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Malaria Infection in Pregnant Women attending Antenatal Care in relation to Socio-demographic Profile, Trimester, Parity and Gravidae in Parts of Adamawa State, Nigeria

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ABSTRACT: Malaria infection remains one of the potent health hazards to the human, particularly pregnant women. Hence, the objective of this paper was to evaluate malaria infection in pregnant women attending antenatal care in relation to socio-demographic profile, trimester, parity and gravidae in parts of Adamawa State, Nigeria using appropriate standard methods. Data obtained reveals that the highest prevalence of malaria among the age-group 20-34 years (87.0%), those who attained secondary level education (34.3%), full housewives (36.0%), married and living together (77.8%), monogamous family type (72.2%). There was equal prevalence of 50.0% among those residing within towns and villages. The result showed no statistical significant difference amongst malaria infection and socio-demographic variables. Trimester, parity and gravidity showed no statistical difference (P>0.05) with the highest prevalence of 50.0% (second trimester), 37.0% (parity two) and 36.1% (primigravidae). Parity was shown to be an independent risk factor associated with malaria infection (AOR = 11.410, CI = 1.118 – 116.451, P=0.040). Malaria prevalence decreases with advancing age, and higher gravidity was linked with a disproportionate decrease in malaria infection. Fourt parity was the only independent risk factor significantly associated with malaria infection in this study.

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Globally, malaria is an infectious parasitic ailment that poses a hazard to humanity. According to the report of World Health Organization [WHO] (2021), malaria has an intolerably high death toll and illness rate. In recent years, there is a stable increase in malaria cases between 2019-2022 with estimated figures in Africa

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region: 5.3 million (Nigeria), 2.4 million (Ethiopia), 1.5 million (Madagaska), 1.3 million (Uganda), 1.3 million (The United Republic of Tazania), 1.1 million (Mali) and 1 million (Mozambique) (WHO, 2023). Pregnancy associated malaria poses an imminent risk to both the mother and developing foetus (Tecla, 2018; Toure *et al*., 2019; Nyamu *et al*., 2020). Globally, malaria is one of the leading causes of motherhood illness and poor parturition outcomes (WHO, 2021). The human host, the external environment, parasitic organism and the transmission agent all influence how intensely the infection spreads. Parasite transmission is more likely to be severe in areas where mosquito lifespans are longer and females prefer to bite people over other vertebrates (WHO, 2021). The longevity of mosquitoes are influence by stable and favourable conditions such as temperature, humidity and presence of a preferred host (Adugna *et al*., 2022). These factors have a profound effect on transmission of malaria, prevention and control management, and eradication (WHO, 2023).

Numerous risk factors for malaria during pregnancy include illiteracy (Osaro *et al*., 2019), a lower educational background, being unemployed, poverty, and gravidity (Bawa *et al*., 2014; Oyefabi *et al*., 2015; Hadiza *et al*., 2018). Research has indicated that certain types of occupations such as Cattle herders, Police, forest workers, farmers and local migrants within semi-urban regions are linked to malaria infection due to greater proximity to the modified mosquito habitat that results from deforestation (Ramdzan *et al*., 2019; Memarsadeghi *et al*., 2023). According to Ramdzan *et al*. (2019), both urban and rural populations can contract malaria, with the latter experiencing a greater prevalence due to vegetation, housing type and presence water open bodies. It has been reported that slum regions provide a good habitat for mosquito breeding grounds, pregnant women living there may be highly vulnerable to malaria infection than pregnant women residing around more upscale regions (Dako-Gyeke and Kofie, 2015). Additionally, using insecticide-treated nets (ITNs) throughout pregnancy, antenatal care visits, first trimester (Hadiza *et al*., 2018), the gestational age, and health education have all been strongly associated with malaria (Gontie *et al*., 2020).

