



WALLAGA UNIVERSITY
INSTITUTE OF HEALTH SCIENCE
MEDICAL SCIENCE ACADEMIC AND SERVICE
DIRECTORATE

ADVERSE FETAL AND NEONATAL OUTCOMES AND
ASSOCIATED FACTORS AMONG MALARIA INFECTED
PARTURIENTS AT WALLAGA UNIVERSITY COMPREHENSIVE
SPECIALIZED HOSPITAL, NEKEMTE, ETHIOPIA: A CROSS-
SECTIONAL STUDY

BY: Dr. DINAOL ALEMU (MD, OB/GYN RESIDENT)

APRIL, 2026

NEKEMTE, ETHIOPIA



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**A THEISIS SUBMITTED TO INSTITUTE OF HEALTH SCIENCES,
DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, MEDICAL
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APPROVAL SHEET FOR SUBMITTING THE THESIS

As members of the examining the Thesis defense, we certify that we have read and evaluated the Final thesis performed by: **Dr. Dinaol Alemu under the title “Adverse Fetal and Neonatal Outcomes and Associated Factors among Malaria Infected Parturients at Wallaga University Comprehensive Specialized Hospital, Nekemte, Ethiopia: A Retrospective study”**

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STATEMENT OF AUTHOR

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ACRONYMS AND ABBREVIATIONS

AICU	Adult Intensive Care Unit
ANC	Antenatal Care
CMHS	College of Medicine and Health Sciences
IUFD	Intrauterine Fetal Death
LBW	Low Birth Weight
NICU	Neonatal Intensive Care Unit
OB/GYN	Obstetrics and Gynecology
WHO	World Health Organization
WUCSH	Wallaga University Comprehensive Specialized Hospital

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ABSTRACT

Background: Parturient with malaria infection are at increased risk of developing severe clinical manifestations, which may ultimately result in adverse fetal outcomes. Despite this, there is limited evidence on the extent of these adverse outcomes among pregnant women in general, and no study has been conducted in the specific study area to address this gap.

Objective: This study was aimed to assess the adverse fetal and neonatal outcomes and associated factors among malaria infected parturients at Wallaga University Comprehensive Specialized Hospital from March 10, 2024 to March 9, 2025.

Methods: An institutional-based retrospective cross-sectional study was conducted among malaria-infected parturients. All medical records of parturients diagnosed with malaria at Wallaga University Comprehensive Specialized Hospital from March 10, 2024, to March 9, 2025, were reviewed. Data were collected using a semi-structured checklist developed from relevant literature. Data entry and analysis were performed using Microsoft Excel and SPSS version 27, respectively. Bi-variable and multivariable logistic regression analyses were conducted to assess the association between independent variables and the outcome variable. Variables with a p-value < 0.05 were considered statistically significant, and the strength of association was determined using adjusted odds ratios with 95% confidence intervals.

Results: Prevalence of overall adverse fetal and neonatal outcomes was 37.27% (95 C.I; 32.0%-42.9%). Residing in rural area (AOR=4.97; 95% CI, 1.92-12.90), being primigravida (AOR=5.41; 95% CI, 1.95-15.05), having moderate anemia (AOR=3.25; 95% CI, 1.46-7.25), having severe anemia (AOR=4.89; 95% CI, 1.95-12.29) and having less than four ANC contact (AOR=5.70; 95% CI, 2.56-12.72) were significantly associated with adverse fetal and neonatal outcome.

Conclusion: Nearly four in ten fetuses and newborns in this study experienced adverse outcomes, highlighting a significant public health challenge. The risk is highest for mothers who are living in rural areas, experiencing their first pregnancy, or struggling with moderate to severe anemia. Crucially, failing to complete at least four ANC contact is a major predictor of poor outcomes, suggesting that increasing the frequency and accessibility of prenatal care, especially in rural settings, is vital for improving neonatal health. . To improve fetal and neonatal health, healthcare systems must prioritize rural outreach, ensure mothers complete at least four antenatal contact, and provide targeted support for anemia and first-time pregnancies.

