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Prevalence of Malaria among Patients in Selected Health Centres in Otukpo, Benue State

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Abstract

Malaria remains a serious public health concern in many nations, including Nigeria. The present study is a hospital based cross-sectional study that was aimed at determining the prevalence of malaria among patients in selected health centres in Otukpo, Benue State. Three millilitres (3 mL) of venous blood was collected aseptically from two hundred (200) respondent using sterile syringe and dispensed into an Ethylene Diamine Tetra-acetic Acid (EDTA) bottle. The samples were taken to the microbiology Laboratory of the Federal University of Health Science, Otukpo for processing. Blood was collected from EDTA bottles with capillary pipettes and a small drop was placed on grease-free clean slides to prepare smears and subsequently, staining. The slides were properly labelled to allow for identification of each respondent's result. The smears were examined under the microscope using X40 and X100 objective lenses for morphological features of *Plasmodium* spp. Statistical analysis was done using the statistical package for social sciences (SPSS) version 26. Person's chi-square was used to determine association between variables at 95% confidence level. A p value less than or equal to 0.05 ($p \leq 0.05$) was considered to be indicative of a statistically significant relationship. Findings of the present study revealed a prevalence of 76.5% (n=153, N=200) for malaria parasites in the studied area. The prevalence of malaria parasite revealed a statistically significant difference with respect to location; St. Veronica's clinic had the highest isolation rate (91.2%, n=31, $p<0.05$). The prevalence of malaria parasite (77.5%, n=69; $p>0.05$) showed female preponderance over male subjects. Patients >59 years (old adults) had the highest prevalence of malaria (100%, n=2; $p>0.05$). There was no statistically significant difference in the prevalence of malaria parasite with respect to gender and age. The high prevalence of malaria parasite in the study calls for concern.

Keywords: Age, gender, health centres, malaria, prevalence

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Introduction

Malaria remains a serious public health concern in many nations, including Nigeria [1, 2]. The disease is transmitted in humans through the bites of infected female anopheles mosquitoes [3]. The genus *Plasmodium* contains five species of parasites that cause malaria, with *Plasmodium falciparum* being the most common [4, 5]. Globally, there were 247 million cases of malaria and 619,000 deaths in 2021 [6]. However, only 15 nations, mostly in Africa, accounted for about 80% of all malaria-related deaths [7]. World Health Organization (WHO) reported that 48% of the world's population is still at danger of malaria despite frantic efforts and interventions aimed at its eradication [8]. This percentage is significantly greater than the 40% commonly quoted.

In Africa, malaria is the leading cause of both hospital admissions and outpatient visits [9, 7]. Variations in sociodemographic, environmental, and climatic factors may contribute to the variation in the prevalence of malaria infection among patients, even within the same nation [10, 11]. In Nigeria, malaria prevalence of 66.7% [9], 64.0% [2], and 58.0% [11] have been reported by previous studies. There are about 100 million malaria cases and 300,000 deaths each year in Nigeria making her the country with the highest number of malaria causalities worldwide [12]. Malaria is responsible for 60% of outpatient visits to health facilities, 30% of childhood deaths, 25% of deaths in children under one year, and 11% of maternal deaths in Nigeria [13].

In urban and peri-urban areas, socio-demographic factors like age, gender, education, occupation, and income have been well-reported to have a direct impact on human exposure and treatment. Climate factors like temperature, humidity, and rainfall have also been shown to facilitate mosquito vector development and rapid growth [14, 10]. Malaria transmission is more common in Africa's rural than urban areas, which may be caused by the region's increased vector density, subpar housing conditions, and inadequate drainage infrastructure [15, 8].

It has been reported that slow economic progress and cycle of poverty in Africa could be attributed to difficulties in managing malaria [16]. The majority of deaths are among children in Africa, where a child dies every minute from malaria [1, 13].

