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## HOSPITAL-BASED STUDY OF MALARIA IN UNIVERSITY OF NIGERIA MEDICAL CENTRE, NSUKKA, ENUGU STATE, NIGERIA

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### ABSTRACT

***A hospital-based study on malaria was carried out at the University of Nigeria Medical Centre in Nsukka, Enugu State, Nigeria between 2016 and 2021. Data with diagnoses for malaria cases; such as person count and sex distribution were received from the Hospital's Records Department and extrapolated before being entered into a Microsoft Excel spreadsheet. A total of 33,792 cases of malaria were noted in the hospital's medical records. The results of this study also demonstrated that the report of malaria cases in 2020 was lowest due to the COVID-19 lockdown, while that of 2019 was the highest. The mean annual malaria cases varied over the other years. In total, there were 13,705 cases of malaria in males compared to 20,087 cases in females (40.6 vs. 59.4%). The number of malaria cases in males and females varied significantly ( $F = 27.74$ ,  $p = 0.0001$ ). The high rate of malaria cases at the University of Nigeria, Nsukka suggests that further malaria intervention and prevention strategies, such as the free distribution of insecticide-treated mosquito nets, are required to achieve the goal of drastic reduction of malaria infection in the study area. The government should also ensure that medical facilities are strengthened with adequate tools and a steady supply of affordable and high-quality drugs.***

**Keywords:** Malaria cases, Diagnosis, Insecticide-treated mosquito nets, University of Nigeria Medical Centre Nsukka

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### INTRODUCTION

Malaria is a serious worldwide health issue that results in considerable morbidity and mortality each year, which results in more than 228 million cases and 405,000 fatalities yearly (WHO, 2019). Approximately 106 nations are thought to be at risk of malaria illness (WHO, 2011). *Plasmodium falciparum*, *P. vivax*, *P. ovale* and *P. malaria* are the four species of *Plasmodium* that infect humans, with *P. falciparum* being the most prevalent (Doumbo *et al.*, 2009; Gazzinelli *et al.*, 2014). More and more cases of human infections with *P. knowlesi*, the parasite that causes monkey malaria, have been discovered in South-East

Asian forests (Jeyaprakasam *et al.*, 2020). The bite of female *Anopheles* mosquitoes introduces the parasites (*Plasmodium*) into their human hosts. There were 216 million cases of malaria worldwide in 2010, with 81% of the cases recorded in Africa, 13% in South East Asia, and 5% in the Eastern Mediterranean; the trend is on drastic reduction and elimination of malaria parasites with the global target of 2016 – 2030 (WHO, 2011; WHO, 2016). Khanam (2017) reported that malaria continued to be Nigeria's number one killer, accounting for around 227,645 fatalities in 1990 and 192,284 deaths in 2015. Furthermore, WHO (2022) reported that malaria continued to be Nigeria's number one killer and

public health issue, accounting for 68,000,000 cases and 194,000 deaths in 2021. Malaria is a tremendously complex illness with widely varying epidemiology and clinical manifestations across the world (Looareesuwan and Wilairatana, 1999; Ryan, 2001; Mawson, 2013). Globally, the variety of malaria parasite species, their susceptibility to widely available antimalarial medications, climatic conditions and other environmental variables, as well as behaviour and the degree of acquired immunity, all contribute to their heterogeneity (Parroche *et al.*, 2007; WHO, 2010a, b; Cowman *et al.*, 2012).

Since the beginning of recorded history, malaria has been understood to be a major health issue. This research was conducted to find out the clinical surveillance of malaria at University of Nigeria Medical Centre Nsukka. The study's particular aim was to determine the incidence of malaria parasite infection among patients visiting University of Nigeria Medical Centre, Nsukka, Enugu State, Nigeria while the objectives included determining the total cases of malaria infection in the study area over the previous years, between 2016 and 2021 and malaria cases between male and female patients.

