Scientific Research Publishing

Advances in Infectious Diseases, 2024, 14, 873-887
https://www.scirp.org/journal/aid
ISSN Online: 2164-2656
ISSN Print: 2164-2648

Prevalence of Malaria Parasites among Febrile Patients in a Teaching Hospital in South East Nigeria

Felix Edoiseh Ehidiamhen[1*], Ruth Chinenye Ibegbulem[2], Idakari Chinedu Nweke[2], Comfort Nne Akujobi[2], Aja Josiah Nwandibia[2], Anemeje Onyeka Afam[3], Dafup Katdel Istifanus[3], Kenneth Eze Etu[3], Elom Onochie Peter[4], Onwe Francis Idenyi[4], Robinson Uchenna Ugwuanyi[5], Chinyere Grace Chukwu[6]

[1]Department of Pathology, Faculty of Basic Clinical Sciences, David Umahi Federal University of Health Sciences, Uburu, Nigeria
[2]Department of Clinical Microbiology, David Umahi Federal University Teaching Hospital, Uburu, Nigeria
[3]Department of Family Medicine, David Umahi Federal University Teaching Hospital, Uburu, Nigeria
[4]Department of Public Health, David Umahi Federal University Teaching Hospital, Uburu, Nigeria
[5]Reproductive Endocrinology, Fertility and Invitro-Fertilization Unit, Department of Obstetrics and Gynaecology, David Umahi Federal University Teaching Hospital, Uburu, Nigeria
[6]Department of Planning, Research and Statistics, David Umahi Federal University Teaching Hospital, Uburu, Nigeria
Email: *edoiseh@gmail.com, ibegchinenye@gmail.com

How to cite this paper: Ehidiamhen, F.E., Ibegbulem, R.C., Nweke, I.C., Akujobi, C.N., Nwandibia, A.J., Afam, A.O., Istifanus, D.K., Etu, K.E., Peter, E.O., Idenyi, O.F., Ugwuanyi, R.U. and Chukwu, C.G. (2024) Prevalence of Malaria Parasites among Febrile Patients in a Teaching Hospital in South East Nigeria. *Advances in Infectious Diseases*, **14**, 873-887.
https://doi.org/10.4236/aid.2024.144065

Received: November 8, 2024
Accepted: December 23, 2024
Published: December 26, 2024

Abstract

Background: Malaria remains a global health threat affecting approximately 97% of the population in sub-Saharan African countries, particularly Nigeria. Despite efforts made to reduce the mortality rate in Nigeria, the disease still poses a major morbidity challenge. ***Aim***: This study, therefore, was aimed at identifying malaria prevalence in symptomatic febrile patients attending David Umahi Federal University Teaching Hospital, Uburu Ebonyi State, Nigeria. ***Methods***: A hospital-based cross-sectional study was conducted with primarily structured data collected from the hospital medical laboratory between September 2023 and April 2024 among 613 febrile patients attending David Umahi Federal University Teaching Hospital, Uburu Ebonyi State, Nigeria using microscopy (thick and thin blood films). Primarily structured data was used to collect data on sociodemographic characteristics and factors perceived to be associated with Plasmodium infection. Malaria Parasitological Record Book data was collected, while thin and thick blood films were prepared from capillary blood buffy coat samples. Data were analyzed using Excel, Python, and Google Sheets. Out of 613 febrile patients, 480 were confirmed to be infected by Plasmodium species. ***Results***: Our results, thus, showed a malaria prevalence of (78%) of the study population. The age groups 31 - 40 years

constituted the greater proportions of the population with malaria parasite infection 18.5% (89). On the basis of gender, the highest prevalence occurred in females (297) constituting 61.9% of the positive malaria cases observed in this study. ***Conclusion***: It is recommended that a malaria surveillance unit be established to help standardize data collection and monitoring of malaria patients in teaching hospitals, while Molecular Malaria Surveillance (MMS) also needs to be introduced in teaching hospitals in line with international best practices.

Keywords

Malaria, Prevalence, Microscopy, Malaria Molecular Surveillance (MMS)

1. Introduction

Malaria is a vector borne disease caused by plasmodium parasites which are transmitted by the bite of infected female Anopheles mosquitoes. The plasmodium parasites implicated in malaria include *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, *P. knowlesi*. Malaria parasite trophozoites are generally ringed shaped 1 - 2 μ in size, although other forms (ameboid and band) may also exist [1]. The sexual forms of the parasites (gametocytes) are much larger and 7 - 14 microns in size [2].

Malaria is a serious threat to human health. The disease has had a great impact on human populations affecting 3.3 billion people worldwide in at least 106 countries [2] [3]. However, it is both preventable and curable. In 2019 alone, 229 million malaria cases were detected globally with 409,000 estimated deaths. Children under five years were particularly susceptible to malaria, which accounted for 67% (274,000) of all malaria deaths worldwide [3]. Presently, malaria parasite still poses a major global public health concern, with sub-Saharan Africa bearing the most burden of the disease [3]. Malaria transmission and severity within this part of Africa varies greatly from region to region, village to village and even from person to person [3] [4]. The impact of the disease is, however, greater in rural areas where the disease is common during periods of agricultural activity [3].

Nigeria accounts for 27% of the global malaria burden and 32% of malaria deaths globally [4]. Malaria poses a risk of about 97% to the Nigerian population and contributes about 11% of maternal mortality. The result of 2021 Nigeria Malaria Indicator Survey (NMIS), however, shows a decline in national prevalence of malaria to 22% from 23% in 2018 and 42% in 2010 [4] [5].