Malaria affects children's ability to work, hinders their physical and mental growth, lessens the benefits of education, and restricts their ability to contribute to the social and economic development of their nation [17, 18]. Financial losses due to malaria in Nigeria are estimated to be ₦132 billion annually; this includes cost of treatment, prevention and loss of man hours [19]. The prevalent species in Nigeria is *Plasmodium falciparum* accounting for over 90% of all diagnosed cases. *Plasmodium ovale* and *P. malariae* account for 2 and 5% respectively while *P. vivax* is not endemic [20]. The majority of endemic nations, including Nigeria, rely mostly on clinical evidence for the diagnosis of malaria; however, thick and thin film microscopy may occasionally be utilized for laboratory confirmation [21, 18]. The World Health Organization recommends parasite-based diagnosis before starting antimalarial therapy [8]. However, due to the alleged high prevalence of malaria, empirical treatment and over-prescription of antimalarial medications continue to be commonplace in Nigerian households and clinical settings [22, 20]. This is made worse by a lack of knowledge on the precision of malaria diagnosis [23]. Since the advent of expensive antimalarials (artemisinin-based treatments), it has become necessary to develop reliable diagnostic instruments for tracking the efficacy of the fight against malaria [14, 24]. The gold standard for diagnosing malaria and the accepted procedure for laboratory confirmation of the disease is still conventional light microscopy of a blood smear, which has a threshold sensitivity of 5 to 50 parasite/ÉL (depending on the microscopist expertise) [17, 8]. In cases of severe malaria, it helps with the assessment of the parasitological response to chemotherapy and the determination of parasite densities and their circulatory stages.

However, the delay between collecting the sample and receiving the results is frequently too great, allowing doctors to diagnose malaria patients clinically (presumptively). Oyerogba *et al*. reported that physicians treat febrile patients empirically based on clinical diagnosis most of the time [2]. Consequently, artemisinin-based combination therapy (ACT) is assumedly administered to anyone exhibiting feverish symptoms, which may result in the mishandling of other potentially fatal conditions [9]. Drug resistance to the currently available antimalarial medications, which are expensive, and the progression of malaria after therapy have been connected to the indiscriminate treatment of non-malaria feverish individuals without parasitological diagnosis [25, 26]. Thus, the purpose of this study is to ascertain the prevalence of malaria among clinically suspected patients who visited selected health facilities in Otukpo, Benue State.

Materials and Methods

Study area

This study is a hospital-based cross-sectional study and was conducted in Otukpo, Otukpo LGA of Benue State in the North central part of Nigeria between July 2023 and February 2024. Otukpo has Longitude 5 0 32'14.8''N and Latitude 7 0 29'50.3''. It has a rain forest belt with dry and wet seasons typical of the West African sub-region. Otukpo is an urban area with temperature ranges from 27-32^{o}C. The population is predominantly civil servant. Others are traders, students, farmers, and artisans. Otukpo is characterized by blocked drainage systems; this creates stagnant water for mosquito breeding. Other predisposing factors include open containers of water for house use, discarded empty tins, leaf foliages which trapped water and serve as breeding sites for mosquitoes.

Collection of blood samples and examination for malaria parasites

Blood samples were collected from selected hospitals across Otukpo. The hospitals are: St. Daniel's hospital, St. Veronica's hospital, Royal Specialist hospital, Primary Health care and Federal University of Health Sciences, Otukpo (FUHSO) Teaching Hospital.

Three milliliters (3 mL) of venous blood was collected aseptically from each respondent using venipuncture by the health practitioner in the hospital and dispensed into an Ethylene Diamine Tetra-acetic Acid (EDTA) bottles and gently mixed. The samples were taken immediately to the Microbiology Laboratory of Federal University of Health Sciences, Otukpo for processing. Blood was collected from EDTA bottle with a capillary pipette and a drop of each was placed on two clean grease-free slides to prepare thick and thin smears. The slides were properly labelled to allow for identification of each respondent's result. The thick smears were air-dried for 30 min while the thin smears were air-dried for 15 min, both at room temperature. The thin smears were fixed for one minute in methanol before staining. Staining was done according to Ochei and Kolhalkar, using Field's stains A and B [27]. The slides were carefully air-dried and placed in vertical positions. The blood smears were examined under microscope using X40 and later X100 objectives lens for morphological features of *Plasmodium* species. All slides with malaria parasites were recorded as positive while slides without malaria parasite were recorded as negative [28].

Inclusion criteria

Patients who presented with febrile illness (with an axillary temperature at 37.5^{o}C). This included those who consented (aged 18 years and above) and those who assented by adults (below 18 years of age).

