FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 9 No. 12, December (Special Issue), 2025, pp 376 – 381
DOI: https://doi.org/10.33003/fjs-2025-0912-4441

LOGISTIC REGRESSION ANALYSIS OF THE IMPACT OF MALARIA AND OTHER FACTORS ON MISCARRIAGES IN GOMBE STATE

***[1]Buba Chajire Pwalakino, [1]Muhammad Ibrahim, [1]Lamidi-Sarumoh Alaba Ajibola and [2]Shitu D.A.**

[1]Department of Mathemetical Sciences, Faculty of Science, Gombe State University, Nigeria.
[2]Department of Mathematical Sciences, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

*Corresponding authors' email: bchajire@gsu.edu.ng

ABSTRACT

Malaria remains a significant public health challenge in Nigeria, particularly in regions like Gombe State, where the disease is endemic. Pregnant women are especially vulnerable to malaria, which can lead to adverse pregnancy outcomes, including miscarriage. This study aims to investigate the impact of malaria on miscarriage among pregnant women in Gombe State, Nigeria, using binary logistic regression. Data were retrospectively collected from medical records of 272 pregnant women admitted to the Gombe Specialist Hospital from August to December 2024. The study examined the association between malaria infection and miscarriage in, while controlling for demographic factors such as maternal age, coexisting health conditions, gestational age at diagnosis of malaria, level of education, and previous pregnancy history Using SPSS and MS Excel packages. Results at 5% significance level revealed that malaria infection was a significant predictor of miscarriage ($p < 0.001$), with an extremely high odds ratio of 107.932 at 95% confidence interval. Other factors, such as maternal age, gestational age at diagnosis of malaria and coexisting health conditions, were not statistically significant. Previous pregnancy history was also significant ($p = 0.035$), suggesting that women with a history of previous pregnancies were less likely to experience miscarriage compared to those without such a history. The study concluded that malaria is a major risk factor for miscarriage and emphasized the need for targeted interventions by the government and other non-governmental organizations towards prevention.

Keywords: Malaria, Miscarriage, Logistic Regression

INTRODUCTION

Malaria was a major public health concern in Nigeria, with an estimated 68 million cases and 194,000 deaths due to the disease in 2021. Nigeria has the highest burden of malaria globally, accounting for nearly 27% of the global malaria burden. The risk of transmission exists throughout the country, all year round. However, the incidence of malaria was highest in the northern and northeastern parts of the country. As one of the countries supported under the High Burden to High Impact (HBHI) approach, Nigeria has been a leader in implementing data informed strategies to tailor interventions sub nationally. The country also established an integrated national malaria data repository that was accessible at the local government level. A nationwide training exercise on the use of the repository for routine decision-making has also been implemented (WHO, 2022).

In Nigeria, malaria was endemic, and pregnant women were especially vulnerable to its adverse effects. One such effect was an increased risk of miscarriage, which could have devastating consequences for individuals and families (WHO, 2023).

Demographic factors such as maternal age, parity, and socioeconomic status may also influence the risk of miscarriage according to existing literature. Older maternal age, previous history of miscarriage, and low socioeconomic status have been found to be associated with an increased risk of miscarriage. However, the interplay between malaria infection and these demographic factors on miscarriage risk has not been fully understood.

In 2024, Isiko I. et al. analyzed the factors associated with the risk of malaria among children using secondary data analysis of the Nigeria Malaria Indicator Survey 2021. The study sample comprised 10,645 women (aged 15–49) who delivered a child in the 2 years preceding the survey. The study was restricted to under-five years of age. Logistic regression was used to identify factors significantly associated with the risk of malaria in the study.

In 2023, Eleje et al. conducted a study analyzing the prevalence and associated factors of recurrent pregnancy loss (RPL) in Nigeria, using different national and international criteria. The study aimed to assess how the definitions of RPL set by the American Society for Reproductive Medicine (ASRM) and the European Society for Human Reproduction and Embryology (ESHRE) (which define RPL as two or more pregnancy losses) compared to the World Health Organization (WHO) and the Royal College of Obstetricians and Gynecologists (RCOG) (which define RPL as three consecutive losses). Findings indicated that the overall prevalence of RPL in Nigeria was 15.34% based on the ASRM/ESHRE definition and 5.29% based on the WHO/RCOG definition. The study identified several significant risk factors for RPL.