The 2021 World Malaria Report from World Health Organization (WHO) also showed that 9 - 10 persons die every hour due to malaria, or malaria-related issues in Nigeria, with Osun state, recording the highest prevalence (11.85%) [5].

Since understanding where infection prevalence and transmission potentials are highest in a population is very key in developing targeted control interventions, the prevalence of malaria parasites has long been observed and researched

globally, continentally, nationally, and even sub-nationally.

In Nigeria, for instance, a series of studies have been carried out on the prevalence of malaria parasite in Ebonyi State in Southeastern part of Nigeria [5]. These studies have traversed various demographics spanning various areas like Afikpo North Local Government Area, Ezza North Local Government Area, and Onicha Local Government Area, between 2010 and 2022. Ezza North Local Government Area had the highest prevalence of 13.4% while Izzi Local Government Area had the lowest prevalence of 12.5%. However, as can be gleaned from **Figure 1**, no study has been done for Uburu community in Ohaozara Local Government Area.

Generally, symptoms of malaria include fever, flu-like illness, chills, headache, muscle aches, tiredness, nausea, vomiting, and diarrhea [5]. Other symptoms are elevated body temperature ≥ 37.5˚C, enlarged spleen or liver (especially in children), pallor in children or pregnant women.

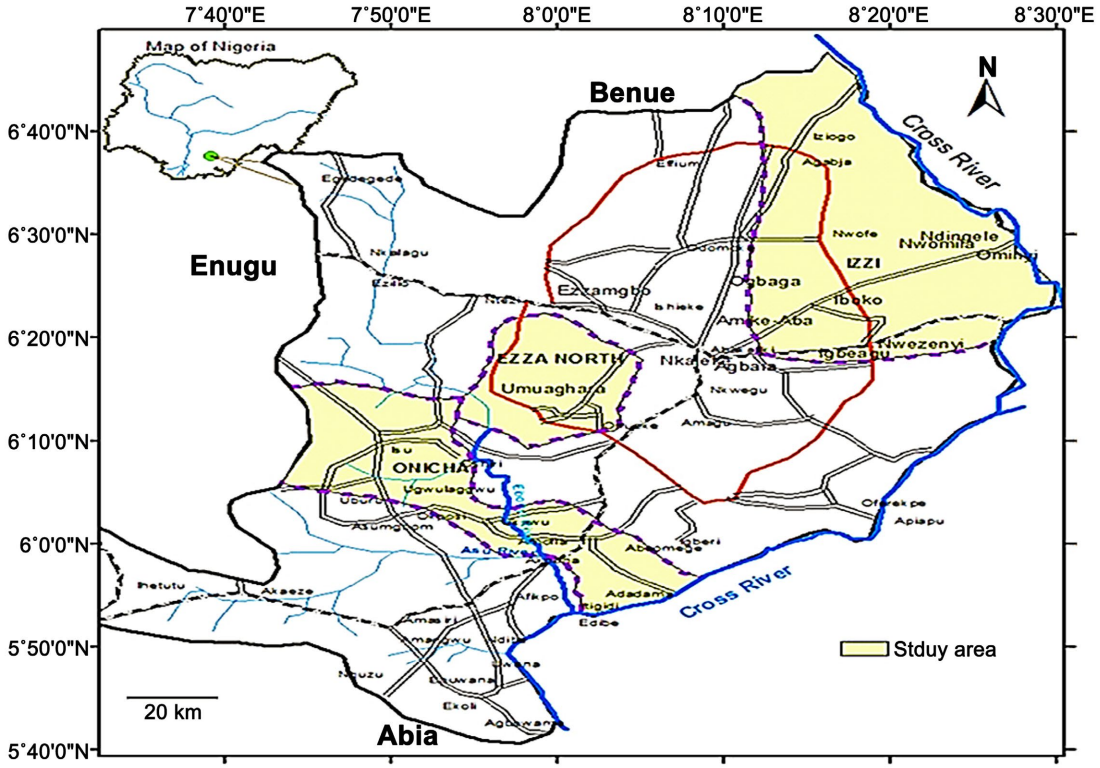

Figure 1. Map of Ebonyi [5].

The national guideline for diagnosis and treatment of malaria (2020) recommends parasitological diagnosis for all suspected malaria cases. The guideline states that the signs and symptoms of malaria are non-specific. However, clinical suspicion is primarily based on fever or a history of fever in the last 24 hours and/or the presence of anemia [6] [7].

Fever has been defined as "a state of elevated core temperature, which is often, but not necessarily, part of the defensive response of multicellular organisms to invasion by live microorganisms or inanimate matter recognized as pathogenic or

alien by the host [8].

2. Objective of the Study

The objective of this study was to determine the prevalence of malaria parasites among febrile patients in a teaching hospital in Southeast Nigeria, using David Umahi Federal Teaching Hospital, Uburu, Ebonyi State, Nigeria, as a case study.

3. Materials and Method

3.1. Study Area

This study was carried out in David Umahi Federal University Teaching Hospital, located in Uburu, Ohaozara Local Government Area of Ebonyi State. The climate of the area (just like in other parts of Ebonyi State) is tropical, and the vegetation is typical of the rain forest type. Average annual rainfall in Ebonyi State generally, is about 1300 mm and average monthly temperature is of 30˚C ± 5˚C.