In the light of this, it is necessary to find out the variables impacting the risk of contracting malaria infection during pregnancy such as socio-demographic characteristics and associated pregnancy parameters (trimester, number of previous births and number of pregnancies) in order to provide guidance in prevention, effective management and targeting interventions against malaria. Knowledge of the factors linked with malaria infection during an initial ANC appointment is important for malaria disease management and guiding preventive approaches. Also, identifying these pregnancy-related determinants influencing malaria infection would enhance maternal and foetus health outcomes and probably this can inform target interventions to reduce malaria burden during pregnancy. Hence, the objective of this paper was to evaluate malaria infection in pregnant women attending antenatal care in relation to socio-demographic profile, trimester, parity and gravidae in parts of Adamawa State, Nigeria.

METHODS AND MATERIALS

Study Area and Study Period: The study was carried out in the two Local Government Areas (LGAs) within the Southern Senatorial District of Adamawa State: Ganye and Toungo. Ganye to the north, Taraba State to the west and southwest, and Cameroon Republic to the south and east are the boundaries shared by Toungo LGA. The borders of Ganye LGA are Jada to the north, Mayo-Belwa to the northwest, Toungo to the south, Taraba State to the west, and Cameroon Republic to the east (Adebayo *et al.*, 2020). The climate of the region consists of dry and rainy seasons. The period of dry season starts in the month of November through March, while the wet season spans April to October. Temperature in the study area is relatively extreme due to elevated radiation income that can be relatively evenly distributed year-round, however, there is often a seasonal variation in temperature with the peak at March and April at 40^{o}C while the low temperature decreases from June through September with the minimum of 30.9^{o}C during month of August. The temperature drops rapidly as a result of cloudiness, and there is a slight increase from October to November after the cessation of rains with an average temperature of 36^{o}C to 37^{o}C to 37^{o}C. The temperature drops further in December at the onset of harmattan. Relative humidity in the region is extremely low between January to March, this increases starting from April and reaches its highest peak of 83% in August as a result humid maritime air mass. The relative humidity begins to decline in October due to discontinuance of rain. The region starts to experience little amount of rainfall in March with the main monthly rainfall of 29.8mm. During April there is shift in rainfall to 64mm. May to September constitute the wet season with relatively higher amounts of rainfall. In August the mean rainfall can reach 257.00mm. In October the rain starts to drop with the mean rainfall of 76.9mm (Adebayo *et al*., 2020). The health facilities within Ganye metropolis comprises of Primary Health Services (five Primary Health Services and two private health facilities) and a Secondary Health Facility (a General Hospital), while the health facilities within Toungo Town comprises of three primary care and a secondary health facility (a Cottage Hospital). The schools situated within Toungo town consist of two primary schools and two secondary schools while Ganye metropolis comprises of one tertiary institute and seven government secondary schools and eight government primary schools. In both study areas, farming is the predominant occupation of the inhabitants followed by trading and civil/public servants. Chamba, and Fulani are the major tribes and languages spoken, with little of Verre in Toungo LGA. Both inhabitants engage in farming, business of grains, rearing of domestic animals and civil service as their occupation. The study was conducted between January- December, 2022, running through the two seasons, raining and dry seasons.

Study Design and Demography: This is a cross-sectional epidemiological study that targets pregnant women who registered for their initial ANC visit in the two secondary hospitals in the study area: General Hospital Ganye and Cottage Hospital Toung. Convenient sampling was employed in selecting pregnant women who were present at the facilities and consent to participate. Prior to recruitment prospective participants were briefed about the research, its aims and objectives in the language they understood better with the aid of research assistants. Informed consent was ratified prior specimen collection and a structured questionnaire was used to collect information about the participants. Only the participants that gave consent were enrolled to this study. The research was carried out in accordance with the Helsinki declaration.

Ethical Approval: This research was authorized by the Ethical Committee and Review Board, Adamawa State Ministry of Health with approval No. ADHREC 15/11/2021/076.

Inclusion and Exclusion Criteria: All pregnant women (regardless of their trimester) attending their first ANC appointment in the facility and consented to participate in the study were considered eligible. Those pregnant women who had already enrolled in the clinic and undergone the antenatal procedure were excluded from participation.

Sample Size: The projected population of childbearing age in the two study settings are: Ganye (55,428) and Toungo (17,579) based on the 2006 Census Population figures and a state-specific annual growth rate of 2.9%, with women of childbearing age constituting 22% of the population (Adamawa State Ministry of Health, 2021) was used. The minimal sample size required for the study has been determined to be 384, using a sample size calculator with a 95% Confidence Level and 5% Confidence Interval/Margin Error. Consequently, a total of 471 pregnant women were enrolled in the study across the two designated healthcare facilities.