## MATERIALS AND METHODS

**Study Area:** The site of the study was the University of Nigeria Medical Centre, Nsukka. The Medical Centre is situated within the University of Nigeria, Nsukka Campus, Nsukka Local Government Area, Enugu State, Nigeria. The hospital was established in 1960. Its mandate was to cater for minor illnesses affecting the students and staff of the University of Nigeria. Sources of patients are lecturers, students, other staff and some people from outside the University. The hospital specializes on child delivery, maternity care, laboratory diagnosis such as malaria, typhoid, PCV, pregnancy tests, etc. The location's latitude and longitude are 6°51'24"N and 7°23'45"E, respectively. The region is usually tropical with distinct wet (April to October) and dry (November to March) seasons. Although farming has been the main occupation in this region particularly for those patients visiting the hospital from outside the

campus, majority of patients are civil servants and students.

**Study Design:** The study design was a retrospective survey of hospital record. This study was carried out between November 2021 and March 2022. To obtain details on malaria reports from 2016 to 2021, a visit was made to the University of Nigeria Medical Center. In order to get entry to the record unit, the director of the Medical Centre was given an introduction letter from the Department of Zoology and Environmental Biology, University of Nigeria, Nsukka. The importance of this study was reviewed with the director before access was granted. Confidentiality was also upheld. The data gathered included the number of malaria cases, the population impacted, and the sexes affected.

**Data Collection:** The record unit provided a file of diagnoses for various diseases; the file was sorted to only contain information on people who had been diagnosed with malaria. The essential information was entered into a Microsoft Excel spreadsheet, including the diagnosis of malaria, the number of affected people, the sex proportion, age, seasonal and occupational distribution of malaria.

**Statistical Analysis:** Statistical Packages for Social Sciences (SPSS) version 23.0 (IBM Corporation, Armonk, USA) and Microsoft Office Excel (Microsoft Incorporated, Redmond, USA) were used to analyze the data. Total and mean morbidity counts were calculated. To compare morbidity counts across years and sexes, generalized linear regression was utilized. Actual significant probability values were used.

## RESULTS

**Monthly and Yearly Distribution of Malaria:** From the medical records of the hospital, 33,792 cases of malaria were identified at the University of Nigeria Medical Centre. Table 1 provides a summary of monthly and yearly distribution of malaria. Due to the COVID-19 shutdown, there were no records of malaria for the five months of June – October in the year 2020.