There are two distinct seasons: the wet (between April and October) and the dry seasons (from November to March). Uburu is a community in Ohaozara Local Government Area of Ebonyi State, which is mainly flat table land with the capacity to hold water after rainfall [5]. These topographic features usually create breeding grounds for mosquito vectors.

3.2. Study Design

This was a hospital-based retrospective cross-sectional study. Primarily structured data were collected from the hospital medical laboratory between September 2023 and April 2024. The data also sought information on the patient's socio-demographic characteristics (age, gender, and period/time of presentation).

3.3. Study Population

A total of 613 febrile patients in David Umahi Federal University Teaching Hospital between September 2023 and April 2024, aged 0 - 100 years, comprising males (n = 246) and females (n = 367) were attending for malaria parasite. The patients (and their guardians, as the case may be) consented to the study.

3.4. Inclusion/Exclusion Criteria

Individuals who visited the hospital with signs and symptoms of malaria (especially fever) and gave their consent were included in the study. Consent was also obtained from the caregivers of minors. Those on treatment for malaria or had just completed anti-malaria treatment within two weeks before the conduct of this study was excluded. Also, individuals that were too ill that required immediate medical attention were excluded.

3.5. Blood Sample Collection

The technique used in this study was adapted from WHO 2000 on severe and

complicated malaria [3]. Capillary blood samples were collected using a lancet to prick the fingertip in adults, or the heel in infants and small children. The blood drop that forms on the fingertip or the heel was collected via a tiny glass capillary tube and transferred to a glass slide, or applied to filter paper, or absorbed via the tip of a micro sampling device.

3.6. Malaria Parasite Determination

3.6.1. Microscopy

Thick and thin films were made from the samples and were prepared on clean, dry microscopic glass slides and allowed to dry. The thin smear was fixed in methanol and both smears were stained with 5% Giemsa stain. The stained slides were viewed under the microscope. A slide was declared negative if parasites were absent after examining 200 high power fields. Parasite density or load was quantified against 200 leucocytes on an assumed leucocyte count of 8000 per microliter of blood. However, if any parasites were found after the examination, the result was declared positive.

3.6.2. Sample Size Determination

In this retrospective study, sample size was determined using the parameter $n = Z^2 \times p \times (1 - p)\, E^2$ where n = sample size, Z = z-score corresponding to the desired confidence interval (for 95% confidence interval, Z is approximately 1.96), p = estimated population proportion (typically 0.5), E = margin of error (as a proportion). Substituting the values, $n = 384.16$. Primarily structured data retrieved from the Malaria Parasitological Record Book was used to collect data on sociodemographic characteristics perceived to be associated with Plasmodium infection.

3.7. Data Analysis

Data were analyzed using Excel 2016. Trend analysis of positive cases was done using a Python script chi-square goodness-of-fit test, to determine the peak period of malaria infections. Binary logistics regression was employed to determine correlations between the results and each age group.

3.8. Limitation of Study

Since the study was a hospital-based study and not community-based, the prevalence of malaria in the study area may have been underestimated. Also, the sample size is not large enough; thus, there is a probability of sampling error. The study did not include vector surveillance to validate the malaria vector species in the study area. Notwithstanding this, the study provides relevant information that can help in shaping appropriate policies in the study area.

4. Ethical Consideration

The study was approved by the Research and Ethics Committee of David Umahi Federal University Teaching Hospital Uburu, Ebonyi State, Nigeria. The implications of the study were clearly explained to the participants before they were

recruited. In other words, informed consent was obtained from them, before starting the study. Data collected were kept confidential and privacy was ensured; and they did not bear the cost of the study.

5. Result

5.1. General Overview

613 febrile patients presented in DUFUTH in the study period; out of which, malaria parasite was present in 480 patients' blood film with no other infective or parasitic process found in their blood test (prevalence of 78% (480 cases) out of 613). The age group 31 - 40 years constituted the greatest proportion of the population with malaria parasite infection at 18.5% (89). On the basis of prevalence among gender, females constituted 61.9% (297) of the positive malaria cases observed in this study while males made up 38.1% (183) of positive cases.

5.2. Sex Distribution

Out of the 613 participants in this study, 246 (40%) were males, while females 367 (60%) were females. The pie chart representation of this distribution is shown in Figure 2.

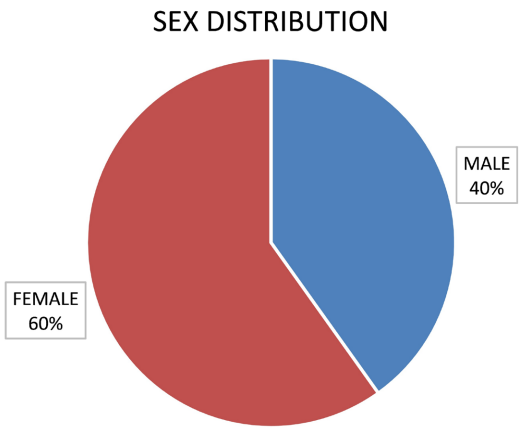

Figure 2. A Pie chart showing the sex distribution of the participants.

5.3. Age Distribution

The age range of patients that participated in this study is displayed below in Table 1.

Table 1. Showing the age frequency among participants.