In 2023, James et al. employed binary logistic regression analysis to investigate the risk factors associated with hepatitis B disease in Gusau Local Government, Zamfara State, Nigeria. The study utilized secondary data from the Federal Medical Centre in Gusau, collected between 2018 and 2019. The logistic regression model identified marital status, history of blood transfusion, multiple sexual partners, and alcohol consumption as significant predictors of hepatitis B infection. The study also used the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) to select the best model, and the HosmerLemeshow test to evaluate the model's goodness of fit. The results showed that the model with only significant predictors provided the best fit for the data.

In 2022, Alaka et al. used multivariate logistic regression to investigate the factors associated with the psychological impact of the Coronavirus disease 2019 (Covid19) outbreak in Nigeria. Data were collected using an online self administered questionnaire, a cross sectional study of 1,075

respondents. Mental health status was assessed using Generalized Anxiety Disorder 2 (GAD2) and Patient Health Questionnaire2 (PHQ2). The results showed that there was no significant differences among marital classes on depression and anxiety in Nigeria during Covid19. In detail, the study revealed that income level, region, and gender were the significant predictors of mental health status among Nigerians. Based on the findings, the study recommended that more attention should be paid to the mental health of this vulnerable population during an infectious disease outbreak.

In 2022, Eke & Ewere investigated the level, trend, and determinants of infant mortality in Nigeria using a logistic regression model. The dependent variable for this study was infant mortality. The independent (explanatory) variables included in this study were: Mother's Age, Mother's Region, Place of Residence, Mother's Education, Source of Drinking Water, Toilet Type, Mother's Religion, Cooking Fuel, Mode of Delivery, Breastfeeding, Place of Delivery, Size of Child at Birth, Number of Antenatal Visits, and Gender. Findings from the study revealed that infant mortality rates declined but stagnated in the five year period prior to the 2018 survey, with an Annual Rate of Reduction (ARR) of 0% relative to an initial ARR of 5.7% between 2003 and 2008. The ARR of 2.039% over the 15year period spanning 2003 to 2018 suggested that the rate of infant mortality reduction was slow. This study also showed that maternal characteristics such as age and educational levels, as well as cultural practices like the use of clean water and toilet facilities, were statistically significant determinants of infant mortality in Nigeria with Pvalues < 0.05 across each of the survey years.

In 2021, Akanbi et al. conducted a study analyzing the influence of socioeconomic factors on teenage pregnancy in Nigeria. The study utilized the Theory of fertility as developed by Davis and Blake (1956) and later refined by Bongaarts (1978) to explain why teenage fertility remained high in Nigeria. Using data from the 2018 Nigeria Demographic and Health Survey (NDHS), the study examined how age, residence, education, marital status, religion, wealth status, and employment influenced teenage pregnancy. Findings from the work indicated that 19% of girls aged 15–19 years had experienced teenage pregnancy in Nigeria.

In 2016, ChaoYing Joanne Peng conducted a comprehensive study on logistic regression, published as a chapter in The BERA/SAGE Handbook of Educational Research. The study aimed to provide a detailed theoretical and applied perspective on logistic regression, emphasizing its use in education, social sciences, and epidemiology. Findings here highlighted that logistic regression was first introduced in the 1940s as an alternative to ordinary least squares (OLS) regression for handling dichotomous outcome variables. By the 1980s, it became widely available in statistical software packages and has since been extensively used in fields such as higher education, medical research, and behavioral sciences. The study also discussed the advantages of logistic regression over linear regression, particularly its ability to model categorical dependent variables without requiring strict statistical assumptions such as linearity, normality, or homoscedasticity. The author concluded that logistic regression remained a powerful and versatile statistical tool for analyzing binary and multinomial outcomes. However, researchers must adhere to best practices in model selection, reporting standards, and diagnostic analysis to ensure accurate and meaningful results. These findings provided valuable insights for statisticians, educators, and researchers using logistic regression in quantitative research (Peng, 2016).

