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Malaria Infection and Maternal Factors Among Pregnant Women in Gombe Central Zone, Nigeria

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ABSTRACT
Pregnancy-related malaria can have catastrophic consequences for the health of the mother, including severe anemia, hypoglycemia, acute lung injury, and even death. The aim of this study is to determine the prevalence of Malaria Infection in relation to age groups, trimester and gravidae among pregnant women in Gombe Central Zone, Nigeria. Blood samples of 600 pregnant women from eight health facilities in the zone were collected and examined using Rapid Diagnostic Test (RDT) to detect *Plasmodium falciparum* species. A total of 600 pregnant women who participated were examined in this study, 187 (31.2%) were found positive with malaria parasites. The women in the age group of 16-24 years had the highest prevalence of malaria infection of 111 (34.6%) of all the respondents. This was then succeeded by the age group 25-34 years with 68 (27.9%) ($\chi 2$=5.991, p=0.044), women during the second trimester registered the highest prevalence of infection with 88 (32.9%) testing positive, closely followed by women during the first trimester with 16 (32.0%) and third trimester with 83 (29.6%) respectively ($\chi 2$=5.991, p=0.750) while multigravidae recorded the largest percentage of malaria infection with 98 (16.3%), followed by the Secundigravidae with 46 (7.7%) and primigravidae with 43 (7.2%) ($\chi 2$=5.991, p=0.981). Therefore, antenatal care services that include malaria prevention programs with regular screening, diagnosis, and treatment throughout pregnancy should be enhanced.

Keywords: Antenatal care, Trimester, Gravidae, Gombe central zone

INTRODUCTION

Malaria is a parasitic disease caused by Plasmodium species and transmitted mainly through the bites of infected female Anopheles mosquitoes. The disease remains a major public health challenge, particularly in tropical regions, due to the continuous transmission of malaria parasites by competent mosquito vectors (Umar and Nock, 2023). Malaria infection among pregnant women can lead to high morbidity, anemia, low birth weight, miscarriage, stillbirth and death (Foghi *et al.*, 2021). In localities where the acquired immunity is high, malaria can be asymptomatic, hence with the possibility of causing pregnancy-related anemia (Acquah *et al.*, 2020). The consequences of malaria infection during pregnancy could be acute infant illness, premature childbirth or pregnancy termination, or maternal mortality, depending on the immunologic status of the mother to malaria infection. The mother and fetal growth retardation is also related to infections (Anna et al., 2015; Sarki *et al.*, 2018). The human immunity is also a major factor especially in adult communities whereby the transmission of malaria is border-line to high. Decades of exposure to Plasmodium species result in the development of partial immunity, but do not prevent a malaria infection from leading to a severe disease but only partially. Due to this reason, malaria morbidity and deaths need to be represented as young children and pregnant women in Africa, yet in places with weak immunity and low transmission; all groups are susceptible to it (Kunihya *et al.*, 2016).

Malaria is a severe health issue of the global society, more so in Nigeria and other parts of the tropical and sub-Saharan regions. It causes 300-500 million clinical and 1 to three million deaths annually (Funmilola and Olubunmi, 2017). In spite of the considerable advancements in prevention and control activities, malaria remains a significant threat to public health in most countries, especially in tropical ones (Wogu and Nduka, 2018). Pregnancy-related malaria is still a major public health concern that puts the woman, her fetus, and the unborn child at significant danger (Ali *et al.*, 2020). The illness places a heavy weight on society because it negatively impacts people's physical, emotional, and social well-being as well as the country's economic growth (Sarki *et al.*, 2019).

In Nigeria, malaria is all-pervasive, in addition to contributing to an estimated 11% maternal mortality rate; almost 90% of Nigeria's population is at danger of catching malaria (Okore *et al.*, 2015). Pregnant women, particularly primigravidae, are known to be more susceptible to malaria infection in malaria endemic locations. They also exhibit increased parasite prevalence and densities compared to multigravidae and non-pregnant women in the same population (Anna *et al.*, 2015). The magnitude of the additional risk fluctuates according to the age of the expectant mothers, which represents the total amount of malaria exposure throughout their lifetime, and according to parity, which is caused by the pregnancy-specific immunity developed following prior malaria exposure in pregnancies (Anna *et al.*, 2015).