**Table 1: Cases of malaria diagnosed at the University of Nigeria, Nsukka Medical Centre from 2016 to 2021**

Months	Years						Total
	2016	2017	2018	2019	2020	2021	
January	714 <sup>de</sup>	368 <sup>de</sup>	374 <sup>b</sup>	179 <sup>a</sup>	446 <sup>a</sup>	216 <sup>a</sup>	2297 <sup>de</sup>
February	615 <sup>de</sup>	551 <sup>de</sup>	631 <sup>de</sup>	478 <sup>de</sup>	763 <sup>c</sup>	286 <sup>de</sup>	3324 <sup>de</sup>
March	728 <sup>de</sup>	618 <sup>de</sup>	113 <sup>a</sup>	579 <sup>de</sup>	643 <sup>b</sup>	515 <sup>de</sup>	3196 <sup>de</sup>
April	392 <sup>de</sup>	306 <sup>b</sup>	178 <sup>de</sup>	780 <sup>de</sup>	157 <sup>de</sup>	535 <sup>de</sup>	2348 <sup>de</sup>
May	369	597 <sup>de</sup>	183 <sup>de</sup>	837 <sup>b</sup>	197 <sup>de</sup>	599 <sup>de</sup>	2782 <sup>de</sup>
June	871 <sup>c</sup>	480 <sup>de</sup>	733 <sup>de</sup>	629 <sup>de</sup>	-	540 <sup>de</sup>	3253 <sup>b</sup>
July	452 <sup>de</sup>	678 <sup>de</sup>	816 <sup>c</sup>	734 <sup>de</sup>	-	524 <sup>de</sup>	3204 <sup>de</sup>
August	496 <sup>de</sup>	692 <sup>de</sup>	670 <sup>de</sup>	700 <sup>de</sup>	-	419 <sup>de</sup>	2977 <sup>de</sup>
September	448 <sup>de</sup>	547 <sup>de</sup>	710 <sup>de</sup>	658 <sup>de</sup>	-	613 <sup>b</sup>	2976 <sup>de</sup>
October	302 <sup>b</sup>	554 <sup>de</sup>	705 <sup>de</sup>	586 <sup>de</sup>	-	382 <sup>de</sup>	2529 <sup>de</sup>
November	553 <sup>de</sup>	704 <sup>c</sup>	523 <sup>de</sup>	612 <sup>de</sup>	146 <sup>de</sup>	538 <sup>de</sup>	3076 <sup>de</sup>
December	120 <sup>a</sup>	208 <sup>a</sup>	421 <sup>de</sup>	627 <sup>de</sup>	166 <sup>de</sup>	288 <sup>de</sup>	1830 <sup>a</sup>
<b>Total</b>	6060 <sup>c1</sup>	6303 <sup>c1</sup>	6057 <sup>c1</sup>	7399 <sup>b3</sup>	2518 <sup>a2</sup>	5455 <sup>c1</sup>	33792 <sup>c1</sup>
<b>Mean ± SD</b>	505.00 ± 206.40 <sup>c1</sup>	525.25 ± 157.91 <sup>c1</sup>	504.75 ± 245.44 <sup>c1</sup>	616.58 ± 168.16 <sup>c1</sup>	359.71 ± 258.55 <sup>c1</sup>	454.58 ± 133.06 <sup>c1</sup>	494.31 ± 194.92 <sup>c1</sup>

Values with different alphabet superscript along the column while values with different numeric superscript across a row were significantly different ( $p < 0.05$ )

In the years 2016, 2017, 2018, 2019, 2020 and 2021, consecutively, 6060, 6303, 6057, 7399, 2518 and 5455 cases of malaria morbidity were reported. The most cases were reported overall in 2019. According to the total number of cases recorded over the course of the study, December typically had a low number of malaria cases (Table 1).

**Malaria Morbidity:** The mean malaria morbidity within the six years under study presented in Table 2 indicated wide disparities in daily malaria cases within each of the months. Recorded malaria cases were lower in the months of December. There was no consistent pattern in magnitude of malaria cases recorded, in some years the number of cases were more during the early or late rainy months, in others it was during the dry months. The mean annual malaria morbidity across the six years were not different, even in the year 2020. Mean annual malaria morbidity was between  $359.71 \pm 258.55$  in 2020 and  $616.58 \pm 168.16$  in 2019 (Table 1).

**Sex distribution of Malaria:** More cases of malaria in females than males were documented in each of the six years under study. In all, 20,087 cases malaria were reported in females, compared to 13,705 cases of malaria in males (59.4 vs. 40.6%) (Table 3). For each year, the percentage differential in malaria morbidity cases remained the same, maintaining a roughly equal

ratio of 40 to 60% of male to female cases. Table 3 provides a summary of the mean malaria morbidity counts for males and females. However, on an annual basis, there were no significant variations in the number of instances between male and female over the course of the six years ( $F = 27.74$ ,  $p = 0.0001$ ).

**Age Distribution of Malaria:** The reported cases of malaria in University of Nigeria Medical Centre, Nsukka by the age for the period 2016 to 2021 is presented in Table 4. The highest cases of malaria occurred among people in the age groups, 15 – 19 years and 20 – 24 years, while the lowest cases occurred in people who were 70 years old and more. The pattern was consistent yearly, except for 2020.