In 2015, Sharif B. M. provided a comprehensive review of the severity of malaria infection during pregnancy, particularly in subSaharan Africa. The article highlighted the significant risks of malaria infection during pregnancy, including maternal anemia, placental parasitemia, low birth weight, and neonatal mortality. While the article provided valuable insights, there were gaps in the literature, including a limited focus on Nigeria, a need for more recent data, and a lack of discussion on prevention methods, healthcare system challenges, and the economic impact of malaria. Overall, the article emphasized the importance of preventing and treating malaria infection during pregnancy to reduce maternal and neonatal mortality.

From the reviewed literature, studies have investigated the relationship between malaria and miscarriage in various African countries but the specific context of Gombe State, Nigeria, has remains understudied. This could be due to differences in demographics, healthcare systems, and environmental factors. Furthermore, the current literature has not adequately captured the complexities of malaria and miscarriage relationships in Gombe State. Therefore, a comprehensive study is needed to fill this knowledge gap.

Problem Statement

Malaria is a significant health concern in Nigeria (WHO, 2023), and Gombe state is one of the regions with high malaria prevalence. Miscarriage is a common adverse pregnancy outcome in Nigeria, and Malaria infection was identified as a potential risk factor (WHO, 2023). However, the relationship between malaria and miscarriage while controlling for other factors in Gombe State, Nigeria has been understudied and not registered in the available literature. This knowledge gap has hindered the development of effective interventions and policies which might reduce the impact of malaria on pregnancy outcomes in the region, hence, the need for this study.

Aim/Objectives

This work aims to carryout logistics regression analysis on the impact of malaria and other factors on miscarriage in Gombe State, Nigeria. Descriptive Statistics, multi-collinearity test, logistic regression model parameter estimations and logistic regression model fitting, and test for Goodness of fit of the fitted model were employed as objectives to achieving the aim.

Significance of The Work

This study will significantly contribute to the knowledge of understanding the impact of malaria on maternal health in Gombe State. Findings from this study will also add to the available literature and provide valuable insights for policy makers and healthcare providers in prioritizing malaria prevention and treatment programs in Gombe State and by extension, to other localities of the State.

Hypothesis

$\boldsymbol{H_0}$**:** There is no significant relationship between malaria infection, demographic factors, or a combination of both, and the risk of miscarriage among pregnant women in Gombe State, Nigeria.

$\boldsymbol{H_1}$: There is a significant relationship between malaria infection, demographic factors, or a combination of both, and the risk of miscarriage among pregnant women in Gombe State, Nigeria.

Research Design
This study utilized a retrospective cohort design. This approach involved examining past records to identify a group of individuals (pregnant women) who were exposed to a particular factor (malaria infection) and comparing them to a group who were not exposed, to determine the association between the exposure and an outcome of interest (miscarriage).

Study Limitation
Data availability for the study was limited and so inference made in the work is based on results from the reporting period. Also, retrospective data collection was adopted.

Ethical Considerations
***Ethical approval*:** Ethical approval for this study was obtained from the Gombe State Ministry of Health, Health Research Ethics Committee, and the Institutional Review Board of the Gombe State Specialist Hospital.

MATERIALS AND METHODS

Study Population
The study population comprised all pregnant women admitted to the Gombe Specialist Hospital, Gombe State, Nigeria, during the last quarter of 2024 (October-December 2024).

Sampling Technique
Due to the retrospective nature of the study and the focus on a specific hospital, a convenience sampling technique was employed. This involved utilizing the readily available medical records of pregnant women who met the inclusion criteria (confirmed malaria diagnosis).

Sample Size
A total of 272 pregnant women records collected were used for the study.

Study Period
Data ranging from October to December 2024 was used in the study.

Data Collection Methods
Data Source: Data were collected from the archived medical records of pregnant women admitted to the Gombe Specialist Hospital during the specified period.

Data Extraction
A standardized data extraction form was developed to systematically collect relevant information from the medical records. This form ensured consistency and accuracy in data collection. The following variables were extracted:
Dependent Variable: Miscarriage (Yes/No)
Independent Variable: Malaria Infection Status (Yes/No)
Confounding Variables:
Maternal Age (Years)
Coexisting Health Conditions (Yes/No)
Gestational Age at Diagnosis of Malaria (Weeks)
Level of Education (Primary/Secondary/Tertiary)
Previous Pregnancy History **(**Yes/No)

Data Quality Control
To ensure data quality, the extracted data were double checked by a second researcher. Any discrepancies were resolved through discussion and cross referencing with the original medical records.

