Level of significance was set at $P < 0.05$.

RESULTS

Prevalence of malaria in relation to districts, sex and marital status

A total of 814 people were examined for malaria Parasites across four districts in Qua'an-Pan LGA, Plateau State. Out of which, 635 (78%) people were found to be positive of the parasites while 179 (22%) were negative of the parasites as reflected in (Table 1). Malaria parasites prevalence in relation to districts revealed that Kwande district recorded the highest prevalence of the malaria infection 183 (85.5%) while the least prevalence was observed in Kwang district 146 (73.4%). However, there was no significant difference ($\chi^2 = 1.081$, $df = 3$, $P = 0.782$)

in malaria parasite prevalence between the districts. The prevalence of malaria parasite infection in relation to sex revealed that, out of the 429 male participants examined, 334 (77.9%) were positive for the infection while out of the 385 female participants examined 301 (78.2%) were positive for malaria parasites infection (Table1). Thus, giving a higher prevalence in female participants than in the male participants. Statistical analysis showed that there was significant difference ($P < 0.05$) in the prevalence of malaria parasites infection in relation to sex. Malaria parasites infection rate in relation to marital status of participants revealed that 'single' group had the highest rate of infection (78.7%) while the lowest rate of infection was recorded among the 'married' group (77.5%) as reflected in (Table1). Nevertheless, there was no significant difference ($P > 0.05$) in the prevalence of malaria parasite infection in relation to marital status.

Table 1: Malaria parasites prevalence in relation to districts, gender and marital status

Variable	No. Examined	No. Infected	Prevalence (%)	χ^2	P-value
Districts					
Dokan	197	152	77.2	1.081	0.782
Kasuwa					
Kwalla	204	154	75.5		
Kwande	214	183	85.5		
Kwang	199	146	73.4		
Total	814	635	78.0		
Sex					
Male	429	334	77.9	0.0006	0.981
Female	385	301	78.2		
Total	814	635	78.0		
Marital Status					
Married	472	366	77.5	0.009	0.924
Single	342	269	78.7		
Total	814	635	78.0		

Prevalence of malaria parasite in relation to occupations

The prevalence of malaria parasites infection in relation to occupation revealed that students recorded the highest prevalence of malaria parasites infection with (80.1%), followed by farmers with (78.6%), traders (75.2%), civil servants (74.3%), artisans (68.8%) while the least was recorded in retiree with (50%) as shown in (Table 2). Hence, there was significant difference ($P < 0.05$) in the malaria parasites infection rates in relation to occupations.

Prevalence of malaria in relation to age groups

The prevalence of malaria in relation to age group revealed

Table 2: Malaria prevalence in relation to occupations.

Occupation	No. Examined	No. Infected	Prevalence (%)
Artisan	16	11	68.8
Traders	125	94	75.2
Civil Servant	35	26	74.3
Farmer	309	243	78.6
Retiree	4	2	50
Student	296	237	80.1
Dependents	29	22	75.9
Total	814	635(78)	78

$\chi^2 = 410.203$, $df = 6$, $P = 0.0001$

Table 3: Prevalence of malaria in relation to age groups.

Age Group	No. Examined	No. Infected	Prevalence (%)
0-5	167	138	82.6
6-10	124	94	75.8
11-15	152	113	74.3
16-20	169	131	77.5
21-25	91	67	73.6
26-30	67	53	79.1
≥ 31	44	39	88.6
Total	814	635	78.0

$$\chi^2 = 2.139, df = 6, P = 0.906$$

that the highest prevalence (88.6%) was recorded among the age group ≥ 31 followed by participants within age group 0-5 (82.6%) while the lowest prevalence was recorded among participants within the age group of 21-25 (73.6%) as reflected in (Table 3). However, there was no significant difference ($P > 0.05$) in the prevalence of malaria parasites infection across age groups.

Prevalence of malaria in relation to seasons

Malaria prevalence in relation to seasons revealed that early dry season (81.8%) recorded the highest parasites infection rates followed by late wet season (79.7%) and early wet season (78.2%) while the least parasites infection rates was recorded during the late dry season (71.3%) (Table 4). Statistical analysis showed that there was no significant difference ($P > 0.05$) in the malaria parasites infection rates in relation to seasons.