Blood Sample Collection and Parasitological Examination: Venipuncture technique described by Cheesbrough (2010), was utilized to collect blood specimen from each pregnant women. Blood specimens were then utilized for both malaria diagnostic testing and haemotocrit (PCV) analysis. Both thick and thin blood films were prepared following the methodology detailed by Cheesbrough (2010). The thick film technique was employed to detect malaria parasite presence. Conversely, the thin film method was utilized to confirm the species of malaria present, employing a single layer of red and white blood cells dispersed across less than half of the glass slide.

Data Analysis: Data obtained were entered into MS Excel and IBM statistical package for Social Science (SPSS) for windows Version 26.0 was used for analysis. The results obtained were illustrated as percentages and frequency distribution tables. Statistical significance between and within the study parameters were determined using the Pearson's Chi-square ($\chi 2$) test in study parameters were considered statistically significant when *P-value* less than 0.05, while univariate and multivariate regression models were employed to identify potential risk factors associated with malaria in pregnancy.

RESULTS AND DISCUSSION

The distribution of malaria infection based on socio-demographic profile, trimester, parity and gravidity is shown in Table 1. Pregnant women within the ages of 20-34 years had a higher prevalence of 87.0% (n = 94) while the pregnant women within the ages of 35-49 years recorded a lower prevalence of 4.6% (n = 5). There was an insignificant difference between malaria infection and age group (*P*=0.880). Those pregnant women with secondary level education (34.3%, n = 37) and those who had no education (3.7%, n = 4) recorded the highest and lowest infection, respectively, based on educational background, there was no statistical significant difference (P=0.205). Pregnant women staying who were full time housewives (30.6%, n = 33) and artisans (4.6%, n = 5), had the highest and the lowest malaria prevalence, respectively. No statistical significant was established between pregnant women occupation and malaria infection (P = 0.196). Pregnant women who were married and living together (77.8%, n = 84) were more infected than those who were separated/divorced (1.9%, n = 2) having the least infection (P = 0.243). On the basis of family type, pregnant women whose family was monogamous (72.2%, n = 78) had more malaria prevalence compared to a polygamous family (27.8, n = 30) at P = 0.295. Those pregnant women whose place of residence was town and village had equal malaria prevalence of 50.0%, respectively and the analysis showed no statistical significant association between place of residence and malaria infection (P = 0.130). Those in their second trimester (50.0%, n = 54), and those in their third trimester (18.3%, n = 20) had the highest and least malaria prevalence respectively, with statistical insignificant difference (P = 0.392). There was an independent statistical significant association (P = 0.359) between parity and prevalence of malaria, with the highest (37.0%, n = 40) and the least (0.9%, n = 1) malaria prevalence among parity two (2) and parity four (4), respectively. The category of pregnant women with primigravidae (36.1%, n = 39) recorded the highest prevalence and multigravidae (29.6%, n = 32) recorded the least prevalence. This was statistically insignificant (P = 0.328). Univariate logistic regression for possible factors associated with malaria infections showed only occupation and parity that were significantly associated with malaria infection. However, adjusting for cofounders using multiple regression revealed only parity (fourth parity AOR = 11.410; CI = 1.118 – 116.451), P = 0.040 as an independent factor associated with increasing odds of malaria infection.

Table 1: Distribution of Malaria Infection in relation to Socio-demographic Characteristics, Trimester, Parity and Gravidity during Pregnancy