In Africa's malaria-endemic areas, between 25 and 30 million women become pregnant each year. A comparable number of people are also exposed to malaria in Asia, Oceania, and South America (Stephen *et al.*, 2007). The costs and global

burden associated with a malaria infection rank high; in malaria-infested countries, the illness decreases per capita GDP by an approximate of 50 percent in comparison with non-endemic countries (Ismail *et al.,* 2022). The mother, her fetus, and even the newborn baby are all at risk from malaria infection during pregnancy (Omong *et al.,* 2020). Malaria is the second most common infectious disease cause of death in the world. In the globe, sub-Saharan Africa is the region with highest malaria infection burden with about 90 percent of all the deaths being malaria related. Malaria is estimated to take between 350–500 million and Mosquito-borne illness kills an estimated 1- 2 million people each year (Julianna and Nawal, 2009).

According to the World Health Organization (WHO), malaria remains a major global public health challenge. The estimated number of malaria cases increased from 219 million cases in 2017 to approximately 263 million cases in 2023, and further increased to 282 million cases in 2024, indicating a persistent global burden despite continued prevention and control interventions (WHO, 2025). It is noteworthy that the African region remained to have a proportionately high percentage of the world malaria burden (Kalyetsi *et al.,* 2019). Malaria elimination is not achieved through a series of isolated consecutive steps, but rather as a dynamic and long-term process involving progressive reduction of transmission, strengthening of health systems, maintenance of surveillance, and rapid response to prevent resurgence (WHO, 2022). The rate at which countries, sub-national areas, and communities eliminate malaria varies depending on a number of factors, including the amount of investment made, biological determinants (pertaining to the populations affected, the parasites, and the vectors), environmental factors, the effectiveness of health systems, and social, demographic, political, and economic realities (World Health Organization {WHO, 2021c). Nassai *et al.* (2020) found that malaria prevalence can also be decreased by improving sanitation and awareness of how the disease is spread. However, malaria parasites have developed a level of resistance to majority of the antimalarial drugs. The resistance that enhances the effect of the medications is known as drug resistance. Traditional medicinal herbs are widely utilized to treat or cure malaria fever in Africa and other tropical nations where the disease is widespread. This is especially true in rural and isolated areas where people have limited access to healthcare facilities (Labaran *et al.,* 2022).

MATERLALS AND METHODS

Study Area

The research took place in the central senatorial zone of Gombe State in northeast Nigeria. The zone includes Akko and Yamaltu/Deba Local Government Areas (LGAs), which are among the largest in the state by both population and area. Gombe State, often called the jewel in the savannah, is located in Nigeria within the Sudan Savannah ecological zone. Gombe State which is better referred to as the Jewel in the Savannah is located in Nigeria and this is within the Sudan Savannah ecological zone. Its neighboring states are Adamawa, Bauchi, Borno and Yobe and east and north respectively where lays Yankari game reserve and river bend. Gombe State covers an area of approximately 20,265 km² and lies within the Guinea and Sudan savannah ecological zones, with elevations generally ranging between 400 and 500 m above sea level (National Bureau of Statistics [NBS], 2022).

Akko Local Government Area is located at the central part of Gombe State and its population is estimated to be 337,853 (NPC, 2006). It occupies approximately 2,627km² and lies between latitudes 9°50′N–10°20′N and longitudes 10°40′E–11°30′E (Figure 1). It has its administrative center at the town known as Kumo 40km south of Gombe metropolis. Akko LGA is highly diverse in terms of ethnography with Fulani, Tangale, Tera, Hausa, and minority groups with Islam and Christianity being the most dominant religious. There are two different seasons viz the wet and dry defined by the Inter-Tropical Convergence Zone (ITCZ). The LGA has a rainy season that falls between April and October and dry season that falls between November and March with an annual precipitation of between 850 and 1,000mm (NMA, 2019. The highest economic activity in the LGA is farming and trade which is partially served by several market and health facilities. The main occupation of the people is farming and trading.