Table 4: Prevalence of Malaria in Relation to Seasons.

Season	No. Examined	No. Infected	Prevalence (%)
Early Dry	220	180	81.8
Early Wet	216	169	78.2
Late Dry	181	129	71.3
Late Wet	197	157	79.7
Total	814	635	78.0

$$\chi^2 = 2.139, df = 3, P = 0.850$$

Risk factors associated with malaria prevalence

A total of four hundred and nine (409) questionnaires were administered to respondents and three hundred and eighty four (384) were retrieved validly.

Table 5: Ownership and utilization of insecticide-treated bed nets (itns) among respondents (n=384).

Questions/Responses	No. Respondents	Percentage (%)	χ^2	P-value
Do you have ITN?				
Yes	108	28.1	0.875	0.350
No	276	71.9		
Is your ITN in good shape?				
Yes	124	32.3	2.087	0.149
No	260	67.7		
Do you sleep under ITN the previous night?				
Yes	108	28.1	0.875	0.350
No	276	71.9		
Do you frequently sleep under ITN				
Yes	49	12.8	0.183	0.669
No	335	87.2		
Do you tuck in the ITN very well?				
Yes	59	15.4	1.201	0.273
No	325	84.6		

The result of the ownership of insecticide-treated bed net (ITNs) revealed that 108 (28.1%) respondents had ITNs while 276 (71.9%) respondents didn't have (Table 5). All the respondents that owned ITNs slept under it the previous night before the research were 108 (28.1%) individuals. However, the respondents that didn't have the habit of sleeping under the insecticide-treated bed net frequently were just 49 (12.8%) individuals. Only 59 (15.4%) respondents tuck in their ITN very well before sleeping under it (Table 5).

DISCUSSION

The overall prevalence of malaria infection of 78% in this study clearly indicates inhabitants' high susceptibility profile and vulnerability to *Plasmodium* parasite. This high incidence highlights the reality that malaria is a significant burden in the study area. This agrees with the findings of Njila *et al.* (2022a, b) and Musa *et al.* (2023) in Plateau and Nasarawa States, respectively, who recorded a high malaria infectivity rate of 33%, 76.2%, and 75.9%. According to Adekola, *et al.* (2023), malaria prevalence remains high, particularly in rural and peri-urban regions, indicating the importance of the disease as a public health concern. Also, the observed prevalence in this study is in agreement with the findings of Gboeloh *et al.* (2022) who reported malaria prevalence of 78.1% in the three senatorial zones of Rivers State, Nigeria. Similarly, Ogomaka (2020) reported high malaria parasites prevalence of 78.3% among students of Imo State University, Owerri, and 78.5% in Ifedore Local Government Area of Ondo State Nigeria (Obimakinde *et al.*, 2021). Contrary to the finding in this study, Ombugadu *et al.* (2022), Maikenti *et al.* (2022), and Kolawole (2023) recorded a lower prevalence of 16.5%, 21.4%, and 23% among subjects screened in Lafia metropolis, Nasarawa state, Gombe state, and the Nigerian Army Reference Hospital Kaduna state, respectively. The high prevalence recorded in this study could be attributed to practice and habit of the people such as sleeping outdoor unprotected in the night in order to take fresh air due to heat as a result of high environmental temperature.

However, the malaria prevalence rate in this study was lower than the finding of Ogbole *et al.* (2023) who recorded a higher malaria parasite infection of 92.72% in Sagbama LGA of Bayelsa State. The higher prevalence could be as a result of the swampy nature of the locality which is a good breeding ground for mosquito species. According to Midekisa *et al.* (2014), swamps support high transmission of malaria as they serve as breeding grounds for mosquitoes which are the vector of *Plasmodium* species. Higher malaria parasite prevalence of 80.6% has also been reported by Erinle and Bada (2023) among students of the Federal University of Technology Akure and attributed the higher prevalence to presence of bushes and stagnant water around the students environ. Awosolu *et al.* (2020) also recorded a higher prevalence of 84.2% from the same institution. Malaria in Kwande district recorded the highest prevalence of the parasite 183 (85.5%). This was evident in the number of malaria vectors

collected in the study district due to many breeding sites in the area.