**Seasonal Distribution of Malaria:** For the duration under study, there was no significant difference between dry and wet season malaria morbidity, ( $F_{(1,67)} = 0.731$ ,  $p = 0.396$ ). There was no significant interaction between year and seasonal malaria morbidity (Year\*Season,  $p = 0.141$ ) (Table 5).

**Occupational Distribution of Malaria:** The most commonly reported occupation of malaria patients within the period 2016 to 2021 were students and civil servants. Farmers, traders and artisan report less to the Medical Centre for malaria diagnosis.

**Table 2: Six-year mean malaria morbidity counts in University of Nigeria Medical Centre, Nsukka for six years (2016 to 2021)**

Months	Year					
	2016	2017	2018	2019	2020	2021
January	26.44 ± 13.82 <sup>de</sup>	14.15 ± 7.11 <sup>ab</sup>	13.85 ± 6.91 <sup>a</sup>	9.42 ± 3.13 <sup>a</sup>	22.30 ± 8.21 <sup>c</sup>	10.80 ± 5.97 <sup>ab</sup>
February	25.63 ± 12.01 <sup>de</sup>	22.04 ± 11.71 <sup>cde</sup>	22.54 ± 8.38 <sup>b</sup>	26.56 ± 7.80 <sup>cd</sup>	38.15 ± 11.47 <sup>c</sup>	12.43 ± 6.35 <sup>ab</sup>
March	28.00 ± 9.81 <sup>de</sup>	28.09 ± 8.87 <sup>e</sup>	12.56 ± 4.98 <sup>a</sup>	28.95 ± 9.86 <sup>d</sup>	29.23 ± 12.31 <sup>c</sup>	22.39 ± 7.05 <sup>de</sup>
April	17.04 ± 9.02 <sup>b</sup>	17.00 ± 6.83 <sup>bc</sup>	8.90 ± 4.73 <sup>a</sup>	39.00 ± 8.95 <sup>e</sup>	9.81 ± 5.79 <sup>ab</sup>	24.32 ± 8.28 <sup>e</sup>
May	16.04 ± 7.06 <sup>b</sup>	22.11 ± 10.77 <sup>cde</sup>	9.63 ± 5.70 <sup>a</sup>	39.86 ± 6.69 <sup>e</sup>	14.07 ± 6.83 <sup>b</sup>	31.54 ± 8.37 <sup>f</sup>
June	31.11 ± 15.46 <sup>e</sup>	17.78 ± 12.04 <sup>bc</sup>	38.58 ± 5.81 <sup>e</sup>	29.95 ± 11.00 <sup>d</sup>	-	25.71 ± 9.38 <sup>e</sup>
July	25.11 ± 8.70 <sup>cde</sup>	25.11 ± 12.40 <sup>de</sup>	37.09 ± 5.97 <sup>e</sup>	31.91 ± 9.58 <sup>d</sup>	-	26.20 ± 10.90 <sup>e</sup>
August	22.55 ± 5.58 <sup>bcd</sup>	25.63 ± 10.65 <sup>de</sup>	31.90 ± 7.67 <sup>cd</sup>	29.17 ± 12.42 <sup>d</sup>	-	20.95 ± 6.55 <sup>cde</sup>
September	22.40 ± 6.72 <sup>bcd</sup>	20.26 ± 10.82 <sup>bcd</sup>	35.50 ± 8.08 <sup>de</sup>	221.23 ± 9.28 <sup>bc</sup>	-	22.70 ± 11.86 <sup>de</sup>
October	18.88 ± 7.51 <sup>bc</sup>	20.52 ± 11.56 <sup>cd</sup>	30.65 ± 5.72 <sup>cd</sup>	20.93 ± 11.08 <sup>bc</sup>	-	15.92 ± 10.14 <sup>bc</sup>
November	26.33 ± 8.64 <sup>de</sup>	24.28 ± 9.07 <sup>de</sup>	24.90 ± 13.65 <sup>b</sup>	20.40 ± 9.69 <sup>b</sup>	8.59 ± 6.17 <sup>a</sup>	18.55 ± 8.41 <sup>cd</sup>
December	6.00 ± 4.34 <sup>a</sup>	9.04 ± 5.23 <sup>a</sup>	30.07 ± 4.55 <sup>c</sup>	20.23 ± 9.38 <sup>b</sup>	7.90 ± 5.43 <sup>a</sup>	10.29 ± 5.46 <sup>a</sup>