Exclusion criteria

Patients who were too ill that required immediate attention or those with mental illness. Also, those on treatment for malaria or have just completed anti malaria within two weeks prior to the conduct of this study.

Sample size determination

Two hundred (200) samples were examined. Sample size was determined using the formula below [29]:

$$S = X^2 NP (1-P) \div d^2 (N-1) + X^2P (1-P)$$

Where: S = Sample size being sought; X^2 = table value for chi-square at 1 degree of freedom at the desired alpha level (0.05 = 3.84: 01 =6.64); N = Population size (3,017); P = the population proportion (usually 0.05 as this provides the maximum sample size); d = degree of accuracy desired, expressed as a proportion (usually 0.05);

$S=3.84 \times 3,012 \times 0.05(1-0.05) \div (0.05)^2 (3,012-1) +3.84 \times 0.05 (1-0.05)$

$=204 \approx 200$.

Ethical clearance, consideration and consent

The study was approved by the Ethics and Research Committee of Federal University of Health Sciences, Otukpo (FUHSO/02/05/2023-02/05/2023). When seeking consent from the respondents who were 18 year and above or assent from the guidance/parents of the respondent below aged 18 years, the methods and objectives of the study were explained clearly to the respondents individually. For those respondents that could not read or write, the questionnaire was translated from English language to their local language by an independent interpreter who served as their legal guardian while back translation to English language was done to maintain response consistency. Thus, written informed consent either by appending signature or thumbprint was obtained from all adult respondents and guardians/parents on behalf of their children before starting the study. Confidentiality and privacy were ensured throughout the study. The study was at no cost to the respondents.

Quality control

To ensure that the authorized standard operating procedure was followed for all the investigations, a senior microscopist was recruited to examine the slides for quality control.

Statistical analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 26. Pearson's chi-square test was used to determine associations between variables at 95% confidence level. A *p* value less than or equal to 0.05 was considered to be indicative of a statistically significant relationship.

Results and Discussions

Findings of the present study revealed a prevalence of 76.5% (n=153) for malaria parasites (Table 1). This is consistent with results from previous studies in Zaria [30], Umuahia [31] and South Western Nigeria [32]. Ukpai, and Lakew *et al*. however reported lower prevalence in Umuahia, Nigeria and Ethiopia, respectively [1, 3]. According to reports of WHO [8], majority of malaria cases and typhoid fever cases occur in Asia, Africa and Latin America where water-borne diseases are highly prevalent. The implication of this finding is that the high prevalence of malaria parasite in the present study suggests the existence of a significant public health hazard in the study population.

Table 1: Prevalence of Malaria parasite with Respect to Location

Location	Positive (%)	Negative (%)	Total
St. Daniel Hospital	53 (65.4)	28 (34.6)	81(100.0)
St. Veronica Clinic	31 (91.2)	3 (8.8)	34 (100.0)
Royal Specialist Hospital	11 (84.6)	2 (15.4)	13 (100.0)
Primary Health Care	40 (76.9)	12 (23.1)	52 (100.0)
FUHSOTeaching Hospital	18 (90.0)	2 (10.0)	20 (100.0)
Total	**153 (76.5)**	**47 (23.5)**	**200 (100.0)**

$\chi^2 = 12.102$, df = 4, P = 0.017 (P < 0.05)

The prevalence of malaria parasite with respect to location revealed that St. Veronica's Clinic had the highest isolation rate (91.2%, n=31, p<0.05) (Table 1). This could be attributable to the fact that the hospital is located in Sabon-Gari; an area characterised by poor drainage system with visible stagnant water in most locations, increased vector density and subpar housing conditions. These factors have shown to facilitate mosquito vector development and rapid growth.

The prevalence of malaria parasite (77.5%, n=69; p>0.05) showed female preponderance over male subjects (Table 2). This is consistent with the findings of Daini *et al*. [33] and Patel *et al*. [34]. This, however, disagree with the findings of Oladele *et al*. [18]. This could be as a result of Benue South's cultural background where a female may easily be exposed to mosquito bites as a result of outdoor activities such as domestic activities and community engagements, petty trading, cooking and fetching water from the stream. Most times, they stay out late to get these tasks done. These habits predispose them to infection.