The higher prevalence of malaria in female (78.2%) than their male counterparts (77.9%) is in agreement with the report of Binta *et al.* (2023) and Micah *et al.* (2023) who recorded higher malaria incidence in female patients than male patients. Ochwedo *et al.* (2021) in their study also reported a higher malaria prevalence in females than males, citing social and cultural factors such as gender roles, which expose females to mosquito bites more frequently as the reason. The prevalence recorded in female in this study may be attributed to the fact that females are usually engaged in outdoor activities earlier in the morning, putting them also at greater risk of being bitten by mosquitoes there by increasing the chance of contracting the disease. However, the findings of this study contradict that of Erinle and Bada (2023), who reported that male subjects have a higher malaria prevalence rate 130 (53.7%) than their female counterparts 112 (46.3%). They attributed the reasons to the fact that males exposed their bodies regularly sleeping outside which increase the risk of infection than female that are conservative, rarely expose themselves nude in public but stay indoors, doing household chores limiting their exposure to malaria. According to Minwuyelet and Aschale (2021), males are thought to have a greater malaria positivity rate because they are more likely to engage in outdoor activities that expose them to the disease, little chance of sleeping under bed nets and travel to endemic areas for labour work.

Even though there was no significant variation in relation to marital status, malaria parasites infection rate was slightly higher in single group than the married group. The finding of this study is in agreement with that of Nyasa *et al.* (2021) who recorded higher malaria prevalence in singles than in married individuals. The higher prevalence recorded in single group could be attributed to the fact that single individuals mostly stay late outdoor in social places unlike the married individuals who would be indoors with their families. Benjamin *et al.* (2017) also recorded higher malaria prevalence in singles than in married individuals.

According to Lerman (2002), marriage could improve economic well-being and health outcomes by enhancing access to health care or lowering stress. In addition to this, a spouse may play an important role in monitoring and encouraging healthy behaviors. Contrary to the findings of this study, Gboeloh *et al.* (2022) reported higher prevalence of malaria among married people than single individuals even though no significance difference was observed. They attributed this to the general habit of the people, maintaining that single and married individuals dwell in the same environment and behaviorally are affected by the same climatic conditions.

The prevalence of malaria parasites infection in relation to occupation revealed that students recorded the highest prevalence of malaria parasites infection with (80.1%), even though there was no significant difference in parasites infection in relation to occupation. The high prevalence of malaria infection could be ascribed to student staying outdoor at dusk unprotected, thereby

exposing them to mosquito bites. The finding of this study is in agreement with that of Abubakar *et al.* (2022) who recorded the highest prevalence of malaria infection in students, citing the presence of bushes and stagnant water around most of the students' habitations. Contrary to this finding, Nwalozie *et al.* (2023) in their study on assessment of the relationship between the level of parasitaemia and occupation reported that civil servants had the highest prevalence of malaria parasite in the blood than other occupations, citing the availability of vector population as the reason for the prevalence. Duguma *et al.* (2022) in their study on prevalence of malaria and associated risk factors among the community of Mizan-Aman town and its catchment area also recorded the higher prevalence of malaria in housewife 26 (6.3%) than student 23 (5.6%) and other occupations.

The very high malaria infection rate among age group ≥ 31 might be due to diminished capacity to establish sufficient immune response due advancement in age.. The finding of this study is similar to the finding of Onyiri (2015) who reported higher malaria among those under the ages ≥ 31 but contrary to the findings of Abossie *et al.* (2020) who reported high malaria infection in children under 5 years Old particularly those aged between 37 and 59 months old, in Arba Minch, Zuria district of South Ethiopia, attributing the reason for proximity of residence to stagnant water. Gboeloh *et al.* (2022) and Nwele *et al.* (2022) also reported high malaria infection rate among age groups 1-10 years and 21-30 years, citing low transferred immunity from mother to child and first-time pregnancy as possible reason. According to Valiathan *et al.* (2016), ageing has been shown to have impact on a number of human hematological parameters and peripheral blood lymphocyte.