Values with different alphabet superscript along a column were significantly different ( $p < 0.05$ )

**Table 3: Malaria morbidity counts for male and female patients at the University of Nigeria, Medical Centre Nsukka for six years (2016 to 2021)**

Year	Male	Female	Total
2016	2442 203.50 ± 81.03	3618* 301.50 ± 126.02	6060
2017	2549 212.42 ± 62.36	3754* 312.83 ± 98.49	6303
2018	2471 205.92 ± 103.05	3556* 298.83 ± 143.69	6057
2019	2997 249.75 ± 68.54	4402* 366.83 ± 100.50	7399
2020	996 142.29 ± 99.42	1522* 217.43 ± 159.16	2518
2021	2250 187.50 ± 59.07	3205* 267.08 ± 77.46	5455
<b>Total</b>	13,705	20,087*	33,792
<b>Mean ± SD</b>	2284.17 ± 678.03	3342.83 ± 974.32*	5632.00 ± 1653.16

Values with asterisk (\*) are significantly different at  $p < 0.05$

**Table 4: Age distribution of malaria in University of Nigeria Medical Centre, Nsukka for six years (2016 to 2021)**

Age (year)	Year					
	2016	2017	2018	2019	2020	2021
0 - 4	29.00 ± 18.86 <sup>bc1</sup>	36.42 ± 17.06 <sup>b1</sup>	30.42 ± 14.53 <sup>b1</sup>	24.67 ± 13.51 <sup>b1</sup>	26.00 ± 19.11 <sup>a1</sup>	33.17 ± 13.91 <sup>bc1</sup>
5 - 9	39.00 ± 24.82 <sup>bc1</sup>	42.00 ± 15.13 <sup>b1</sup>	36.83 ± 18.96 <sup>b1</sup>	34.33 ± 18.58 <sup>b1</sup>	28.29 ± 21.69 <sup>a1</sup>	33.33 ± 9.02 <sup>bc1</sup>
10 - 14	42.33 ± 22.21 <sup>b1</sup>	40.17 ± 15.31 <sup>b1</sup>	32.75 ± 18.90 <sup>b1</sup>	41.50 ± 21.53 <sup>b1</sup>	50.71 ± 54.77 <sup>a1</sup>	35.17 ± 17.30 <sup>bc1</sup>
15 - 19	87.50 ± 41.74 <sup>a2</sup>	105.00 ± 48.51 <sup>a2</sup>	100.17 ± 63.08 <sup>a2</sup>	126.58 ± 94.03 <sup>a2</sup>	55.57 ± 46.56 <sup>a1</sup>	85.83 ± 50.79 <sup>a2</sup>