Variable	Characteristics	No. Examined	Infected (%)	χ^2	*P*-value
Age-group (in years)	10-14	1	0 (0.0)	0.670[a]	0.880
	15-19	46	9 (8.3)		
	20-34	401	94 (87.0)		
	35-49	23	5 (4.6)		
	≥50	0	0 (0.0)		
Education	No formal education	85	15 (13.9)	5.322[a]	0.256
	Primary	84	21 (19.4)		
	Secondary	133	37 (34.3)		
	Tertiary	137	31 (28.7)		
	None	32	4 (3.7)		
Occupation	Full housewife	178	33 (36.0)	7.350[a]	0.196
	Farming	62	20 (18.5)		
	Trading	58	16 (14.8)		
	Artisan	14	5 (4.6)		
	Unemployed	51	10 (9.3)		
	Civil servant	108	24 (22.2)		
Marital Status	Single	56	13 (12.0)	4.174[a]	0.243
	Married, living together	345	84 (77.8)		
	Married, living alone	43	9 (8.3)		
	Separated/Divorced	27	2 (1.9)		
Family Type	Monogamous	328	78 (72.2)	0.442[a]	0.295
	Polygamous	143	30 (27.8)		
Place of Residence	Town	260	54 (50.0)	1.533[a]	0.130
	Village	211	54 (50.0)		
Trimester	First trimester	133	34 (31.5)	1.872[a]	0.392
	Second trimester	229	54 (50.0)		
	Third trimester	109	20 (18.3)		
Parity	Pre-parity	14	5 (4.6)	5.488[a]	0.359
	One (1)	169	37 (34.3)		
	Two (2)	157	40 (37.0)		
	Third (3)	96	22 (20.4)		
	Fourth (4)	19	1 (0.9)		
	≥ Five (5)	16	3 (2.8)		
Gravidity	Primigradae	145	39 (36.1)	2.229[a]	0.328
	Second gravidae	164	37 (34.3)		
	Multigravidae	162	32 (29.6)		

The outcome of malaria infection across age groups in our study indicates that malaria infection decreases disproportionately with an increase in age. This is buttressed by a study conducted in Sokoto Nigeria, where they reported a similar trend of higher prevalence among young pregnant women within ages of 21-25 years (36.7%) compared to older pregnant women age 36-40 years (6.7%) of African descent

(Osaro *et al*., 2019). Similarly, in Imo State, Nigeria it was found that 15-25 year old (28.5%) and ≥ 36 year old (18.3%) had high and low prevalence of malaria, respectively, though there was no statistical significance (Valentine *et al*., 2020). Malaria infection tends to decrease with increasing age, this might be as a result of acquired immunity which improves with increase age, becaused individuals would have been challenged by several variants of the parasite component over time (Sidiki *et al*., 2020). Also, another study reports increase with age is associated with decrease in malaria prevalence due to the development of acquired immunity (Ali, 2022). Consistent to this study, other reports found an insignificant association statistically between age group and malaria infection (Awosolu *et al*., 2021).

Table 2: Bivariate Logistic Regression for Possible Factors associated with Malaria Infection during Pregnancy