The high malaria infection rate (81.8%) in early dry season in this study implies that malaria parasites transmission does not depend only on rainfall but other climatic elements. The high prevalence recorded at the beginning of the dry season in this present research could be attributed to relatively stable breeding ground of malaria vector as torrential rainfall normally experience from August to September do wash away the breeding ground of mosquitoes thereby reducing vector population which is the determinant for malaria transmission. Therefore, highest prevalence of malaria recorded at early dry season in this study revealed that malaria parasites transmission does not depend only on rainfall but other climatic elements. This finding is in agreement with the report of Collins *et al.* (2022) who recorded higher parasite densities at the beginning of the dry season. Mayengue *et al.* (2020) also reported higher proportions of malaria cases at the beginning of the main dry season. Debash *et al.* (2022) in their study on malaria trend analysis from 2016-2020 in Nirak Health Center recorded the highest number of malaria cases (55.2%) in dry season. Haile *et al.* (2020) recorded the highest peak of malaria infections during the late transition (October-December). Binta *et al.* (2023) in their study on ten-year trend of malaria prevalence in Kaltungo general hospital, Gombe state recorded highest positive cases in the month of October which is the

beginning of early dry season. Contrary to the present finding, Ibrahim, *et al.* (2021) recorded more malaria cases in wet season (77.6%). Similarly, Simon-Oke *et al.* (2023) recorded the highest malaria prevalence in the month of September which is late wet season. The prevalence of malaria recorded during wet season could be attributed to the abundance of vector population as a result of availability of breeding ground due rainfall (Ombugadu *et al.*, 2024).

Insecticide-treated bed nets (ITNs) are an essential public health tool to prevent mosquito bites, which are a common cause of diseases such as malaria, especially in Sub-Saharan African countries, including Nigeria (WHO, 2020). According to Nyavor *et al.* (2017), efforts have been made by WHO and roll back malaria (RBM) partners to promote ITNs as a form of personal protection that reduces illness, severe disease, and deaths in malaria endemic regions. In this study, 28.1% ownership of ITN implies low ownership by the respondents as it was lower than the RBM-recommended standard of 80%. Ugoeze *et al.* (2022) in their study on students' awareness and use of treated mosquito nets also reported low ownership of treated nets by students in school. The low percentage ownership of ITNs in this study could be due to factors such as cultural beliefs, and financial constraints to purchasing ITNs from the market.

However, percentage ownership of ITNs in this study was higher than the findings of Adebayo *et al.* (2014) who reported percentage ownership of 11.1% and lower than the findings of Pukuma and Ibrahim (2023) who reported 58.7% of the respondents owned ITNs.

The findings from this study was also lower than that of Fru *et al.* (2021) who reported ownership of long-lasting insecticidal treated bed nets (LLINs) of 89%, Ravi *et al.* (2022) reported 86% of bed net ownership by respondents, Tula *et al.* (2023) reported 57.87% ownership of ITNs by respondents and Esomonu *et al.* (2021) recorded 58.8% ownership of ITNs and attributed the reasons to be the high proportion of respondents (68.1%) that received free ITNs from government health facilities and some NGOs. Regarding the condition of insecticide-treated net, only 32.3% of the respondents agreed that their ITN were in good shape. The lower percentage could be as a result of poor handling and maintenance by the users. According to Randriamaherijaona *et al.* (2015), long-lasting insecticidal nets with holes in them reduce personal protection. The findings from this study showed that only 28.1% of the respondents slept under bed net night before the survey.