<b>20 – 24</b>	80.67 ± 40.59 <sup>a2</sup>	95.17 ± 38.27 <sup>a2</sup>	86.50 ± 51.82 <sup>a2</sup>	118.50± 58.57 <sup>a2</sup>	40.43± 38.55 <sup>a1</sup>	92.42 ± 61.26 <sup>a2</sup>
<b>25 – 29</b>	47.58 ± 24.40 <sup>bc1</sup>	50.50 ± 26.34 <sup>b1</sup>	51.42 ± 26.41 <sup>b1</sup>	81.33 ± 43.07 <sup>b1</sup>	23.43± 27.07 <sup>a1</sup>	55.42 ± 52.53 <sup>b1</sup>
<b>30 – 34</b>	36.67 ± 17.49 <sup>bc1</sup>	29.17 ± 13.50 <sup>bc</sup>	37.25 ± 27.95 <sup>b1</sup>	47.50 ± 22.61 <sup>b1</sup>	22.57± 22.29 <sup>a1</sup>	29.83 ± 21.39 <sup>c1</sup>
<b>35 – 39</b>	28.08 ± 11.21 <sup>bc1</sup>	27.17 ± 12.51 <sup>bc1</sup>	23.08 ± 16.29 <sup>b1</sup>	39.42 ± 21.45 <sup>b1</sup>	20.14 ± 15.97 <sup>a1</sup>	15.17 ± 10.29 <sup>c1</sup>
<b>40 – 44</b>	19.75 ± 8.55 <sup>bc1</sup>	23.08 ± 9.96 <sup>bc1</sup>	20.42 ± 10.13 <sup>b1</sup>	21.83 ± 16.31 <sup>b1</sup>	13.14 ± 10.99 <sup>a1</sup>	16.00 ± 11.38 <sup>c1</sup>
<b>45 – 49</b>	24.50 ± 13.06 <sup>bc1</sup>	18.42 ± 6.87 <sup>bc1</sup>	17.83 ± 14.73 <sup>b1</sup>	15.33 ± 11.63 <sup>b1</sup>	15.29 ± 9.86 <sup>a1</sup>	12.08 ± 5.77 <sup>c1</sup>
<b>50 – 54</b>	16.75 ± 15.73 <sup>bc1</sup>	14.67 ± 6.99 <sup>bc1</sup>	11.50 ± 8.99 <sup>b1</sup>	15.75 ± 10.10 <sup>b1</sup>	16.86± 14.05 <sup>a1</sup>	11.00 ± 6.10 <sup>c1</sup>
<b>55 – 59</b>	18.00 ± 13.68 <sup>bc1</sup>	14.92 ± 8.37 <sup>bc1</sup>	14.00 ± 10.69 <sup>b1</sup>	14.00 ± 12.84 <sup>b1</sup>	9.57 ±10.21 <sup>a1</sup>	8.08 ± 6.33 <sup>c1</sup>
<b>60 – 64</b>	13.83 ± 9.90 <sup>bc1</sup>	11.92 ± 8.66 <sup>bc1</sup>	11.25 ± 9.44 <sup>b1</sup>	11.50 ± 6.04 <sup>b1</sup>	10.86 ± 8.05 <sup>a1</sup>	9.17 ± 9.07 <sup>c1</sup>
<b>65 – 69</b>	12.08 ± 13.93 <sup>c1</sup>	10.67 ± 5.93 <sup>bc1</sup>	8.17 ± 7.45 <sup>b1</sup>	14.00 ± 10.57 <sup>b1</sup>	12.14 ± 4.91 <sup>a1</sup>	11.17 ± 5.27 <sup>c1</sup>
<b>≥ 70</b>	9.25 ± 7.42 <sup>c1</sup>	6.00 ± 4.99 <sup>c1</sup>	33.65 ± 36.15 <sup>b1</sup>	10.33 ± 8.48 <sup>b1</sup>	14.71± 11.22 <sup>a1</sup>	6.75 ± 3.57 <sup>c1</sup>

Values with different alphabet superscripts along a column were significantly different, while values with different numeric superscript across a row were significantly different ( $p < 0.05$ )

**Table 5: Seasonal distribution of malaria in University of Nigeria Medical Centre, Nsukka from 2016 to 2021**

Year	Season	
	Dry	Wet
<b>2016</b>	546.00 ± 248.81*	475.71 ± 185.55
<b>2017</b>	489.80 ± 200.19	550.57 ± 131.16*
<b>2018</b>	412.40 ± 194.43	570.71 ± 270.29*
<b>2019</b>	495.00 ± 185.95	703.43 ± 87.60*
<b>2020</b>	432.80 ± 276.96*	177.00 ± 28.28
<b>2021</b>	368.60 ± 147.25	516.00 ± 86.28*
<b>Total</b>	457.43 ± 203.01	542.41 ± 192.23*