Keywords: Adverse fetal outcomes, malaria, parturient, Wallaga University Comprehensive Specialized Hospital

1. INTRODUCTION

1.1. Background

Malaria is a vector-borne tropical and sub-tropical disease which is caused by parasites and transmitted through the bite of female *Anopheles* mosquitoes (1). The disease is attributed to infection by *Plasmodium* parasites. There are five known species of genus *Plasmodium* to cause malaria among humans which include *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale*, and *Plasmodium knowlesi* (2, 3), among which *Plasmodium falciparum* is the most deadliest human malaria and the most prevalent in sub-Saharan Africa (4, 5).

These *Plasmodium* parasites undergo a complex life cycle both in vertebrate hosts and a mosquito vector. Their reproduction mechanisms involve both sexual and asexual reproduction, making development of drugs and vaccines more challenging (6). Malaria infection starts with the inoculation of a small number of sporozoites by female *Anopheles*' mosquito and within an hour, the parasites will move to the liver (7).

Pregnant mothers are highly susceptible to malaria infection and they are more likely to experience severe manifestations as compared to non-pregnant women (8). Report from World Health Organization (WHO) indicates that up to 32% of pregnant mothers suffer from malaria infection in zone African countries in 2021 (9). This heightened vulnerability might be attributable to genetics and socio-demographic factors (10, 11), pregnancy-related hormonal, immunological and nutritional changes (12). Although the clinical manifestations of malaria may vary across individuals, fever of irregular type, sense of chilliness, shivering, headaches, muscle pains, nausea, vomiting, fatigue, and dizziness are among the most common (13, 14).

Studies conducted in Sub-Saharan African countries showed that pregnant mothers are affected by malaria with prevalence range of 7.7% to 41.6% (15-18). Additionally, studies were conducted among pregnant women in different parts of Ethiopia and findings reveal the prevalence ranging from 16.3% to 28.3% (19-21). However, there is a dearth of evidence indicating the adverse fetal outcomes of malaria among pregnant mother in general and there was no study conducted particularly in Ethiopia, to the effort of investigator's search. Therefore, this study will provide information regarding overall outcome of malaria among mothers who visited WUCSH.

1.2.Statement of the problem

Reports from World Health Organization (WHO) estimates reveal that malaria led to 219 million cases in malaria-endemic areas by 2017 (22) and it was increased to 247 cases by 2021(23). Malaria in pregnancy is an important public health problem that affects more than 25 million pregnant women who give birth in malaria-endemic areas each year (24). World Health Organization (WHO) estimate from 38 moderate-to-high transmission African countries show that 32% of all pregnant women were infected by malaria in 2021 (9). Additionally, studies reveal that pregnant women develop placental malaria with the prevalence range of 26–28% (25, 26).

Pregnancy-associated malaria (PAM) imposes adverse consequences to the fetus and newborns (27, 28). Additionally, the parasites have tendency to attach themselves to placental intervillous spaces (29, 30), which contributes to placental insufficiency (31-34). Consequently, this may induce intrauterine growth restriction (IUGR), low birth weight (LBW), stillbirth, preterm birth (PTB) and infant anemia (24, 35, 36). This makes PAM the significant contributor to infant mortality, being responsible for approximately 200,000 annual infant deaths (26).

Despite continuous efforts to control and eradicate, malaria remains a significant burden on pregnant women and their infants, particularly in sub-Saharan Africa, (37, 38). Contributing factors to this challenge include poverty and limited access to healthcare (39), poor maternal nutritional status (40), inadequacy of vector control measures (41) and low compliance to WHO treatment recommendations (42-44)

In attempt of tackling this issue, various ways of effective malaria control and intervention programs have been recommended(45). For instance, the WHO 2023 treatment guidelines of malaria artemether-lumefantrine (AL) is recommended as a treatment option for uncomplicated *Plasmodium falciparum* malaria during the first trimester, while at least 24 hours of parenteral artesunate therapy, followed by a 3-days oral treatment with artemisinin-based combination for three days is recommended in severe malaria for all demographic categories, including pregnant women (46). During the last two decades, malaria-endemic sub-Saharan countries including Ethiopia took up various interventions for effective malaria control. These include vector control,

prophylactic chemotherapy, introduction of rapid diagnostic tests at community level and case management (47, 48).