AGE RANGE IN YEAR	FREQUENCY	% FREQUENCY
0 - 10	78	12.7
11 - 20	63	10.3
21 - 30	85	13.7
31 - 40	98	16.1

Continued

41 - 50	62	10.1
51 - 60	56	9.1
61 - 70	75	12.2
71 - 80	43	7.1
81 - 90	31	5.1
>91	22	3.6

Age range between 31 - 40 years has the highest number of percentage population of 16.1% (98) while age range > 91, has the least population of 3.6% (22).

5.4. Malaria Prevelence among Febrile Cases

Results from the microscopic examinations of the blood film showed that of the 613 febrile patients presented in DUFUTH within the study period, 480 patients tested positive for malaria, parasite (thick and thin film microscopy) showing a prevalence of 78%. While 22% were negative for malaria parasite. Among the negative lies all other febrile Cases diagnosed within the study period which include, meningitis, Lassa fever, gastroenteritis, pyrexia of unknown origin, typhoid fever, Tonsillitis, upper respiratory tract infections, urinary tract infections, lower respiratory tract infections, mumps, HIV infection, hepatitis B & C infections, etc. in no particular order. (all of which make up the 22%). A bar chart representing the prevalence of malaria parasites among febrile patients is shown in Figure 3.

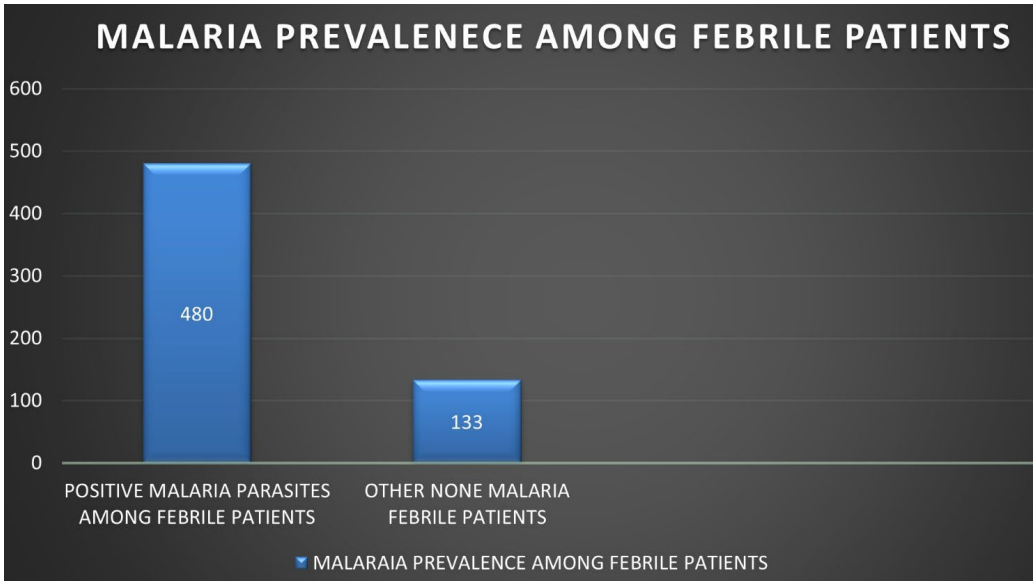

Figure 3. Showing the prevalence of malaria parasites among febrile patients.

5.5. Prevalence of Malaria in Relation to Age

The prevalence of malaria by age group is shown in Figure 4. Age group between 31 - 40 years had the highest prevalence of 18.5% (89) among the positive patients

and the lowest prevalence in the >91 age group 1.7% (8). Other age groups are as follows; 0 - 10 years 14.8% (71), 11 - 20 years 10.8% (52), 21 - 30 years 12.1% (58), 41- 50 year 10.8% (52), 51 - 60 year 10.2% (49), 61 - 70 years 9.6% (46), 71 - 80 years 6.9% (33), 81 - 90 years 4.6% (22) respectively.

Overall, cases in adults (age group 18 and above) irrespective of the sexes, are 74.4% (357) cases while the prevalence in children (ages less than 18 years below was 25.6% (123).

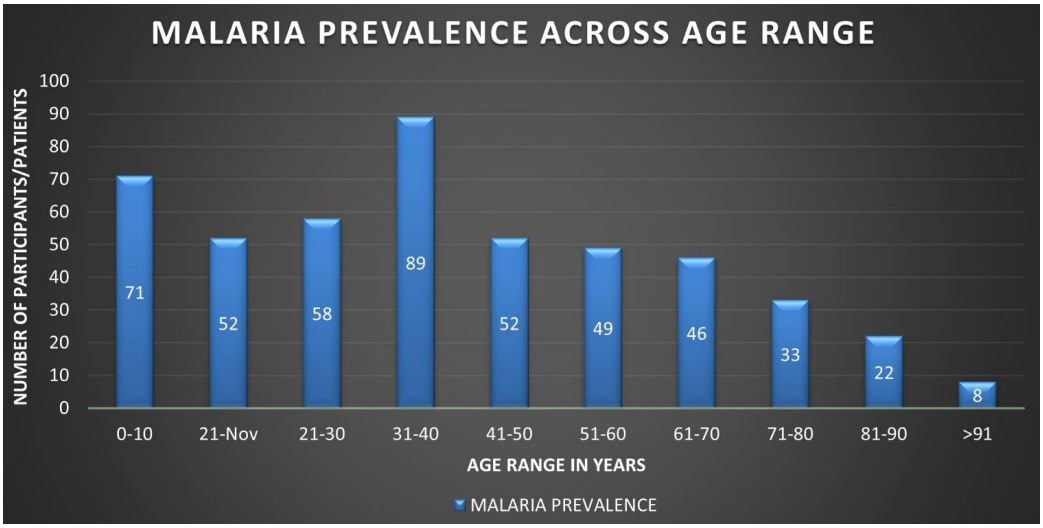

Figure 4. Showing the prevalence of malaria across the age group of patients that participated in this study.