Soft wares Used: Statistical Package for Social Sciences (SPSS) version 24, and Microsft Excel 2016 were used for the analysis.

Data Analysis Techniques
The collected data were analyzed using the following statistical techniques:

Descriptive Statistics
Frequency distributions were used to describe the characteristics of the study population, including the prevalence of malaria infection and miscarriage.
Measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation) were calculated for continuous variables.

Logistic Regression Analysis
Logistic regression analysis was applied to test the relationship that may have existed between malaria infection and the occurrence of miscarriage while adjusting for confounding variables, including maternal age, level of education, and previous pregnancy history. Logistic regression, sometimes called the logistic model or logit model, analyzed the relationship between multiple independent variables and a categorical dependent variable and estimated the probability of occurrence of an event by fitting data to a logistic curve.
The logistic regression equation used in this work is:

$$P(X=1)=\frac{1}{1+\exp(-(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6))} \quad (1)$$

Where:
Dependent Variable:
$Y_1 = Miscarriage\ Status\ (0 = no\ miscarriage, 1 = miscarriage)$
Independent Variables:
$X_1 = Malaria\ Infection\ Status\ (0 = no\ infection, 1 = infection)$
$X_2 = Maternal\ age\ (in\ years)$
$X_3 = Coexisting\ health\ conditions\ (0 = no\ conditions, 1 = conditions\ present)$
$X_4 =$
$Gestational\ age\ at\ diagnosisof\ Malaria\ (in\ weeks)$
$X_5\ Level\ of\ Education\ (1 = primary, 2 = secondary, 3 = tertiary)$
$X_6 = Previous\ pregnancy\ history\ (0 = no\ previous\ pregnancy, 1 = previous\ pregnancy)$
$\beta's =$ regression parameters
The logistic regression model was used to estimate the odds ratio (OR) for miscarriage associated with malaria infection, along with its corresponding confidence intervals (CIs) and p-values. Multicollinearity among independent variables was assessed using the variance inflation factor (VIF) and correlation matrix. If multi-collinearity was detected, appropriate measures were taken, such as removing one of the highly correlated variables. Model fitness was evaluated using the Hosmer-Lemeshow goodness-of-fit test and ROC curve analysis.

RESULTS AND DISCUSSION

Presentation of Results
Results from data collection and findings are presented in the following tables and figures.

Table 1: Descriptive Statistics

		Occurrence of Miscarriage	Malaria	Maternal Age	Coexisting Health Condition	Gestational Age At Diagnosis of Malaria	Level of Education	Previous Pregnancy History
N	Valid	272	272	272	272	272	272	272
Missing		0	0	0	0	0	0	0
Mean		.26	.57	26.83	.39	17.77	1.93	.59
Median		.00	1.00	25.00	.00	18.00	2.00	1.00
Mode		0	1	25	0	20	2	1
Std. Deviation		.442	.495	6.672	.489	5.639	.710	.493
Range		1	1	31	1	32	3	1
Minimum		0	0	16	0	6	0	0
Maximum		1	1	47	1	38	3	1

Table 1 presents a description of the total number of samples collected. The range, minimum, maximum, mean and standard deviation of the variables

Table 2: Categorical Variables Coding

	Frequency		Parameter coding		
			(1)	(2)	(3)
Level of Education	Non Formal Education	16	.000	.000	.000
	Primary	31	1.000	.000	.000
	Secondary	182	.000	1.000	.000
	Tertiary	43	.000	.000	1.000
Previous Pregnancy History	No	112	.000		
	Yes	160	1.000		
Coexisting Health Condition	No	166	.000		
	Yes	106	1.000		
Malaria	No	116	.000		
	Yes	156	1.000		

The logistic regression model was evaluated using the following metrics

Table 3: Measurement of The Strength of Association

Step	2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	209.453[a]	.320	.467

The Nagelkerke R Square value of 0.467 indicates that the model explains approximately 47% of the variance in the occurrence of miscarriage.

Test of Goodness-of-fit of the Model
H_0: The model fits the data.
H_1: The model does not fit the data.

Level of Significance
5% level of significance

Decision Rule
Reject null hypothesis if p-value is less than level of significance, otherwise do not reject.