Yamaltu/Deba Local Government Area situated in the central location of the state and the headquarters of this local government area is the Deba Town situated about 25 km, to Gombe city. The LGA has an estimated population of 255,726 (NPC, 2006), and a land area of about 1,981 km², lying between latitudes 10°00′N–10°20′N and longitudes 11°20′E–11°50′E (Figure 1). It bears temperatures of 20.0-30.0ºC and is also comparable to Akko LGA in the Sudan Savannah weathers. The population is predominantly Fulani, Kanuri and Tera and the main occupations include crop farming, fishing and leather. Commercial activities are supported in the local markets and the most common types of crops include rice, millet, sorghum, beans and onions.

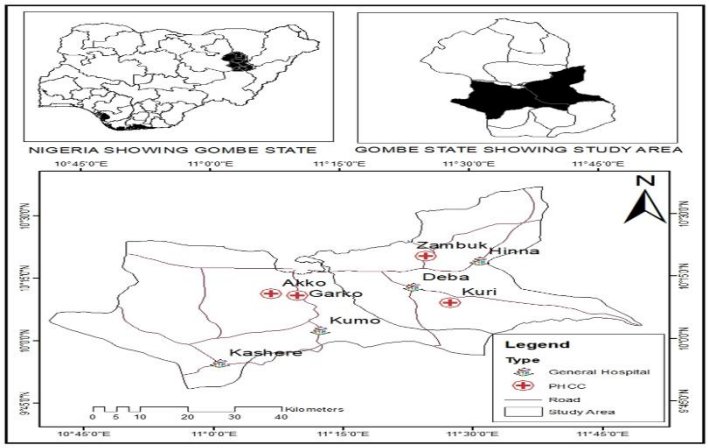

Figure 1: Map of Gombe Central Zone Showing the Study Area (Akko and Y/Deba)

Ethical Considerations
Introduction to the ethical committee of the Gombe State Ministry of Health in relation to the research was presented by the Department of Zoology of Modibbo Adama University Yola and three copies of the research proposal were submitted to the committee. The ethical clearance was then issued as duplicates to the Medical Directors/facility managers of the selected health care facilities and participants were provided the permission to carry out the research

Study Design
Samples of consenting pregnant mothers were collected (with the help of a medical laboratory scientist) at the antenatal clinic in the selected hospitals in the study areas An interview was conducted with the participants to obtain information on their age, trimester, and gravidity.. The Laboratory Scientist of the Federal Teaching Hospital Gombe was selected to help in carrying out the Rapid Diagnostic Test (RDT).

Determination of Sample Size and Study Population
The sample size of this investigation was determined by the formula suggested by Araoye (2004). A study population larger than 10,000 can be calculated using the formula n = $\frac{Z^2PQ}{d^2}$, and 384 were obtained in two Local Government Areas of the Gombe Central Zone (that is, the LGAs of Akko and Yamaltu/Deba).
The study population comprised of six hundred (600) pregnant women that visited and received antenatal care in eight (8) hospitals/health facilities in twelve (12) months duration (50 participants/month) in Gombe Central Zone; General Hospital Hinna (66 participants); General Hospital Deba (77 participants); Primary Health Care Kuri (87 participants); Primary Health Care Zambuk (70 participants); General Hospital Kumo (69 participants); General Hospital Kashere (73 participants); Primary Health Akko (67 participants); and Primary Health Care kundulum/Garko (91 participants).

Inclusion/Exclusion Criteria
The inclusion criteria comprised pregnant women who attended the selected healthcare centres during the sampling period, received care at the facilities, and voluntarily provided informed consent to participate in the study. The exclusion criteria included pregnant women who were absent in the day of the sampling, non-pregnant women and pregnant women who denied taking part in the study.