1.3. Significance of the study

This study is significant as it provides crucial localized evidence on the burden of malaria in pregnancy and its devastating fetal and neonatal outcomes at Wallaga University Comprehensive Specialized Hospital in Nekemte, Ethiopia. Despite ongoing malaria control efforts, the disease remains a significant public health challenge, particularly among pregnant women in resource-constrained settings.

By identifying specific risk factors, such as socioeconomic status, antenatal care contact, and insecticide treated bed net usage, the research will inform targeted interventions and strengthen existing maternal and child health programs, especially given the persistent challenge of malaria despite control efforts.

The findings will provide actionable data for hospital staff, regional health authorities, and policy makers to improve clinical management, allocate resources effectively, and refine prevention strategies to ultimately reduce preventable adverse outcomes like still births, low birth weight, and neonatal mortality.

Furthermore, this research contributes to the academic and public health community by filling a gap in local data and offering a baseline for future longitudinal studies to enhance malaria control and accelerate progress towards broader health goals in resource constrained settings.

2. LITERATURE REVIEW

2.1. Overview

Related to different factors, pregnant women are at an increased risk to develop malaria and copious studies are available to reveal the magnitude of malarial infection during pregnancy. Though some studies conducted in malaria-endemic areas indicate association between malarial infection and adverse pregnancy outcomes, there is scarce of comprehensive finding specifically addressing fetal adverse outcomes in the context of Sub-Saharan Africa and particularly no study is available in Ethiopia to the attempt of investigators search.

2.2. Adverse fetal and neonatal outcomes among parturient with malaria infection

A meta-analysis study which included 31 studies shows 17.4% prevalence of LBW, 17.9% of pre-term delivery and 16.1 % of small for gestational age (49). A report from another meta-analysis study of 32 African countries show that malaria infection was responsible for up to 11% of LBW-related infant mortality (50)

The study nested in a randomized, prospective, clinical trial in six countries (Democratic Republic of the Congo [DRC], Kenya, Zambia, Guatemala, Pakistan, and India) between March 23, 2016 and April 11, 2019 shows that overall prevalence for preterm birth, LBW and perinatal mortality to be 19.6%, 17.2% and 6.8%, respectively (51).

An institutional-based, cross-sectional study conducted among 350 pregnant mothers in Tanzania show that 32% of pregnant mothers with malaria give low birth weight (52).

A prospective cohort study conducted among 1451 pregnant women in Guinea reveals 14.0% of low birth weight and 8.4% of preterm delivery among mothers with placental malaria (53).

An institutional-based cross-sectional study conducted among 300 pregnant women in Nigeria shows that 19.7% of low birth weight and 11% of pre-term delivery (54).

A retrospective study of eleven years among 825 pregnant women in Columbia shows that malaria is associated with 12.8% of abortion, 2.9% of fetal death, 3.6% of stillbirth, 7.1% of low birth weight (55).

A parity-matched comparative cohort study conducted among 3063 mothers in three teaching hospitals of Cameroon reveals that 13.8% had premature delivery, 21.8% of LBW, 4.95% of IUGR, 2.97% of IUFD and 15.6% with Apgar score <7 (56).

A retrospective study was conducted among 12600 pregnant women in India. Findings from the study show that out of pregnant mothers with malaria, 17% with fetal miscarriage, 22% with preterm delivery, 29.26% with LBW and 2.4% with perinatal death (57).

A cross-sectional study conducted among 387 women in Nigeria shows that 52.6% of study participants have adverse fetal outcomes (58).

The pooled prevalence of adverse fetal outcomes from systematic Review of 22 studies in Ethiopia was shown to be was 28% (59)

A finding from a facility-based cross-sectional study employed among 538 mothers with premature rupture of the membrane in Amhara regional state specialized hospitals reveals that 33.1% of them have experienced Adverse fetal birth outcomes (60).