Table 2: Prevalence of malaria parasites with respect to gender

Gender	Positive (%)	Negative (%)	Total (%)
Female	69 (77.5)	20 (22.5)	89 (100.0)
Male	84 (75.7)	27 (24.3)	111 (100.0)
Total	153 (76.5)	47 (23.5)	200 (100.0)

$\chi^2 = 0.094$, df = 1, P = 0.759 (P > 0.05)

Table 3: Prevalence of malaria parasite with respect to age

Age (years)	Positive (%)	Negative (%)	Total (%)
2-4 (Toddler)	4 (66.7)	2 (33.3)	6 (100.0)
5-12 (Child)	40 (78.4)	11 (21.6)	51 (100.0)
13-19 (Teen)	38 (74.5)	13 (25.5)	51 (100.0)
20-39 (Young adult)	55 (74.3)	19 (25.7)	74 (100.0)
40-59 (Middle-aged adult)	14 (87.5)	2 (12.5)	16 (100.0)
>59 (Old adults)	2 (100.0)	0 (0)	2 (100.0)
Total	153(6.5)	47(23.5)	200 (100.0)

$\chi^2 = 2.427$, df = 5, P = 0.787 (P > 0.05)

Patients >59 years (old adults) had the highest prevalence of malaria (100%, n=2; p>0.05) followed by age range 40-59 (middle-aged adults) (Table 3). This could be attributable to the fact that old adults may have been immunologically suppressed due to age and diet. This finding corroborates earlier reports in Western Nigeria [18], Anyigba, Kogi State [34] and Burkina Faso [32] although, they reported much higher prevalence.

However, the findings of this study disagree with those of Nodem *et al.* who reported highest prevalence of malaria among people of 13-19 years age group in Cameroon [35]. The implication of this finding is that the farming activity which is the main source of economic livelihood will be affected; its attendant consequences like economic misfortune, and hunger will be great.

Conclusion

The findings of the present study revealed a high prevalence of 76.5% (n=153) for malaria parasites.The study has shown a statistically significant difference in the prevalence of malaria parasite with respect to location. There is no statistically significant difference in the prevalence of malaria parasite with respect to gender and age; however the prevalence of malaria parasite showed female preponderance over male subjects. The high prevalence of malaria parasite in the study calls for concern.

Conflict of interest: There is no conflict of interest among the authors.

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References

[1] Ukpai, O. M. & Ubiaru, P. C. (2016). Prevalence of malaria and social determinants of transmission among febrile patients attending Obioma Hospital, Umuahia, Abia State, Nigeria. *The Zoologist*, 14, 19-24.

[2] Oyerogba, O. P., Adedapo, A., Awokson, T., Odukogbe, A. & Aderinto, N. (2023). Prevalence of malaria *Parasitaemia* among pregnant women at booking in Nigeria. *Health Science Reports*, 6(13), 1-8. doi:10.1002/hsr2.1337

[3] Lakew, Y. Y., Fikrie, A., Godana, S. B., Wariyo, F. & Seyoum, W. (2023). Magnitude of malaria and associated factors among febrile adults in Siraro District Public Health facilities, West Arsi Zone, Oromia, Ethiopia 2022: A facility-based cross-sectional study. *Malaria Journal*, 22(5), 1-10.

[4] Ocheje, A. J. & Dogara, M. M. (2016). Prevalence of malaria and risk factors among patients attending Dutse General Hospital, Jigawa State, Nigeria. *International Research Journal of Public and Environmental Health*, 3(11), 270-277.

[5] Belay, B., Gelana, T. & Gebresilassie, A. (2021). Malaria prevalence, knowledge, attitude, and practice among febrile patients attending Chagni health center, Northwest Ethiopia: A cross-sectional study. *Tropical Diseases, Travel Medicine and Vaccines*, 7(20), 1-10.

[6] Centres for Disease Control and Prevention. CDC–Malaria–About Malaria–FAQs [Internet]. 2022. Available from https://www.cdc.gov/malaria/about/faqs.html/

[7] World Health Organisation. Malaria [Internet]. 2023 [Last accessed 2024 March 3]. Available from https://www.who.int/news-room/fact-sheets/detail/malaria/

[8] World Health Organisation. World malaria report 2022: Tracking progress and gaps in the global response to malaria [Internet]. 2022 [Last accessed 2024 Feb 16]. Available from https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-

[9] Omoya, F. O. & Ajayi, K. O. (2020). Prevalence of malaria among febrile patients attending Government Hospitals in Ondo State, South-West Nigeria. *American Journal of Epidemiology and Public Health*, 4(4), 017–024.