Sampling Techniques
A multistage sampling technique involving purposive and consecutive sampling methods was employed for this study.
In the first stage, Akko and Yamaltu/Deba Local Government Areas (LGAs) were selected because they constitute the Gombe Central Senatorial Zone. Each LGA comprises eleven (22) wards, 11 from each LGA. Four (4) wards were purposively selected from each LGA based on the presence of functional health facilities providing antenatal care (ANC) services and their suitability for the study. The selected wards in Akko LGA were Kumo Central, Garko, Akko, and Kashere, while the selected wards in Yamaltu/Deba LGA were Deba, Hinna, Kuri/Lambam, and Zambuk/Kwali. In the second stage, one health facility providing ANC services was purposively selected from each selected ward, resulting in a total of eight (8) health facilities. In the third stage, pregnant women attending ANC clinics in the selected health facilities were recruited using consecutive sampling. Eligible pregnant women who met the inclusion criteria and consented to participate were enrolled consecutively during their ANC visits until the required sample size was achieved. The data was collected for six (6) weeks in each facilities and the final sample size was determined by the number of participants that turned up throughout the period of the study.

Blood Sample Collection for Rapid Diagnostic Test (RDT)
A capillary blood sample was collected by finger-prick using sterile disposable lancet, and the blood was applied to the malaria Rapid Diagnostic Test (RDT) cassette according to manufacturer's instructions. About 5uL of the capillary blood was loaded into the sample well of the test cassette and the assay buffer supplied was added. After 15-20 minutes, the results of the test were read. A positive test was one which showed a control and a test line whereas one with a single control line signified a negative test. All tests that did not show a visible control line was considered invalid and re-tested (WHO, 2018).

Data Analysis
Data collected were analyzed using Statistical Package for the social Sciences (SPSS) version 23.0. Results were presented on frequency distribution tables, and chi-square test was used to determine the association between malaria prevalence and dependent variables.

RESULTS
The Table 1 shows the prevalence of malaria infection in pregnant women in the two Local Government Areas (LGAs) of Gombe Central Senatorial Zone. 600 pregnant women were studied in the LGAs and the overall prevalence of malaria was 31.2% (187/600).
Table 1 shows that women in the age group of 16-24 years had the highest prevalence of malaria infection of 111 (34.6%) of all the respondents. This was then succeeded by the age group 25-34 years with 68 (27.9%) infected and the lowest prevalence was found in women aged 35-46 years with 8 (22.2%) cases. The chi-square test indicated statistical significance in the age and malaria infection association ($\chi 2$=5.991, p=0.044), which demonstrated that the prevalence of malaria across age groups is statistically different.
Table 2 highlighted the trimesters, women during the second trimester registered the highest prevalence of infection with 88 (32.9%) testing positive, closely followed by women during the first trimester with 16 (32.0%) and third trimester with 83 (29.6%) respectively. There was however no statistically significant relationship between trimester and malaria infection ($\chi 2$=5.991, p=0.750), which indicates that trimester does not play a significant role in the prevalence of malaria among the study population.
In terms of gravidity, multigravidae recorded the largest percentage of malaria infection with 98 (16.3%), followed by the Secundigravidae with 46 (7.7%) and primigravidae with 43 (7.2%). In spite of these variations, the correlation between gravidity and malaria infection was not found to be statistically significant ($\chi 2$=5.991, p=0.981), which indicates that gravidity does not play a significant role in the prevalence of malaria among the participants (table 3).