Also shown in **Figure 5** is a bar chart representation of the comparison in the prevalence of malaria between adult patients and children.

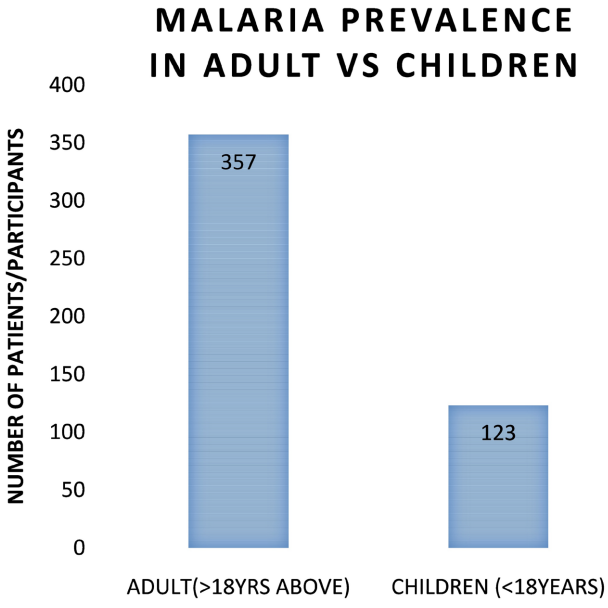

Figure 5. Showing the comparison in the malaria prevalence between adult patents and children.

5.6. Prevalence of Malaria in Relation to Gender

The prevalence of malaria in relation to gender is shown in Figure 6. Amongst the positive patients, the highest prevalence was recorded in female patients, with a prevalence of 61.9% (297) of positive patients, while 38.1% (183) was found in males.

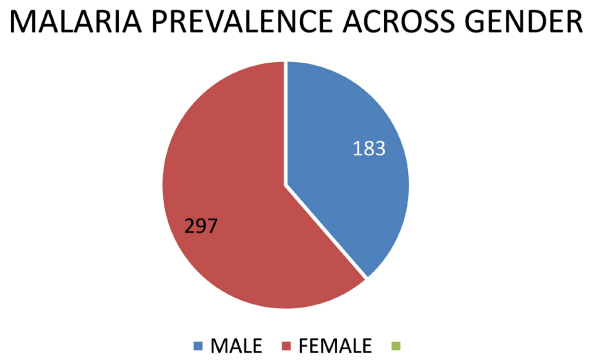

Figure 6. Showing malaria prevalence across gender groups.

5.7. Prevalence of Malaria in Relation to Period of the Year

The prevalence of malaria in relation to period, as shown in Figure 7 and Table 2, revealed that the lowest positive cases were recorded in the month of April 24 with a prevalence of 4.2% (20) while the highest was seen in January 24 with a prevalence of 22.5% (108).

The prevalence of malaria fluctuates through the months and periods of the year, as shown in the line graph below.

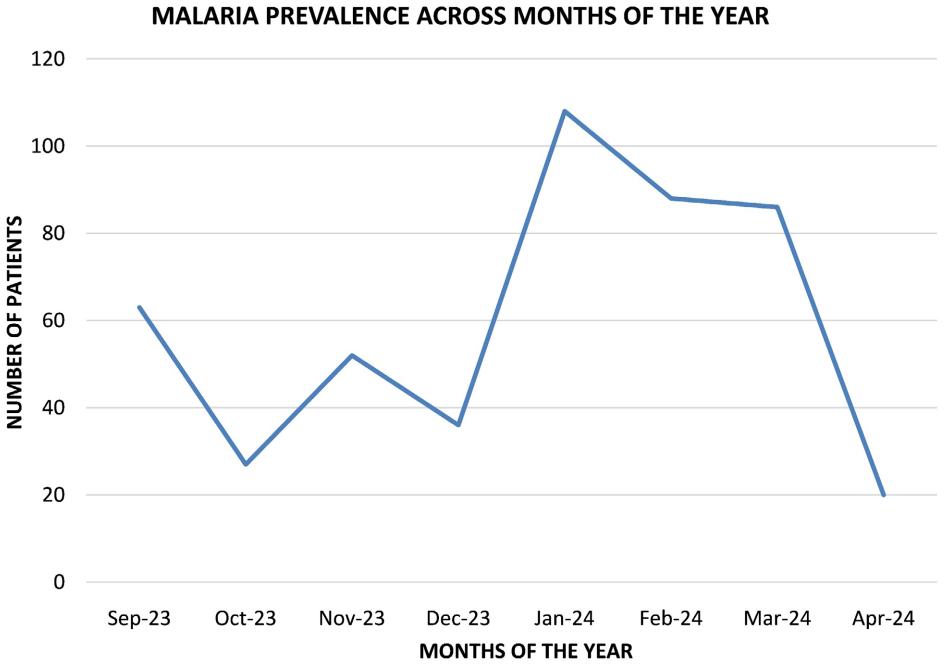

Figure 7. A line graph showing the prevalence of malaria across the months of the year.