This is lower than the findings of Tula *et al.* (2023) who reported 90.42% of the respondents who used the ITNs the night before the administration of the questionnaire. Ravi *et al.* (2022) also reported higher percentage of 61% of respondents slept under a bed net the night before the survey. There was low frequent utilization of the ITNs by the respondents as only 12.8% of the respondents agreed to have used the ITN regularly. Fru *et al.* (2021) also reported low utilization rate of 49.1%, although it is higher than what was obtained in this study. Ekeleme *et al.* (2023) reported low utilization rate of 41% and attributed it to the

fact that it cause discomfort when sleeping under the net and it also generate a lot of heat. The finding in this study is lower than the 58.5% utilization rate of ITNs reported by Pukuma and Ibrahim (2023). The reasons for low utilization of ITNs in this study could be as a result of negligence or perceptions of heat. Fru *et al.* (2021) reported that negligence or forgetfulness, heat, use of repellent or fans, and difficulty to hang up the net as well as LLIN misappropriation were accountable for low utilization of LLINs.

Conclusion

The findings in this study underscore the significant health burden posed by malaria in the study area, as evidenced by the high parasite infectivity rate of 78%. The low ownership rate of insecticide-treated bed nets (28.1%) falls considerably short of the Roll Back Malaria (RBM) initiative's recommended threshold of 80%, highlighting a critical gap in malaria prevention measures. Furthermore, the practice of sleeping outdoors unprotected, driven by elevated environmental temperatures, emerged as a notable risk factor for malaria transmission. To mitigate this public health challenge, there is an urgent need to intensify health education campaigns aimed at increasing awareness about the dangers of malaria and promoting the consistent use of ITNs. Additionally, behavioral interventions should discourage outdoor sleeping practices to reduce exposure to malaria vectors. These measures are imperative for advancing malaria control efforts and improving community health outcomes in the region.

REFERENCES

- Aboessie, A., Yohanes, T., Nedu, A., Tafesse, W., & Damitie, M. (2020). Prevalence of malaria and associated risk factors among febrile children under five years: a cross-sectional study in Arba Minch Zuria district, South Ethiopia. *Infection and Drug Resistance*, 13, 363 – 372. Doi:10.2147/IDR.S223873
- Abraham, M., Massebo, F., & Lindtjorn, B. (2017). High entomological inoculation rate of malaria vectors in area of high coverage of interventions in southwest Ethiopia: implication for residual malaria transmission. *Parasite Epidemiology and Control*, 2(2), 61–69. DOI:10.1016/j.parepi.2017.04.003
- Abubakar, B. M., Haruna, A., Moi, I. M., & Katagum, Y. M. (2022). Prevalence of malaria infection and Associated Risk Factors among students of Bauchi State University Gadau, Bauchi State, Nigeria. *Gadau Journal of Pure and Allied Sciences*, 1(2), 95-102.
- Adebayo, A. M., Akinyemi, O. O., & Cadmus, E. O. (2014). Ownership and utilization of insecticide-treated mosquito nets among caregivers of under-five children and pregnant women in a rural community in southwest Nigeria. *Journal of Preventive Medicine and Hygiene*, 55(2), 58-64.
- Aju-Ameh, C. O. (2020). Mosquitoes is not the major culprits for the high burden of malaria in Nigeria: a commentary. *The Pan African Medical Journal*, 35(11), 10-35.
- Awosolu, O. B., Yahaya, Z. S., Farah Haziqah, M. T., Simon-Oke, I. A., & Fakunle, C. (2021). A cross-sectional study of the prevalence, density, and risk factors associated with malaria transmission in urban communities of Ibadan, Southwestern Nigeria. *Heliyon*, 7(1), e05975.
- Benjamin, G. Y., Kanai, E. T., Moses, B. E., & Aluwong, G. S. (2017). Demographic factors associated with malaria prevalence in zaria Kaduna State, Nigeria. *Bayero Journal of Pure and Applied Sciences*, 10(1), 116 – 119.
- Binta, A., Musa A. M., Patrick D.B., Habiba D. J., Shamsiya M. U. Edith E. I., & Danta B. T. (2023). Ten-year trend of malaria prevalence in