A comparative cross-sectional study was conducted at Awi Zone public hospitals among 788 (260 induced and 528 spontaneous) women reported that adverse neonatal outcomes among women who gave birth through induced labor were 41.1%, whereas spontaneous labor was 10.3% (61).

A community-based retrospective cross-sectional study among 1068 women within child-bearing age at Fafan zone of Somali region, Ethiopia showed that 51.9.0% of women fall under category of adverse fetal outcomes (62).

2.3. Factors associated with adverse fetal and neonatal outcomes among parturient with malaria infection

There is evidence that there is heightened possibility of having malaria infection and developing clinically significant severity of disease among pregnant women than non-pregnant women. This may be attributable to the natural, immunologic and hormonal changes occurring during pregnancy (36). Pregnant women are particularly vulnerable to malaria due to a combination of factors (63-65).

Studies reveal different group of factors to be associated with severity of disease and outcome of malaria among pregnant mothers. These include a decreased immunity to malaria, which permits higher levels of parasitemia, and the sequestration of parasites in the placenta (66). Specific socio-economic and cultural factors may also exacerbate exposure or hinder access to preventive strategies (67-69). Another study also supports this idea as poverty and limited access to healthcare, further influence the severity and management of malaria during pregnancy (39).

Other study also suggest that maternal nutrition is one of the main factors influencing fetal growth in developing countries (70). As well, a recent study has suggested a higher risk of FGR due to malaria in undernourished women (40).

Study conducted in Gambia shows that the severest form of placental parasitization occurred in a higher proportion of the primigravidae than in the multi-gravidae (71). This is supported by another study that indicates significant association of severe malaria infection with primigravida (52). Additionally, nulli-parous pregnant women and primiparous women, are also a vulnerable group to manifest severe manifestations and encounter unfavorable outcomes (24).

Finally, chemoprevention with sulfadoxine-pyrimethamine strategy is getting interesting attention in sub-Saharan Africa as it showed significant reduction in low birthweight and perinatal mortality among pregnant women who took at least three doses of IPTp during pregnancy (41,72,73).

2.4. Conceptual Frame-Work

Factors associated with adverse fetal and neonatal outcomes among parturient with malaria infection include: socio-demographic, obstetric conditions and clinical factors