Table 2. Showing the prevalence of malaria across the months of the year.

Months of the year	Prevalence of malaria	% prevalence
September-23	63	13.1
October-23	27	5.6
November-23	52	10.8
December-23	36	7.5
January-24	108	22.5
February-24	88	18.3
March-24	86	18.0
April-24	20	4.2

5.8. Positive Cases of Malaria in Relation to the Number of Febrile Patients Presented per Month

The prevalence of malaria in relation to the period, as shown in Figure 8, revealed that the highest number of positive cases were recorded in the month of January 2024, 22.5% (108) while the lowest was in April 2024, 4.2% (20) with a relative significance of malaria infestation in relation to other months of the year.

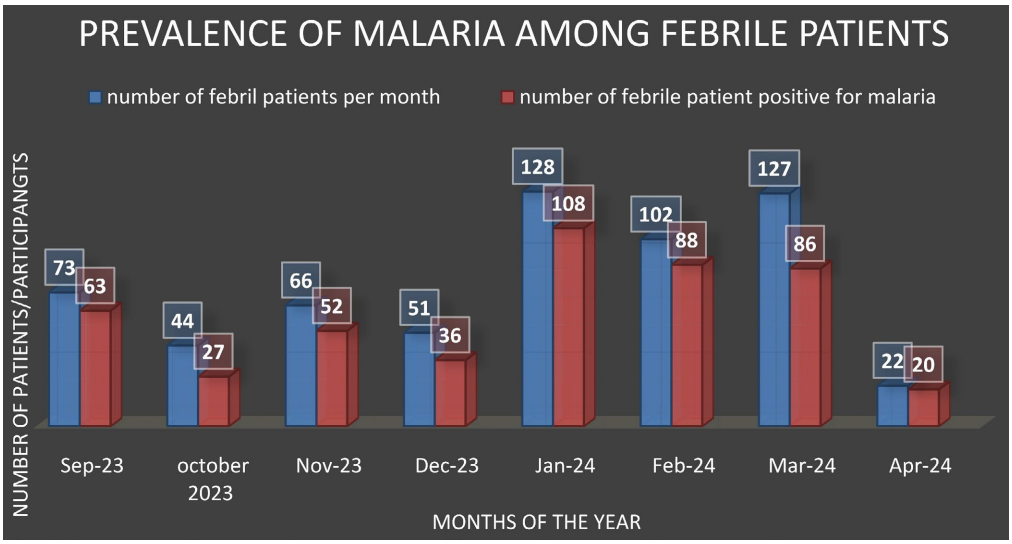

Figure 8. Number of positive and negative cases per period.

5.9. Regression Analysis

Figure 9 displays the logistic regression analysis for age and results. It shows that there is no positive correlation between the prevalence of malaria and any of the age groups studied.

5.10. Trend Analysis

The trend analysis in Figure 10 showed that the peak prevalence occurred in the month of January 2024, which suggests that the observed distribution of positive/negative cases across the months is unlikely to be due to random chance, and

significantly deviates from what was expected based on the chi-square goodness-of-fit test model. There is strong evidence to conclude that the number of positive and negative cases varies significantly between the months (September 2023-April 2024). Therefore, based on the chi-square goodness-of-fit test, it is accepted that there is a significant relationship between malaria cases and period in the data. Thus, the null hypothesis that there is no significant relationship between month and malaria cases is rejected.

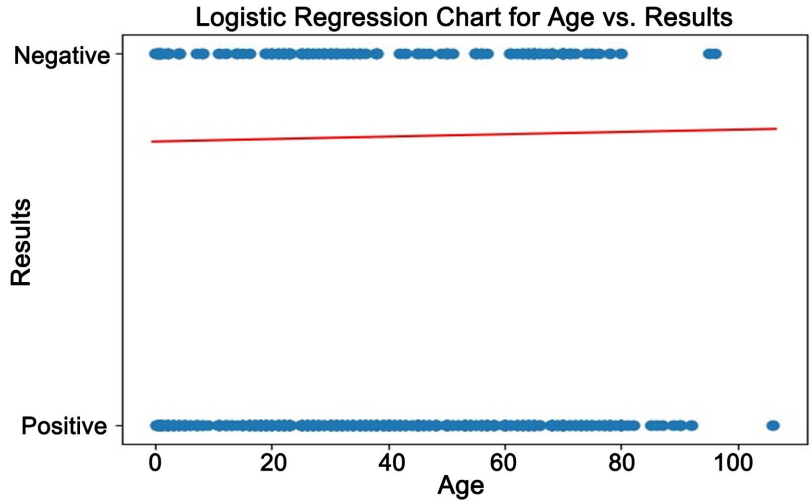

Figure 9. Logistic regression analysis for age.