- Kaltungo general hospital, Gombe state, Nigeria. *Bima Journal of Science and Technology*, 7(2), 1-8.
- Binta, A., Musa, A. M., Patrick, D. B., Habiba, D. J., & Shamsiya, M. U., Edith, E. I., & Danta B. T. (2023). Ten-year trend of malaria prevalence in Kaltungo general hospital, Gombe state, Nigeria. *Bima Journal of Science and Technology*, 7(2), 1-8.
- CDC (2021). Malaria Worldwide - Impact of Malaria [Centers for Disease Control and Prevention Report]. https://www.cdc.gov/malaria/malaria_worldwide/impact.html
- Collins, K. A., Ceasay, S., Drammeh, S., Jaiteh, F.K., Guery, M., Lanke, K. & Claessens, A. (2022). A Cohort Study on the duration of *Plasmodium falciparum* Infections during the dry season in the Gambia. *The Journal of Infectious Diseases*, 226, 128–37.
- Debash, H., Erkihun, Y., & Bisetegn, H. (2022). Malaria Threatens to Bounce Back in Abergele District, Northeast Ethiopia: Five-Year Retrospective Trend Analysis from 2016-2020 in Nirak Health Center. *BioMed Research International*, 20(22), 2-7. doi: 10.1155/2022/3503317
- Duguma, T., Nuri, A., & Melaku, Y. (2022). Prevalence of Malaria and Associated Risk Factors among the Community of Mizan-Aman Town and Its Catchment Area in Southwest Ethiopia. *Journal of Parasitology Research*, 12, 3503317.
- Ekeleme, N. C., Ijioma, C. E., Unachukwu, N. A., Ejikem, P. I., Areh, J. E., Ogwu, C. I., ... & Airaodion, A. I. (2023). Attitudes and Practices of Insecticide Treated Bed Nets Usage among Rural Dwellers in Oyo State, Nigeria. *International Journal of Tropical Disease & Health*, 44(15), 43-58.
- Erinle, B. A., & Bada, E. O. (2023). Prevalence of malaria infection amongst students of a southwest Nigerian federal university. *GSC Advanced Research and Reviews*, 15(01), 110–114.
- Esomonu, S. N., Ossai, E. N., & Onajole, A.T. (2021). Knowledge of Malaria and Utilization of Insecticide-Treated Nets amongst Mothers of Under-five Children in selected Rural Communities of Nigeria's Federal Capital Territory. *Journal of Community Medicine and Primary Health Care*, 33(1), 102-114.
- Fru, P. N., Cho, F. N., Tassang, A. N., Fru, C. N., Fon, P. N., & Ekobo, A. S. (2021). Ownership and Utilisation of Long-Lasting Insecticidal Nets in Tiko Health District, Southwest Region, Cameroon: A Cross-Sectional Study. *Journal of Parasitology Research*, 2, 8848091. Doi:10.1155/2021/8848091
- Gboeloh, L. G., Elele, K., Wokoma, O., & Gura, B. (2022). Evaluation of the Current Status of Malaria Prevalence in the Three Senatorial Zones of Rivers State, Nigeria. *International Journal of Health Sciences*, 5(2), 67 – 86.
- Haile, D., Ferede, A., Kassie, B., Abebaw, A., & Million, Y. (2020). Five-Year Trend Analysis of Malaria Prevalence in Demebecha Health Center, West Gojjam Zone, Northwest Ethiopia: A Retrospective Study. *Journal of Parasitology Research*, 14, 8828670. doi: 10.1155/2020/8828670
- Hassen, J., & Dinka, H. (2020). Retrospective analysis of urban malaria cases due to *Plasmodium falciparum* and *Plasmodium vivax*: the case of Batu town, Oromia, Ethiopia. *Heliyon*, 6(3), e03616.
- Ibrahim, O.R., Lugga, A.S., Ibrahim, N., Aladesua, O., Lawal, M. I., & Suleiman, B. A. (2021). Impact of climatic variables on childhood severe malaria in a tertiary health facility in northern Nigeria. *Sudan Journal of Paediatrics*, 21(2), 173–181.
- Kolawole, E. O. (2023). Incidence of malaria parasites in symptomatic patients attending 44 Nigerian Army Reference Hospital (NARH) Kaduna state. *Microbes and Infectious Diseases*, 4(1), 252-258.
- Lerman, I. R. (2002). Marriage and the Economic Well-Being of Families with Children: A Review of the literature. Washington, DC: The Urban Institute and American University. Pp. 1–36.
- Li, Z., Wang, J., Cheng, X., Hu, H., Guo, C., & Huang, J. (2021). The Worldwide Sero prevalence of DENV, CHIKV and ZIKV Infection: A Systematic Review and Meta-Analysis. *PLoS Negl Trop Dis*, 15, e0009337.
- Maikenti, J. I., Pam, V. A., Omalu, I. C. J., Uzoigwe, R. N., Ombugadu, A., & Koggie, A. Z. (2022). Prevalence of malaria parasite in Billiri Local Government Area of Gombe State, Northeast Nigeria. *International Journal of Applied Biological Research*, 13(2), 159 – 167.
- Micah, L., Titus, S., & Richard, K. (2023). Antimalarial Usage and Associated Symptoms Among Malaria Patients Seeking Treatment at Makongeni Health Centre, Homa Bay County, Kenya. *African Journal of Medical Biosciences*, 15, 34-45.