Values with asterisk (\*) are significantly different at  $p < 0.05$

As expected for a university environment, students had the highest reported cases of malaria, followed by civil servants. Cases of students that reported for malaria from 2016 to 2021 significantly high compared to civil servants ( $p < 0.05$ ). Reported cases of civil servants with malaria were significantly high compared to farmers, artisans and traders. People with other undisclosed occasions were among those who were positive for malaria (Table 6).

## DISCUSSION

This study analysed hospital records that covered six years to determine the distribution of malaria in the study area. The findings of this study demonstrated that malaria is still a problem in University of Nigeria Medical Centre, Nsukka as it

continues to rank among the major causes of morbidity in the research region.

Besides, malaria incidence occurred highest among patients in the age groups, 15 – 19 years and 20 – 24 years. While the lowest cases occurred in patients who were 70 years old and more. It was clear that high number of patients who visited the hospital for healthcare were students followed by civil servants. Most of them were involved in nighttime outdoor activities. The students involved in the study leave their hostels at night to read outside, leaving the windows and doors wide open and inviting mosquitoes to come in and bite whenever they like.

Moreover, it has been demonstrated that a number of variables, such as rainfall, temperature and lack of enough or suitable control instruments or timings for vector control measures, contribute to malaria epidemics (FRN, 2014). The University of Nigeria Medical Centre, Nsukka's high malaria cases indicated that more malaria intervention measures are needed to accomplish the goal of drastically reducing malaria infection the study area.

In addition, the pattern of the six-year retrospective data showed that the cases of malaria fluctuated from year to year, with considerably fewer cases of the disease being reported in 2020, which was due to COVID-19 lockdown.

**Table 6: Occupational distribution of malaria in University of Nigeria Medical Centre, Nsukka from 2016 to 2021**

Year	Occupation					
	Students	Civil servants	Farmers	Traders	Artisan	Others
<b>2016</b>	253.50 ± 136.42 <sup>a1</sup>	118.92 ± 58.82 <sup>b1</sup>	9.08 ± 4.91 <sup>c1</sup>	10.08 ± 4.76 <sup>c1</sup>	3.08 ± 3.06 <sup>c1</sup>	110.33± 57.82 <sup>b1</sup>
<b>2017</b>	261.50 ± 108.08 <sup>a1</sup>	126.25 ± 53.88 <sup>b1</sup>	6.42 ± 5.13 <sup>c1</sup>	10.00 ± 6.44 <sup>c1</sup>	2.50 ± 2.47 <sup>c1</sup>	118.58 ± 34.48 <sup>b1</sup>
<b>2018</b>	263.00 ± 161.07 <sup>a1</sup>	122.00 ± 68.41 <sup>b1</sup>	6.67 ± 4.44 <sup>c1</sup>	10.50 ± 4.85 <sup>c1</sup>	3.50 ± 2.97 <sup>c1</sup>	99.08 ± 50.16 <sup>b1</sup>
<b>2019</b>	374.00± 118.39 <sup>a1</sup>	122.25 ± 82.29 <sup>b1</sup>	5.50 ± 2.43 <sup>c1</sup>	11.58 ± 4.85 <sup>c1</sup>	2.75 ± 2.73 <sup>c1</sup>	100.50 ± 48.38 <sup>b1</sup>
<b>2020</b>	92.86 ± 80.60 <sup>ab1</sup>	149.86 ± 110.25 <sup>a1</sup>	7.14 ± 3.08 <sup>b1</sup>	10.71 ± 4.75 <sup>b1</sup>	3.43 ± 1.62 <sup>b1</sup>	95.71 ± 96.35 <sup>ab1</sup>
<b>2021</b>	206.58 ± 89.40 <sup>a1</sup>	126.00 ± 65.32 <sup>b1</sup>	9.00 ± 4.88 <sup>c1</sup>	9.25 ± 5.19 <sup>c1</sup>	3.08 ± 2.47 <sup>c1</sup>	100.67 ± 25.90 <sup>b1</sup>
<b>Total</b>	253.03 ± 139.41 <sup>a1</sup>	125.88 ± 69.72 <sup>b1</sup>	7.31 ± 4.41 <sup>c1</sup>	10.33± 5.06 <sup>c1</sup>	3.03 ± 2.58 <sup>c1</sup>	104.78 ± 50.82 <sup>b1</sup>