Table 1: Prevalence of Malaria Infection in Relation to Age among the Participants

Variable	Category	No Examined	No Positive (%)	$\chi 2$	*p*-value
Age	16-24 years	321	111 (34.6)		
	25-34 years	243	68 (27.9)	5.991	0.044
	35-46 years	36	8 (22.2)		
Total		**600**	**187(31.2)**		

(Malaria and Age: Calc. $\chi 2$=0.044, Tab. $\chi 2$ =5.991, df=2, Significant)

Table 2: Prevalence of Malaria Infection in Relation to Trimester among the Participants

Variable	Category	No Examined	No Positive (%)	$\chi 2$	*p*-value
Trimester	First	50	16(32.0)		
	Second	270	88(32.9)	5.991	0.750
	Third	280	83(29.6)		
Total		**600**	**187(31.2)**		

(Malaria and Trimester: Calc. $\chi 2$=0.750, Tab. $\chi 2$=5.991, df=2, Not significant)

Table 3: Prevalence of Malaria Infection in Relation to Gravidae among the Participants

Variable	Category	No Examined	No Positive (%)	$\chi 2$	*p*-value
Gravidae	Primigravidae	141	43(30.4)		
	Secondigravidae	147	46(31.3)	5.991	0.981
	Multigravidae	312	98(31.4)		
Total		**600**	**187(31.2)**		

(Malaria and Gravidae: Calc. $\chi 2$=0.981, Tab. $\chi 2$=5.991, df=2, Not significant)

Discussion

The results of the current study on the prevalence of malaria in pregnant women categorized by age, trimester, and gravidity offer important insights into what variables contribute to the risk of malaria infection in pregnant women. The findings fulfill certain past studies but also contain contradictions, indicating the intricacy of the malaria transmission process under various geographical and demographic settings.

In this study, younger pregnant women (16-24 years old) are the most prevalent and 34.6% of them were infected with malaria. This finding echoes various other studies which have been carried on the same issue in Nigeria wherein the prevalence of malaria infection has been observed to be more prevalent among younger women. As an example, young pregnant women were found to be particularly susceptible to malaria compared to their older counterparts in the study conducted in Awka, Anambra State because of their lower acquired immunity, which raises their risk of acquiring the disease (Akogu *et al.,* 2022). This may be because young women especially those who are primagravidae have less exposure to malaria in the course of their lives and are therefore more susceptible to infection. Moreover, younger women are less likely to always adopt the use of malaria preventive measures including insecticide-treated nets (ITNs) or intermittent preventive treatment during pregnancy (IPTp). In this research, whereas the prevalence rate was more among younger pregnant women, the study indicated that the risk factors of malaria infection were not purely age dependent but were affected by other factors like geographical location, access to health care and seasonal changes in malaria outbreak (Agomo, 2009). This shows that age is indeed contributory to malaria susceptibility but other components such as severity of malaria transmission in a certain locality also contribute largely. The age group 25-34 years had a lower malaria prevalence rate as compared to the younger age group in this study, which is consistent with the overall trend where malaria reduces with age because of the development of partial immunity with repetitive exposures to the disease. The lowest prevalence (22.2%) was observed among the older population (35-46 years), and this is in agreement with reports of study findings in North-Western Nigeria where the slowly accrued immunity to malaria with age reduced the risk of infection (Fana *et al.,* 2015).

This number represents the prevalence of malaria at any given trimester. Trimester-wise, this study revealed that malaria was highest among the second trimester women (32.9%), and then the first trimester (32.0%), and lastly the third trimester (29.6%). Nevertheless, statistical analysis did not indicate that there was any significant differentiation in the malaria prevalence in the trimesters ($\chi 2$=5.991, p=0.750) indicating that the trimester of pregnancy does not contribute significantly to the risk of malaria infection (Table 2). This result aligns with the works of a number of studies, including a study carried in Gombe State by Yoriyo and Jonges, (2014) who found 31.5% in first trimester, 35.5% in second trimester and 26.0% in third trimester and also a study in Osogbo, Osun State that found no significant correlation between trimester and prevalence of malaria infection, either. Although the prevalence rates varied, the findings of this study are consistent with reports that found no statistically significant association between pregnancy trimester and malaria infection, suggesting that factors such as seasonal variation, environmental exposure, and access to antenatal healthcare services may play a more important role in malaria occurrence among pregnant women (Bello and Ayede, 2019).