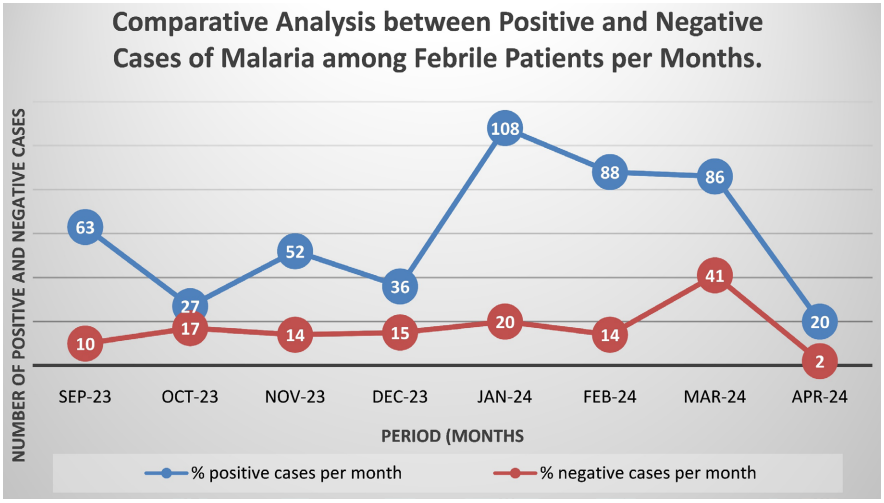

Figure 10. Number of positive and negative cases per period.

6. Discussion

Globally, malaria infects between 300 - 500 million people annually, with a major contribution to public health problems affecting all, including children, under 5 years and pregnant women in Africa. Malaria fever is endemic in sub-Saharan Africa and one of the most affected countries around the sub-Saharan African region is Nigeria, having 25% disease burden [9]-[11]. Southeastern Nigeria has

dense tropical rain forest vegetation with many pools of surface water reserves that serve as breeding grounds for malaria vectors (anopheles mosquitoes).

This study confirmed the endemicity of malaria fever in south east region with overall prevalence of 78%. Similar study was done by Agboeze *et al.*, and Adefioye *et al.* in Oshogbo and Ebonyi before now recorded 79%, and 72% respectively [6] [11], this further buttresses the endemicity and disease burden of malaria parasite among the populace of Nigeria and south east as well. In Nigeria, malaria prevalence is as high as 80% to 85% and at some point, 96.1% with a 1.3 million affectation on the populace and is the most common cause of outpatient visits to health facilities all year round [5] [12].

In this study, malaria affected across all age groups ranging from ages 0 - 100 years. However, the ages 31 - 40 years were the most affected, even among the female patients who were present.

The reason for the higher prevalence in the age group 31 - 40 is unknown; however, it is suggested that the higher prevalence could be due to the fact that young adults have a high mobility rate and, in most cases, are the breadwinners of their homes, frequently engaging in farming and all other agro-allied related jobs and outdoor activities. These occupations/activities are known exposures to mosquito bites, which eventually lead to the transmission of malaria parasites.

Although the prevalence rates of 18.5% recorded as the highest in the age group 31 - 40 years and 14.8% in the age group 0 - 10 years, may appear low when compared with other findings, the findings in the present study are, however, supported by Adefioye *et al.*, with 88.2% as the highest frequency of prevalence in the age group 36 - 39 years followed by age group 32 - 35 years 76% prevalence rate in their independent study [6]. The same goes for Ibeneme *et al.*, who documented 36 - 48 years 50 (39%) as the highest prevalence, followed by 26 - 35 years 45 (35%) in their studies [9].

Another variable study recorded the highest prevalence among children 1 - 10 years (28.9%) and the lowest in 91 - 100 and above in prevalence of malaria by age group studies using RDT examination [12].

We recorded the lowest prevalence among ages > 91 years of age (1.7%), a finding that corresponds with findings above displaying low malaria frequency affectation among the elderly. Although there is a global acceptance of increased prevalence of malaria among children with its attendant increase in under 5 mortality, various findings across the globe as well as this research have a convincing fact that malaria is equally a burden with a high prevalence amongst adults, especially, young adult within age range of 30 - 45 years.

Although malaria was present across all the studied months of the year, the most affected months were January, February, March and September with the highest prevalence in January 22.5% and the lowest in April with 4.2.%. Months like February and March also recorded reasonable spikes in frequency for both male and female patients. Studies done by Adefioye in 2007 and Nwagha (2009) have shown a higher seasonal prevalence of 72% in the months December/January between 2015 and 2020. More cases of malaria were previously recorded between

April and September [6] [13], in Ebonyi by Joseph *et al.* In another study by Andrew *et al.*, on spatial pattern of malaria affectation in Nigeria, the recorded highest periods were in the months of January, February, March, October, November and December in Ebonyi state as well. Other months like April, May, June, July and August and September also have their own fair share of the frequencies that are worthy of note [6]-[10]. It is, therefore, safe to conclude that due to the endemicity of malaria in Nigeria and Southeast region especially Ebonyi state, malaria parasite infection can occur in any month of the year. This knowledge is necessary for prevention and planning for prevention and other relevant public health purposes.

In most studies, malaria is characteristically common among females. Malaria is a known deadly disease among pregnant women. For instance, in a study done in Enugu State, by Enoch and Priscilla (2015) a prevalence of 40.6% was shown among females [11] – a prevalence much higher than that of males. Similarly, the present study has shown a higher prevalence of malaria among female patients, with a value as high as 61.9% (297), while 38.1% (183) was found in males.

The cause of the high prevalence of malaria in female patients is equally generally unknown.