Table 4: The Goodness-Of-Fit of The Model

Hosmer and Lemeshow Test			
Step	**Chisquare**	**df**	**Sig.**
1	8.710	8	.367

The p-value of 0.367 (> 0.05) indicates that the model fits the data well

Table 5: Estimates of The Parameters

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	Malaria(1)	4.681	1.029	20.685	1	.000	107.932
	Maternal Age	.038	.035	1.148	1	.284	1.039
	Coexisting Health Condition(1)	.009	.414	.000	1	.983	1.009
	Gestational Age At Diagnosis of Malaria	.072	.033	4.789	1	.029	.930
	Level of Education			5.489	3	.139	
	Level of Education(1)	.677	.820	.681	1	.409	1.967
	Level of Education(2)	.176	.710	.061	1	.805	.839
	Level of Education(3)	.914	.799	1.309	1	.253	.401
	Previous Pregnancy History(1)	.992	.470	4.444	1	.035	.371
	Constant	3.898	1.591	6.005	1	.014	.020

Interpretation of Results

i. Malaria (1):
ii. B = 4.681: Positive coefficient, indicating that malaria infection increases the log odds of miscarriage.
iii. Exp(B) = 107.932: Women with malaria are 107.932 times more likely to experience miscarriage compared to women without malaria.
iv. Sig. = .000: Highly significant ($p < 0.05$), meaning malaria is a strong predictor of miscarriage.
v. Maternal Age:
vi. B = 0.038: Slightly positive coefficient, suggesting a small increase in the log odds of miscarriage with increasing maternal age.
vii. Exp(B) = 1.039: For every one year increase in maternal age, the odds of miscarriage increase by 3.9%.
viii. Sig. = .284: Not significant ($p > 0.05$), meaning maternal age does not significantly predict miscarriage.
ix. Coexisting Health Condition (1):
x. B = 0.009: Very small positive coefficient, indicating a negligible effect on the log odds of miscarriage.
xi. Exp(B) = 1.009: Women with coexisting health conditions are 1.009 times more likely to experience miscarriage compared to those without such conditions.
xii. Sig. = .983: Not significant ($p > 0.05$), meaning coexisting health conditions do not significantly predict miscarriage.
xiii. Gestational Age at Diagnosis of Malaria:
xiv. B = 0.072: Negative coefficient, indicating that a later gestational age at diagnosis reduces the log odds of miscarriage.
xv. Exp(B) = 0.930: For every one-week increase in gestational age at diagnosis, the odds of miscarriage decrease by 7% (1 0.930 = 0.07).
xvi. Sig. = .029: Significant ($p < 0.05$), meaning gestational age at diagnosis is a significant predictor of miscarriage.
xvii. Level of Education:
xviii. Overall Sig. = .139: Not significant ($p > 0.05$), meaning level of education, as a whole, does not significantly predict miscarriage.
xix. Level of Education (1): Women with primary education are 1.967 times more likely to experience miscarriage compared to those with non-formal education (not significant, p = .409).
xx. Level of Education (2): Women with secondary education are 0.839 times less likely (or 16.1% less likely) to experience miscarriage compared to those with non-formal education (not significant, p = .805).
xxi. Level of Education (3): Women with tertiary education are 0.401 times less likely (or 59.9% less likely) to experience miscarriage compared to those with non-formal education (not significant, p = .253).
xxii. Previous Pregnancy History (1):
xxiii. B = 0.992: Negative coefficient, indicating that a history of previous pregnancies reduces the log odds of miscarriage.
xxiv. Exp(B) = 0.371: Women with a history of previous pregnancies are 0.371 times less likely (or 62.9% less likely) to experience miscarriage compared to those without such a history.
xxv. Sig. = .035: Significant ($p < 0.05$), meaning previous pregnancy history is a significant predictor of miscarriage.
xxvi. Constant:
xxvii. B = 3.898: The log odds of miscarriage when all predictor variables are zero.

Exp(B) = 0.020: The baseline odds of miscarriage are very low (2%).

Discussion of Findings

The study found that malaria infection is the most significant predictor of miscarriage among pregnant women in Gombe State, Nigeria. The extremely high odds ratio for malaria infection suggests a strong association.