Values with different alphabet superscript across a row were significantly different, while values with different numeric superscript along a column were significantly different ( $p < 0.05$ )

In contrast to this pattern, 2019 recorded a comparatively higher mean annual malaria morbidity of 616.58 ± 168.16. The primary cause of the rising trend in malaria cases in 2019 might be due to the behavioural shift of *Anopheles*, which favours resting and biting of humans inside houses, the emergence of insecticide-resistant vector species, or drug-resistant *Plasmodium* parasites. It can be connected to the manner of life of the patients as well as how they prevent malaria and control the breeding sites of the female *Anopheles* mosquitoes. This study is consistent with the observation of Benelli and Beier (2017) who argued that malaria remains a public health issue despite the use of vector intervention measures.

Furthermore, it was found that the number of malaria cases was typically low during the month of December in the study area. This is in line with the result of a study (Tours *et al.*, 2016) which discovered a decline incidence of malaria also in December. This might be due to the fact that students, lecturers and other users of the hospital in residence might have been on holiday during this month. Unlike the month of February that had the highest number of malaria cases.

There was no significant difference between year and seasonal distributional of malaria. This was not consistent with the report of Toure *et al.* (2016) which stated that there was an increase in malaria incidence during the rainy season when compared to the dry season. This

might be due to the fact that both during the dry and wet seasons the University has been in session having great influx of students, lecturers and non-teaching staff who attended the hospital for malaria treatment.

Males had the lowest cases of malaria, while females had the highest cases. This result was consistent with the findings of Olaniyan and Babatunde (2014) who reported that females had the highest cases of malaria (52.0%) in Kishi, the Headquarter of Irepo Local Government Area of Oyo State. Additionally, it agreed with a research conducted by Abdulazeez *et al.* (2017) that found that females predominated among the malaria patients attending Sheik Muhammad Jidda General Hospital, Kano State, Nigeria, with a frequency of 58.5%. The results of this study, however, did not match with the findings of Parida *et al.* (2019) who found that males (58.00%) had more malaria infection than females (41.8%) in a hospital based cross-sectional study conducted in a tertiary care referral hospital in the State of Odisha, India. Males are fond of not wearing their shirts in the evening which coincides with the period when the female *Anopheles* mosquitoes bite, although this was not the same in the present study. Females possess low immunity especially during pregnancy which may be why there were high cases of malaria among them. People can avoid outdoor activities at night, wear clothing that covers their legs and arms, use insecticides and repellents, maintain a clean environment, sleep

under mosquito-nets treated with insecticide, and, most importantly, make an effort to report clinical symptoms for early diagnosis and treatment of cases.

**Conclusion:** There was high prevalence of malaria cases in the study area within the specified period. Higher cases of malaria were also observed in 2019, while 2020 had the lowest cases of malaria infection. It is advised that people protect themselves from malaria by avoiding mosquito bites since it is a severe public health issue in the tropics. The government should make sure that medical institutions are strengthened with enough equipment and a consistent supply of affordable, high-quality medications. With all the required instruments in place, malaria will be reduced to the barest minimum if free medical care is provided to the whole population, especially school students. Further studies should be conducted to ascertain the prevalence of malaria parasites using molecular characterization.

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