However, malaria is characteristically high among pregnant women and as some studies have suggested, a possible reason for the increased risk could be due to the increased attractiveness of pregnant women to mosquitoes, as suggested by Nwagha *et al.*, 2010 [7]. They also noted that cellular immune response changes believed to result from the increased level of circulating maternal steroids in pregnancy could also be a factor, which makes pregnant women attract twice the number of anopheles mosquitoes compared to their non-pregnant counterparts [14].

Of all the variables tested, only the period, age group and gender showed significant associations with malaria prevalence. However, other sociodemographic factors such as—patient's pregnancy-status, lifestyle, and even occupation and educational status—are also important and relevant variables which could also be compared.

7. Conclusion

The results of this study suggest that malaria prevalence amongst febrile patients attending David Umahi Teaching Hospital from September 2023 to April 2024 was higher amongst female patients; and amongst patients within the age group 31 - 40 years, while the disease burden was highest in the month of January 2024. It is recommended that a malaria surveillance unit which will help standardize data collection and monitoring of malaria patients in the hospital, be established, while Molecular Malaria Surveillance (MMS) also needs to be introduced in teaching hospitals in Nigeria and in Southeast hospitals, in line with international best practices.

Recommendation

There is need to step up efforts in malaria surveillance, through the establishment

of a dedicated malaria surveillance unit across teaching hospitals in Nigeria including David Umahi Federal University Teaching Hospital Uburu. This will help to standardize data collection and monitoring of malaria patients, which is in line with international best practices.

In addition, since according to the World Health Organisation, the highest malaria burden is now found in those countries with the weakest malaria surveillance [15], there may be a need to also introduce Molecular Malaria Surveillance (MMS) in the hospitals. This is more so because, according to a recent report from the U.S. President's Malaria Initiative for Nigeria, more robust malaria surveillance systems have been known to help countries design effective health interventions and evaluate the impact of their malaria control programs [16].

Acknowledgements

The authors are grateful to the management of David Umahi Federal University Teaching Hospital, Uburu, for granting approval to conduct this research.

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] Ibrahim, A.O., Agbesanwa, T.A., Aremu, S.K., Bello, I.S., Elegbede, O.T., Gabriel-Alayode, O.E., *et al.* (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**, e0287723. https://doi.org/10.1371/journal.pone.0287723

[2] Sachs, J. and Malaney, P. (2002) The Economic and Social Burden of Malaria. *Nature*, **415**, 680-685. https://doi.org/10.1038/415680a

[3] World Health Organization (2000) Severe and Complicated Malaria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **94**, 10-12. http://helid.digicollection.org/pdf/s13418e/s13418e.pdf

[4] The Federal Republic of Nigeria (2022) Nigeria Malaria Indicator Survey 2021 Final Report. https://dhsprogram.com/pubs/pdf/MIS41/MIS41.pdf

[5] Centre for Disease Control and Prevention (2024) Symptoms of Malaria. https://www.cdc.gov/malaria/about/symptoms_malaria.html

[6] Adefioye, O.A., Adeyeba, O.A., Hassan, W.O. and Oyeniran, O.A. (2007) Prevalence of Malaria Parasite Infection among Pregnant Women in Osogbo, Southwest, Nigeria. *American-Eurasian Journal of Scientific Research*, **2**, 43-45.

[7] Nwagha, U.I., Ugwu, V.O., Nwagha, T.U. and Anyaehie, B.U. (2009) Asymptomatic Plasmodium Parasitaemia in Pregnant Nigerian Women: Almost a Decade after Roll Back Malaria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **103**, 16-20. https://doi.org/10.1016/j.trstmh.2008.07.016

[8] Nwele, D.E., Onyali, I.O., Iwueze, M.O., Elom, M.O. and Uguru, O.E.S. (2022) Malaria Endemicity in the Rural Communities of Ebonyi State, Nigeria. *The Korean Journal of Parasitology*, **60**, 173-179. https://doi.org/10.3347/kjp.2022.60.3.173

[9] Georgian, I., Ojone, M. and Nwode, N. (2017) Prevalence and Effect of Malaria in Pregnancy among Antenatal Women in Ebonyi State, Nigeria.

[10] Joseph, A., Patrick, N., Lawrence, N., Lilian, O. and Olufemi, A. (2017) Evaluation of Malaria Surveillance System in Ebonyi State, Nigeria. *Annals of Medical and Health Sciences Research*, **7**, 101-104.

[11] Enoch, A.S. and Priscilla, N.C. (2015) Malaria in Pregnancy and Its Association with ABO Blood Group and Haemoglobin Genotype. *Indian Journal of Dental Research*, **50**, 5317-5320.

[12] Onwuemele, A. (2014) An Assesment of the Spatial Pattern of Malaria Infection in Nigeria. *International Journal of Medicine and Medical Sciences*, **6**, 80-86. https://doi.org/10.5897/ijmms2013.1006

[13] Caminade, C., Kovats, S., Rocklov, J., Tompkins, A.M., Morse, A.P., Colón-González, F.J., *et al.* (2014) Impact of Climate Change on Global Malaria Distribution. *Proceedings of the National Academy of Sciences*, **111**, 3286-3291. https://doi.org/10.1073/pnas.1302089111

[14] Ghebreyesus, T.A. (2023) World Malaria Report 2023.

[15] Ghebreyesus, T.A. (2022) World Malaria Report 2022.

[16] Federal Ministry of Health (2022) U.S. President's Malaria Initiative; Nigeria Malaria Operational Plan FY 2022 and National Malaria Elimination Programme.