- Midokisa, A., Beyene, B., Mihretie, A., Bayabil, E., & Wimberly, M. C. (2015). Seasonal associations of climatic drivers and malaria in the highlands of Ethiopia. *Parasites & Vectors*, 8, 339. Doi: 10.1186/s13071-015-0954-7
- Minwuyelet, A., & Aschale, Y. (2021). Analysis of five-year trend of malaria at Bichena primary hospital, Amhara region, Ethiopia. *Journal of Parasitology Research*, 2021, 6699373.
- 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.
- Njila, H. L., Idoko, J. E., Ombugadu, A., & Zakari, H. (2022b). Hemoglobin genotype variants and *Plasmodium falciparum* malaria in children receiving postpartum care at Faith Alive Foundation Jos, Plateau State, Nigeria. *Archives of Community Medicine and Public Health*, 8(4), 147-151. DOI: <https://dx.doi.org/10.17352/2455-5479.000>
- Njila, L. H., Onyike, G. S., & Ombugadu, A. (2022a). Assessment of Haemoglobin Genotype Variants in Malaria Infected Patients of Two Government Hospitals in Plateau State, North Central Nigeria. *Transactions on Science and Technology*, 9(1), 1 – 13.
- Njumkeng, C., Apinjoh, T. O., Anchang-kimbi, J. K., Amin, E. T., Tanue, E. A., Njua-yafi, C., & Achidi, E. A. (2019). Coverage and usage of insecticide treated nets (ITNs) within households: associated factors and effect on the prevalence of malaria parasitaemia in the Mount Cameroon area. *BMC Public Health*, 19(1), 1216. Doi:10.1186/s12889-019-7555-x
- Nwalozi, R., Onosakponome, E.O., Nnokam, B.A., & Lawson, S.D. (2023). Study on the association between malaria and occupation among Covid-19 Subjects. *Journal of Applied Health Sciences and Medicine*, 3(4), 22 –30.
- Nwele, D. E., Onyali, I.O., Iwueze, M. O., Elom, M. O., & Uguru, O. E. S. (2022). Malaria Endemicity in the Rural Communities of Ebonyi State, Nigeria. *Korean Journal Parasitology*, 60 (3), 173-179.
- Nyasa, R.B., Fotabe, E.L., & Ndip, R.N. (2021). Trends in malaria prevalence and risk factors associated with the disease in Nkonghombeng; a typical rural setting in the equatorial rainforest of the South West Region of Cameroon. *PLoS ONE*, 16(5), e0251380.
- Nyavor, K.D., Kweku, M., & Agbemafle, I., Takramah, W., Norman, I., Tarkang, E., & Binka, F. (2017). Assessing the ownership, usage and knowledge of insecticide treated nets (ITNs) in malaria prevention in the Hohoe Municipality, Ghana. *Pan Africa Medical Journal*, 28, 67. Doi:10.11604/pamj.2017.28.67.9934.
- Ochomo, E.O., Bayoh, N.M., Walker, E.D., Abongo, B.O., Ombok, M.O., & Ouma C. (2013). The efficacy of long-lasting nets with declining physical integrity may be compromised in areas with high levels of pyrethroid resistance. *Malaria Journal*, 12, 368.
- Ogbole, F.A., Igwe, C. U., Onuoha, H. C., & Nzebude, C. P. (2023). Evaluating the Prevalence of Malaria Parasite Infection among Adults in Wetlands Using Nested PCR and High Resolution Melting Analysis. *Asian Journal of Biochemistry, Genetics and Molecular Biology*, 14(4), 53-63.
- Ogomaka, I. A. (2020). Prevalence and preventive measures of malaria among students of Imo State University, Owerri, Nigeria. *Orapuh Journal*, 1(1), e704-e704.
- Oguntade E. S., Shamarina S., Meenakhshii N., Alaba A. L., & Nader S. (2020). Statistical Modelling of the Effects of Weather Factors on Malaria Occurrence in Abuja, Nigeria. *Int. J. Environ. Res. Public Health*, 17, 3474.
- Ombugadu, A., Mohammed, H., Maikenti, J. I., Attah, S. A., Njila, H. L., Pam, V. A., Abbas, A. A., ... & Uzoigwe, N. R. (2022). Malaria prevalence among potential HIV/AIDS outpatients from selected hospitals in a metropolitan city of Central Nigeria. *Transactions on Science and Technology*, 9(4), 185 – 193.
- Ombugadu, A., Nanvyat, N., & Mwanats, G. S. (2024). Population dynamics of the major anopheline vector in Nasarawa State, Central Nigeria, using the Novel Prokopack Aspirator and an existing protocol. *Zoological and Entomological Letters*, 4(2), 28-33.
- Onyiri, N. (2015). Estimating malaria burden in Nigeria: A geostatistical modeling approach. *Geospatial Health*, 10(2). doi:10.4081/gh.2015.306.
- Pukuma, M. S., & Ibrahim, T. (2023). Distribution, possession and utilization of insecticide treated nets in relation to malaria prevalence in Nangere local government area, Yobe state, Nigeria. *Animal Research International*, 20(3), 5038 – 5046.
- Randriamaherijaona, S., Briet, O.J., Boyer, S., Bouraima, A., N'Guessan,