[10] Ngum, N. H., Fakeh, N. B., Lem, A. E. & Mahamat, O. (2023). Prevalence of malaria and associated clinical manifestations and myeloperoxidase amongst populations living in different altitudes of Mezam division, North West Region, Cameroon. *Malaria Journal*, 22(1), 20-32. https://doi.org/10.1186/s12936-022-04438-6 PMID: 36658587.

[11] Yohanna, J., Oti, V., Amuta, E., Philip, A. & Anizoba, L. (2019). *Plasmodium falciparum* infection among febrile patients attending a tertiary healthcare facility in central Nigeria: Prevalence, hematologic and socio-demographic factors. *International Journal of Tropical Diseases*, 2(2), 1-10.

[12] World Health Organisation. World Malaria Report 2018 [Internet]. 2018 [Last accessed Feb. 16, 2024]. Available from https://apps.who.int/iris/bitstream/handle/10665/275867/9789241565653-eng.pdf

[13] World Health Organization. World Malaria Report 2020: 20 Years of Global Progress and Challenges. Geneva: World Health Organization.

[14] Nmadu, P. M., Peter, E., Alexander, P., Koggie, A. Z. & Maikenti, J. I. (2015). The prevalence of malaria in children between the ages 2–15 visiting Gwarinpa General Hospital Life-Camp, Abuja, Nigeria. *Journal of Health Sciences*, 5(3), 47–51.

[15] Oladeinde, B., Omoregie, R., Olley, M., Anunibe, J., Onifade, A. & Oladeinde, O. (2012). Malaria and anemia among children in a low resource setting in Nigeria. *Iranian Journal of Parasitology*, 7(3), 31–37. PMID: 23109959.

[16] Ibrahim, A. O., Bello, I. S., Ajetunmobi, A. O., Ayodapo, A., Afolabi, B. A. & Adeniyi, M. A. (2023). Prevalence of asymptomatic malaria infection by microscopy and its determinants among residents of Ido-Ekiti, Southwestern Nigeria. *PLoS One*. 18(2), e0280981. https://doi.org/10.1371/journal.pone.0280981

[17] Sultana, M., Sheikh, N., Mahumud, R. A., Jahir, T., Islam, Z. & Sarker, A. R. (2017). Prevalence and associated determinants of malaria parasites among Kenyan children. *Trop. Med. Health*, 45(1), 25. https://doi.org/10.1186/s41182-017-0066-5

[18] Oladele, O. V., Onuoha, S. C., Hamafyelto, H. S., Omisope, O., Fauziyya, A., Akindigh, M., Abdullahi, T., Ilu, M. L. & Ikeh, E. (2018). Prevalence of malaria infection among patients attending Murtala Muhammed Specialist Hospital Kano, Nigeria. *African Journal of Clinical and Experimental Microbiology*, 19(3), 214-220.

[19] Centres for Disease Control and Prevention. Where Malaria Occurs [Internet]. 2020 [Last accessed Feb. 12, 2024]. Available from: https://www.cdc.gov/malaria/about/distribution.html/

[20] Ibrahim, A. O., Bello, I. S., Shabi, O. M., Omonijo, A. O., Ayodapo, A. & Afolabi, B. 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. *SAGE Open Med*. https://doi.org/10.1177/20503121221117853 PMID: 36051785

[21] Noland, G. S., Graves, P. M., Sallau, A., Eigege, A., Emukah, E. & Patterson, A. E. (2014). Malaria prevalence, anemia and baseline intervention coverage prior to mass net distributions in Abia and Plateau States, Nigeria. *BMC Infectious Diseases*, 14(1), 168. https://doi.org/10.1186/1471-2334-14-168 PMID: 24669881.

[22] Umaru, M. L. & Uyaiabasi, G. N. (2015). Prevalence of Malaria in Patients Attending the General Hospital Makarfi, Makarfi Kaduna State, North-Western, Nigeria. *American Journal of Infectious Diseases and Microbiology*, 3(1), 1–5.