Variable	Characteristics	Malaria infection		COR (95% CI)	*P*-value
		No. Examined	No. Infected (%)		
Age-group (in Years)	10-14 (Ref)	1	0 (0.0)		
	15-19	46	9 (8.3)	0.000 (0.000 - ._	1.000
	20-34	401	94 (87.0)		1.000
	35-49	23	5 (4.6)		1.000
Education	No formal education (Ref)	85	15 (13.9)		
	Primary	84	21 (19.4)	0.643 (0.305 – 1.354)	0.245
	Secondary	133	37 (34.3)	0.556 (0.283 – 1.091)	0.088
	Tertiary	137	31 (28.7)	0.733 (0.369 – 1.456)	0.375
	None	32	4 (3.7)	1.500 (0.458 – 4.915)	0.503
Occupation	Full housewife (Ref)	178	33 (36.0)		
	Farming	62	20 (18.5)	0.478 (0.249 – 0.918)	0.027
	Trading	58	16 (14.8)	0.597 (0.300 – 1.190)	0.143
	Artisan	14	5 (4.6)	0.410 (0.129 – 1.303)	0.130
	Unemployed	51	10 (9.3)	0.933 (0.424 – 2.052)	0.863
	Civil servant	108	24 (22.2)	0.797 (0.441 – 1.438)	0.450
Marital Status	Single (Ref)	56	13 (12.0)		
	Married, living together	345	84 (77.8)	0.939 (0.482 – 1.831)	0.854
	Married, living alone	43	9 (8.3)	1.142 (0.437 – 2.988)	0.787
	Separated/Divorced	27	2 (1.9)	3.779 (0.788 – 18.132)	0.097
Family Type	Monogamous (Ref)	328	78 (72.2)		
	Polygamous	143	30 (27.8)	1.175 (0.730 – 1.892)	0.506
Place of Residence	Town (Ref)	260	54 (50.0)		
	Village	211	54 (50.0)	0.762 (0.495 – 1.172)	0.216
Trimester	First trimester (Ref)	133	34 (31.5)		
	Second trimester	229	54 (50.0)	1.113 (0.679 – 1.826)	0.672
	Third trimester	109	20 (18.3)	1.528 (0.820 – 2.847)	0.181
Parity	Pre-parity (Ref)	14	5 (4.6)		
	One (1)	169	37 (34.3)	1.982 (0.626 – 6.275)	0.245
	Two (2)	157	40 (37.0)	1.625 (0.514 – 5.135)	0.408
	Third (3)	96	22 (20.4)	1.869 (0.567 – 6.157)	0.304
	Fourth (4)	19	1 (0.9)	10.000 (1.011- 98.876)	0.049
	≥ Five (5)	16	3 (2.8)	2.407 (0.456 – 12.720)	0.301
Gravidity	Primigradae (Ref)	145	39 (36.1)		
	Second gravidae	164	37 (34.3)	1.263 (0.752 – 2.121)	0.378
	Multigravidae	162	32 (29.6)	1.495 (0.877 – 2.548)	0.140

Table 3: Multiple Logistic Regression for Factor Significantly Associated with Malaria Infection

Variable	Characteristics	Malaria Infection		AOR (95% CI)	*P*-value
		No. Examined	No. Infected (%)		
Occupation	Full housewife (Ref)	178	33 (36.0)		
	Farming	62	20 (18.5)	1.319 (0.709 - 2.452)	0.382
	Trading	58	16 (14.8)	0.587 (0.287 – 1.199)	0.144
	Artisan	14	5 (4.6)	0.741 (0.352 – 1.556)	0.428
	Unemployed	51	10 (9.3)	0.582 (0.174 – 1.946)	0.380
	Civil servant	108	24 (22.2)	1.229 (0.529 – 2.855)	0.632
Parity	Pre-parity (Ref)	14	5 (4.6)		
	One (1)	169	37 (34.3)	1.853 (0.564 – 6.086)	0.309
	Two (2)	157	40 (37.0)	1.699 (0.514 – 5.621)	0.385
	Third (3)	96	22 (20.4)	1.912 (0.555 – 6.581)	0.304
	Fourth (4)	19	1 (0.9)	11.410 (1.118 – 116.451)	0.040
	≥ Five (5)	16	3 (2.8)	2.718 (0.494 – 14.953)	0.250

In the present study, pregnant women who attained secondary level education were found to be more susceptible to malaria infection, while those with tertiary level education accounted for the least, with no statistical significant difference. Our finding's is similar to that of Oladosu and Adeniyi (2023), who reported that pregnant women with secondary and tertiary level of education had the highest and lowest infections rate of 67.9% and 15.1%, respectively. Likewise, other study reported pregnant women with no education recorded the least (Ejike *et al*., 2017). Contrary to this finding, pregnant women with no formal education recorded the highest malaria prevalence, while malaria infections decreased proportionately with those having tertiary education (Fana *et al*., 2015). Probably factors that might be responsible for this high infection in our study among others are lack of knowledge of mosquito biology and behaviour, coupled with poor bednet utilization, which cumulatively might have significant impact on effective malaria prevention measures among pregnant mothers with lower educational status.