Maternal age and coexisting health conditions were not significant predictors of miscarriage in this study. However, the direction of their effects (negative for maternal age and positive for coexisting health conditions) is consistent with existing literature (Eleje et al., 2023).

Gestational age at diagnosis of malaria was marginally significant, suggesting that early diagnosis and treatment of malaria may reduce the risk of miscarriage. This finding underscores the importance of timely antenatal care and malaria prevention strategies for pregnant women.

Level of education was not a significant predictor of miscarriage, but the higher odds of miscarriage among women with primary education compared to those with non-formal education may reflect disparities in access to healthcare and health literacy.

Finally, previous pregnancy history was a significant predictor of miscarriage, indicating that women with a history of previous pregnancies may be less likely to experience miscarriage.

In conclusion, the study provides valuable insights into the factors associated with miscarriage among pregnant women in Gombe State, Nigeria. The findings emphasize the importance of malaria prevention and treatment, timely antenatal care, and targeted interventions for high-risk groups.

CONCLUSION

The study concludes that malaria infection is a major risk factor for miscarriage among pregnant women in Gombe State, Nigeria. The findings highlight the devastating impact of malaria on maternal health and pregnancy outcomes particularly in regions with high malaria prevalence. Other factors such as maternal age, coexisting health conditions and level of education were not found not to be statistically significant which aligns with existing literature. The marginally significant effect of gestational age at diagnosis of malaria underscores the importance of early detection and treatment in reducing the risk of miscarriage.

REFERENCES

Akanbi, M. A., Ope, B. W., Adeloye, D. O., Amoo, E. O., Iruonagbe, T. C., & Omojola, O. (2021). Influence of socioeconomic factors on the prevalence of teenage pregnancy in Nigeria. *African Journal of Reproductive Health,* 25(5s), 138–146. https://doi.org/10.29063/ajrh2021/v25i5s.13

Alaka, S. A., Oshinubu, K., Fasakin, I., & Akintande, O. J. (2022). Factors associated with psychological impact of Coronavirus disease 2019 (Covid19) outbreak in Nigeria: Regression based approach. *Journal of Mathematics and Computer Science,* 12, 119. https://doi.org/10.28919/jmcs/7015

Eke, D. O., & Ewere, F. (2022). Level, trends, and determinants of infant mortality in Nigeria: An analysis using the logistic regression model. *Earthline Journal of Mathematical Sciences*, 8(1), 17–40. https://doi.org/10.34198/ejms.8122.1740

Eleje, G. U., Ugwu, E. O., Igbodike, E. P., Malachy, D. E., Nwankwo, E. U., Ugboaja, J. O., Ikechebelu, J. I., & Nwagha, U. I. (2023). Prevalence and associated factors of recurrent pregnancy loss in Nigeria according to different national and international criteria (ASRM/ESHRE vs. WHO/RCOG). *Frontiers in Reproductive Health*, 5, 1049711. https://doi.org/10.3389/frph.2023.1049711

James, T. O., Onwuka, G. I., & Bello, U. (2023). Binary logistic regression analysis on risk factors associated with hepatitis B disease in Gusau Local Government Zamfara State, Nigeria. *International Journal of Science for Global Sustainability*, 9(3), 79-84. https://doi.org/10.57233/ijsgs.v9i3.531

Isiko, I., Nyegenye, S., Bett, D. K., Asingwire, J. M., Okoro, L. N., Emeribe, N. A., Koech, C. C., Ahgu, O., Bulus, N. G., Taremwa, K., & Mwesigwa, A. (2024). Factors associated with the risk of malaria among children: Analysis of 2021 Nigeria Malaria Indicator Survey. *Malaria Journal*, https://doi.org/10.1186/s12936024049396

Peng, C.Y. J. (2016). Logistic regression. In D. Wyse, E. Smith, L. E. Suter, & N. Selwyn (Eds.), *The BERA/SAGE Handbook of Educational Research*, (Chapter 46). SAGE Publications.

SharifiMood, B. (2015). Malaria in pregnant women. *International Journal of Infectious Diseases*, 2(3), e22992. https://doi.org/10.17795/iji22992

World Health Organization. (2022). *World malaria report 2022*. https://www.who.int/newsroom/factsheets/detail/malaria

World Health Organization. (2023). *World malaria report 2023*. https://www.who.int/newsroom/factsheets/detail/malaria