[23] Centres for Disease Control and Prevention. Where Malaria Occurs [Internet]. 2023 [Last accessed March 02, 2024]. Available from https://www.cdc.gov/malaria/about/distribution.html/

[24] Njila, H. L., Idoko, J. E., Ombugadu, A. & Zakari, H. (2022). 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.

[25] Bamou, R. & Sevidzem, S. L. (2016). ABO/Rhesus blood group systems and malaria prevalence among students of the University of Dschang Cameroon. *Malaria World Journal*, 7(4), 1–4. https://doi.org/10.1371/journal.pone.0287723, accessed July 14, 2023

[26] Ebadan, M. I., Obodo, B. N., Amiegheme, F. E., Uwaifo, F., Omigie, B. E. & Iyevhobu, L. K. (2017). Prevalence and susceptibility of malaria parasites infection in association with blood group and hemoglobin genotype polymorphism in pregnancy. *International Journal of Community Research*, 6(2), 2–8.

[27] Ochei, J. & Kolhalkar, A. (2008). Miscellaneous investigation in Haematology, Medical Laboratory Science, theory and practical data. India: McGraw-Hill Publishing Company Limited.

[28] Cheesbrough, M. (2010). District Laboratory Practice in Tropical Countries. Low Price Publisher: Cambridge University Press.

[29] Rosie, C. (2006). Statistics: An Introduction to Sample Size Calculations. Mathematics Learning Support Centre. Accessed from http://mlsc.lboro.ac.uk/resources/staistics/Samplesize.pdf.

[30] Umar, M., Usman, J., Iliyasu, R. Y. & Mansur, S. A. (2021). Clinico-epidemiological studies of *Plasmodium falciparum* and *Salmonella typhi* co-infection among patients attending selected General Hospital in Northern Nigeria. *Sumerianz Journal of Biotechnology*, 4(4), 133-143.

[31] Dike-Ndudim, J. N., Cajethan, F. I. & Chizaram, W. N. (2022). Assessment of co-infection of typhoid and malaria in patients attending F.M.C Umuahia Abia State. *Magna Scientia Advanced Research and Reviews*, 5(2), 1–7.

[32] Ibrahim, A. O., Agbesanwa, T. A., Aremu, S. K., Bello, I.S., Elegbede, O. T., Gabriel-Alayode, O. E., Ajetunmobi, O. A., , Adewoye, K. R., Olanrewaju, T. M., Ariyibi, E. K., Omonijo, A., Sanni, T. A., Alabi, A. K. & Olusuyi, K. (2023). Malaria infection and its association with socio-demographics, long lasting insecticide nets usage and hematological parameters among adolescent patients in rural Southwestern Nigeria. *PLoS ONE*, 18(7), e0287723.

[33] Patel, D. K., Mittal, S., Nimisha, T., Maurya, A. K., Dhirendra, S., Pandey, A. K. & Anirban, Pal (2018). *Plasmodium–salmonella coinfection* induces intense inflammatory response, oxidative stress, and liver damage: A mice model study for therapeutic strategy. *SHOCK*, 50(6), 741–749.

[34] Daini, T. G., Obafemi, A. S., Adetoyi, H. N., Solaja, O. O. & Abiodun, S. A. (2022). The Incidence of *Plasmodium Falciparum* and *Salmonella Typhi* as Co-Infection among Residents of Idiroko, Ipokia Local Government Area of Ogun State, Nigeria. *Journal Healthcare Treatment Development*, 2(6).

[35] Okolo, M., Kikelomo, A., Cornelius, O., Idache, M. & Eleojo, U. (2023). Prevalence of malaria and typhoid fever co-infection among pregnant women attending antenatal clinic in Anyigba, Kogi State, Nigeria. *Microbes and Infectious Diseases*, 4(2), 671-680.

[36] Nodem, F. S., Ymele, D., Fadimatou, M. & Fodouop, S. P. (2023). Malaria and typhoid fever coinfection among febrile patients in Ngaoundéré (Adamawa, Cameroon): A cross-sectional study. *Journal of Parasitology Research*, 2(3), 1-9.

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