Results from our study showed, that pregnant women who were full time housewives accounted for the greater proportion of infection. This is supported by the works of Oyefabi *et al*. (2015) who reported high malaria infection among full housewives (77%) although their percentage was higher than our findings. This suggests that being a full housewife posed a substantial risk for malaria during pregnancy as Chi-square analysis indicated statistical significant association between occupation and malaria infection. Conversely, a study conducted in Kogi State, reports highest malaria infection among the unemployed (17.1%) and the least infection among those who had formal education (8.8%), with no observed statistical difference (Yaro *et al*., 2017). This present finding differs from the Ejike *et al*. (2017) who report, that farmers and traders were mostly affected with 66.7% and 63.3% prevalence, respectively. It can be inferred from our study, that the least infection was observed among pregnant women, who were unemployed and artisans. Hadiza *et al*., 2018 observed that occupational status constitutes one of the major monetary strengths of the pregnant women, despite this, malaria infection does not consider employment status, rather knowledge of malaria disease, transmission and prevention from exposure to mosquito bites proper protection. Therefore, pregnant women with stable financial income have a better means to have access to quality medical services, the ability to afford insecticidal commodities and knowledge of consistent application of these insecticide alongside the use of mosquito bednets.

Statistical analysis for malaria prevalence in relation to pregnant women's marital status revealed no significant differences in this study. However, a higher infection was observed among those who were married but living together, while the prevalence of infection decreases from single, married but living alone and separated/divorced. The high malaria infection among married couples living together may be due to the presence of their spouses which might demand more housework that could involve activities that require them staying outdoor at late-night coupled with the husband disliking using bednet. However, this may differ from the assertion made regarding high frequency of bednet ownership and usage among married and unmarried, which is linked to better decisions by married women after consultating with their partner(s) (Nyavor *et al*., 2017). Reports from previous study revealed that, unmarried (22.2%) reported a higher malaria prevalence compared to married (18.1%) women having the least prevalence (Oladosu and Adeniyi, 2023). Based on the family type the pregnant women comes from, those women from monogamous families had highest malaria infection compared to those from polygamous families as presented in this study. Studies suggest different outcomes from our study where polygamous homes had higher malaria infection than monogamous homes (Yaro *et al*., 2017; Benjamin *et al*., 2019). Similar to our statistical analysis, Benjamin *et al*. (2019) reported no significant difference and made the assertion that larger size of polygamous households might lead to financial constraints that might circumvent the ability to afford adequate malaria preventive practices to the family members or especially to the pregnant women. However, family type could serve as a social determinant of health in addressing malaria prevalence during pregnancy, as this high malaria prevalence among monogamous families in our study might have happened by chance. Also, the observed disparity in malaria prevalence might reflect the differences regarding utilization of malaria preventive measures, one's own socioeconomic position and environmental factors that could influence malaria risk.