- R., Rogier, C., & Corbel, V. (2015). Do holes in long-lasting insecticidal nets compromise their efficacy against pyrethroid resistant *Anopheles gambiae* and *Culex quinquefasciatus*? Results from a release–recapture study in experimental huts. *Malaria Journal*, 14, 332. Doi:10.1186/s12936-015-0836-7.
- Ravi, N., Holsted, E., Kadiebwe, B., Salthouse, A., & Sattar, A. (2022). A malaria knowledge, attitudes and practice survey in a rural community in Guinea. *Malaria Journal*, 14(1), 329. Doi: 10.1186/s12936-022-04357-6
- Semakula, M., Niragire, F., & Faes, C. (2023). Spatio-Temporal Bayesian Models for Malaria Risk Using Survey and Health Facility Routine Data in Rwanda. *International Journal of Environmental Research and Public Health*, 20(5), 4283.
- Simon-Oke, I. A., Awosolu, O.B., & Odeyemi, O. (2023). Prevalence of Malaria and COVID-19 Infection in Akure North Local Government Area of Ondo State, Nigeria. *Journal of Parasitology Research*, 5, 9529563. doi: 10.1155/2023/9529563.
- Tula, M. Y., Iyoh, O., Toy, B. D., Aziegbemhin, A. S., & Musa, T. (2023). Ownership, usage, and perception of insecticide treated nets (ITNs) for the prevention of malaria among students of a tertiary institution in northeastern Nigeria. *Public Health Toxicology*, 3(1), 8. DOI:10.18332/pht/162333
- WHO (2020). World Malaria Report. World Health Organization Geneva, Switzerland.
- WHO (2021). World Malaria Report. World Health Organization. Geneva, Switzerland.
- WHO (2022a). World malaria report. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO. (accessed 3–1–2023). <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2022>
- WHO (2022b) Malaria Fact-sheets. <https://www.who.int/news-room/fact-sheets/detail/malaria>.