The same is however not the case in a study carried out in Awka, south eastern Nigeria. It established that the most prevalent malaria was experienced during the first trimester by the pregnant women contrary to what the current study has found. The difference between the studies is probably explained by the fact that malaria transmission intensity in various areas is different, and intervention strategies are implemented at different times. Pregnant women in their first trimester in malaria-endemic areas can be considered at risk because of decreased immunity and inaccessibility of preventive measures during the first trimester (Akogu *et al.,* 2022). The differences observed could also be due to regional variations in malaria control measures, where regions which have stronger preventive measures experience fewer variations in the rates of infection between trimesters.

In terms of gravidity, it was observed that more multigravidae women experienced malaria with 16.3% testing positive. Nevertheless, statistical analysis revealed that there is no significant association between gravidity and malaria prevalence ($\chi 2$=5.991, p=0.981) (Table 3), implying that the mature number of pregnancies that a woman has gone through is not significantly related to her vulnerability to malaria in pregnancy. This observation can be correlated with other studies carried out in Ethiopia indicating that there exist incongruent results between gravidity and malaria particularly in localities with light transmission intensity (Gontie, 2020). In North-Western Nigeria, however, studies have revealed that primigravidae women have a higher chance of having malaria as a result of their lower immunity, so they are more vulnerable to malaria in areas that are highly endemic (Nanvyat, 2024). This difference in the results might be accounted by the variation of the dynamics of the local malaria transmission. In the areas with low transmission rates or better prevention plans, past pregnancies may not be a protective factor whereas in high-transmission areas, those women with prior pregnancies may be immune to some extent, and their risk of malaria decreases.

Malaria, especially in pregnant women, is a significant health challenge on the international level, especially in the sub-Saharan region. World Health Organization (WHO) approximates that approximately 39.3% of pregnant women in malaria-infested areas are at risk of malaria exposures and thus, they experience a high burden of morbidity and unfavorable pregnancy outcomes. This number is consistent with the results of this paper, in which high rates of malaria were reported among pregnant women, in particular, younger age groups (WHO, 2022). Researchers in Africa have continuously noted that rapidity pregnant women are at higher risk concerning reasons like immunity deficiency, lesser entry to malaria preventative steps, high transmission of malaria in these endemic regions. The prevalence of malaria during pregnancy differs around the world, although the prevalence rate is lower in Asia and Latin America, which could be linked to the increased strength of control and reduction of transmission in these areas.

Generally, this study has pointed to age as a major factor which predisposes pregnant women to malaria, younger women being more vulnerable. This study found no significant association between malaria infections and the trimester or gravidity of pregnant women. This finding is consistent with some previous studies that reported no significant relationship between malaria prevalence and maternal obstetric characteristics, including trimester and parity/gravidity (Nega *et al*., 2021; Nwankwo *et al.,* 2022). However, it contrasts with other studies that observed a higher risk of malaria infection during specific trimesters, particularly the second and third trimesters, or among women with different parity levels (Okeke *et al.,* 2020; Takem *et al*., 2021). Differences in malaria transmission intensity, use of preventive measures such as insecticide-treated nets, antenatal care attendance, geographic location, and study population characteristics may account for these variations The findings from global and regional studies collectively underscore malaria during pregnancy as an important public health concern, with younger women in malaria-endemic areas experiencing a greater vulnerability to infection and its associated adverse outcomes. Increased emphasis on malaria prevention at all pregnancy stages and targeting services as needed by people of all ages should be the main aspects of future malaria control.

CONCLUSION

The study was conducted in an effort to evaluate the association between malaria and age, trimester and gravidae among pregnant women in Gombe Central Zone. Despite the regular antenatal visits by the pregnant women, there was high prevalence of malaria among the study subjects and the overall prevalence of malaria was 31.2% (187/600). Therefore, the results indicate that there is a need to adopt a multi-model approach in addressing this infection most especially on pregnant mothers and children who are vulnerable in a society, by encompassing a better diagnostic ability, preventive measures, and health promotion.

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