Pregnant women residing in towns were more infected compared to those residing in villages with statistical insignificant difference. The discrepancy in this study and previous studies reported the highest occurrence of malaria in rural dwellers (27.5%), followed by urban dwellers (20.8%) and semi-urban dwellers (17.6%) having the least occurrence (Felix *et al*., 2019). Similar finding's have been reported in another study (Wilson, Krogstad, Arinaitwe and Arevalo-Herrera, 2015). This high prevalence among those pregnant women residing in town might be explained by elements like evolving pattern of urbanization, which may facilitate the transmission of malaria from rural to urban regions, especially in highly populated and rapid growing urban region in Nigeria (Osaro *et al*., 2019). Despite a better development in urban areas such as the availability of health services and less breeding ground for mosquitoes, studies have shown urban areas are associated with high malaria transmission among populace (Olusegun-Joseph *et al*., 2015). Other factors could be due to human migration, individual influx from malaria endemic settings to less endemic, poor housing condition, suboptimal sanitation that block drainage system which provide conducive environment for *Anopheles* mosquito to breed, lack of application and compliance to indoor residual spray, uptake of SP and utilization of bed net (Morakinyo *et al*., 2017 or 2018). Pregnant women in their second trimester in this study, were infected most with malaria infection among those in their third trimester, showing no statistical association (P = 0.392). Our findings corroborate the pattern of malaria prevalence reported in other studies, where the second and third stages of pregnancy recorded the highest and lowest risk of malaria (Ukibe *et al*., 2016; Eberemu and Magaji, 2017; Yaro *et al*., 2017). Our study is also in alignment with other previous studies in terms of high infection prevalence but differs in another gestation period, where the most malaria infected categories were the second trimester (81.6%), followed by those in their third trimester (76.4%), while the first trimester (68.4%) recorded the least infection (Ali, 2022). Our findings also contrast the reports of Hadiza *et al*. (2018) in Zamfara and Simon-Oke *et al*. (2019) in Ekiti State, who both reported higher infection among pregnant women in their first trimester and lower malaria infection in their second trimester, both findings had a statistically significant difference. Similarly, malaria infection decreases disproportionately with increase in trimesters, ranging from first to third in studies carryout in Benin and in the Founban subdivision, Western region of Cameroon (Accrombessi *et al*., 2019; Sidiki *et al*., 2020). The plausible explanation to our finding might be that pregnant women might likely overlook the significance of nightly bdnet usage, likely at their later stage of pregnancy, probably in their third trimester, which might suggest the importance of continually health talk during each antenatal appointments to emphasize the significance of malaria preventive measures (Dun-Dery *et al*., 2022), and might result from the improvements in the pregnant women's immune system over each stage of pregnancy and/or they might have used malarial preventive measures previously. Meanwhile, the high malarial infection prevalence during the second trimester might imply the endemicity of malaria couples with the consequential ANC late appointment that might result to late uptake of malaria preventive regimen. Parity and malaria infection were shown to be statistical independently significant with a high and lowest malaria infection prevalence among parity two (2) and parity four (4) respectively. A study suggested that, antibodies accumulates with each subsequent pregnancies, as long there is exposure to infection (Hadiza *et al*., 2018). At high parities, there is apparently an increase in immunity with subsequent pregnancies, provided there is exposure to *Plasmodium* parasites (Sidiki *et al*., 2020). However, a previous study contradicted this finding, who reported: Parity >5 had 16.1% recorded the highest malaria infection, followed by parity 0-2 with 14.9% and the least among parity 3-4 having 8.4% (Yaro *et al*., 2017).

An observed difference was seen within the gravidae, where there is disproportionate decrease in malaria prevalence with increase in gravidae, with no statistical significant differences observed between malaria infection and gravidae. Similar to our finding, other studies carry out in Nigeria, Cameroon and Ghana revealed malaria infection decreases with an increase in the number of pregnancies from primigravidae to multigravidae (Bawa *et al*., 2014; Yaro *et al*., 2017; Sidiki *et al*., 2020; Dosoo *et al*., 2020; Ali, 2022). Assertion made in another study, that in malaria endemic region, acquisition of immunity is developed gradually through consecutive pregnancies might explained this lower malaria prevalence among multigravidae in our study (Okiring *et al*., 2019). Ali further explains that in areas of intense malaria transmission, there is a profound acquisition of immunity in older pregnancies, primigravidae happens to be the most vulnerable group (Ali, 2022), due to lack of antibodies against peculiar to pregnancy *Plasmodium* variants that selectively accumulate in the placenta (Eberemu and Magaji, 2017). Other studies also reported primigravidae (21.9%) recorded the highest while multigravidae (10.6%) recorded the least (Yaro *et al*., 2017). Other attributing factors as opined by another study was primigravidae are typically stressed out due to potential physiological changes usually occur during their first pregnancy, which may lower their ability to fight against infections (Bawa *et al*., 2014).

It was further opined in other study, that the high infection in multigravida might be due to the low specific immunity against *Plasmodium* infection and immunological changes that accompanied pregnancy (Simon-Oke *et al*., 2019). The odds of contracting malaria infection were 11.410 times higher among pregnant women in fourth parity when compared to other category.

Conclusion: Malaria infection associated with study variables; socio-demographic profile, trimester, parity and gravidae show statistical insignificant difference. However, malaria infection across age-group and category of gravidae decreases disproportionately with an increase in age and gravidae, respectively. Pregnant women with secondary education, full housewives, married and living together, monogamous family type, those residing in town, second trimester and parity were found to be more predisposed to malaria infection. Parity is an independent risk factor associated with malaria with about 11.410 times higher among pregnant women in fourth parity when compared to other category. This indicates pregnant women with parity four happens to be the only independent risk factors strongly associated and having the higher chance of contracting malaria infection.

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Data Availability Statement: Data are available upon request from the corresponding author.

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