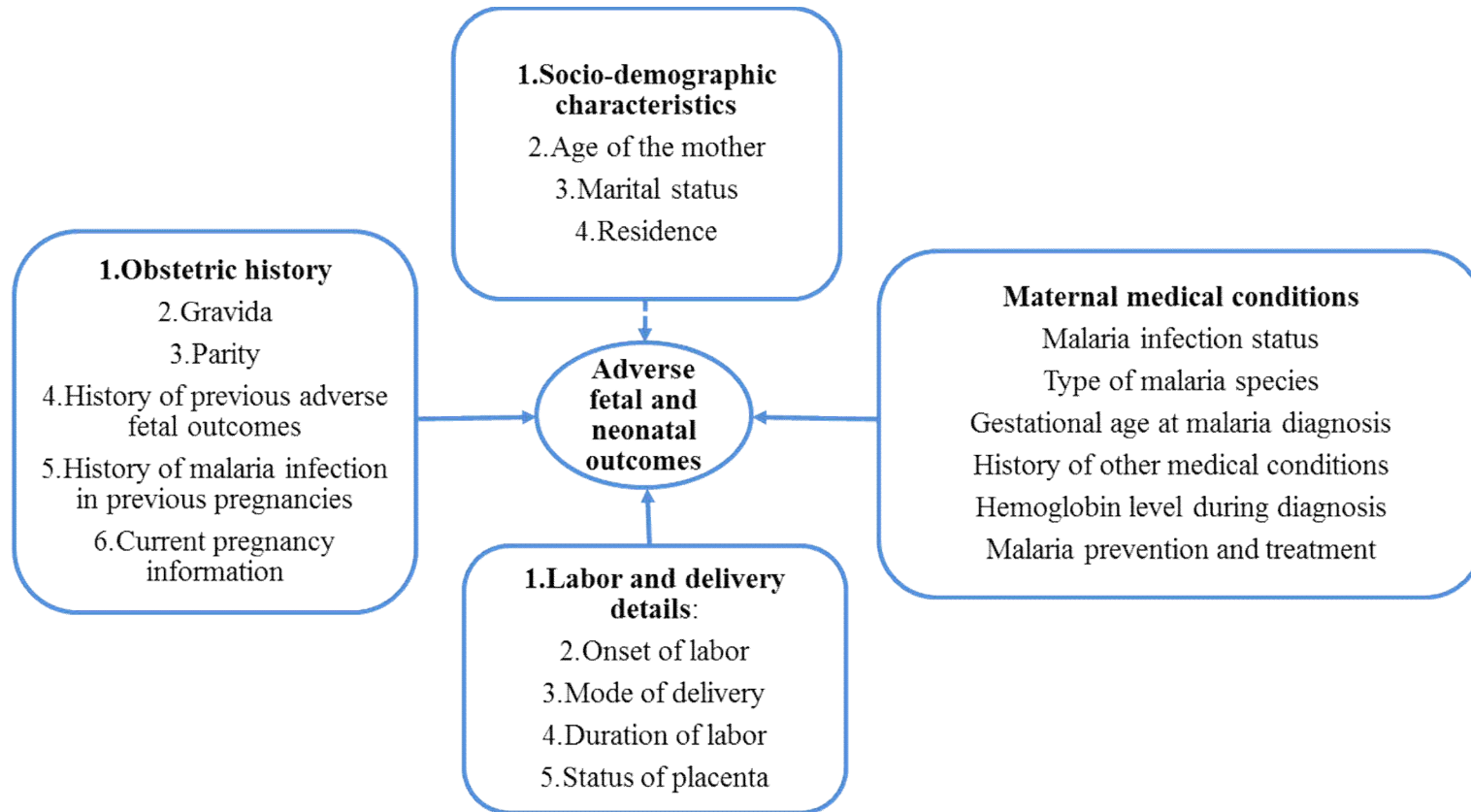


Figure 1: Conceptual frame-work for possible factors associated with adverse fetal and neonatal outcomes among parturient with malaria infection constructed from different literatures by investigator (39, 40, 49, 51, 52).

3. OBJECTIVES

3.1. General objective

To assess adverse fetal and neonatal outcomes and associated factors among malaria infected parturients at Wallaga University Comprehensive Specialized Hospital from March 10, 2024 to March 9, 2025.

3.2. Specific objectives

To determine the magnitude of adverse fetal and neonatal outcomes among malaria infected parturients at Wallaga University Comprehensive Specialized Hospital from March 10, 2024 to March 9, 2025.

To identify factors associated with adverse fetal and neonatal outcomes among malaria infected parturients at Wallaga University Comprehensive Specialized Hospital from March 10, 2024 to March 9, 2025.

4. MATERIALS AND METHODS

4.1 Study area and Period

Wallaga University Comprehensive Specialized Hospital is one of the teaching hospitals in western Ethiopia. It is located in Nekemte town, approximately 331 km from the capital city, Addis Ababa. The hospital serves as a practical training center for medical and health science students while also providing preventive and curative healthcare services to a catchment population of over five million people.

The hospital offers a wide range of services, including both inpatient and outpatient medical care. It also functions as a referral center for surrounding hospitals in the western part of the country.

In addition, the hospital provides specialized services such as adult Intensive Care Unit (AICU), Neonatal Intensive Care Unit (NICU), and dialysis services. It has a total of 250 beds, of which 44 are allocated to the postpartum and maternity ward.

At the Department of Obstetrics and Gynecology, services include preconception care, antenatal care (ANC), delivery services, and postpartum follow-up. The department is staffed by 8 senior obstetricians and gynecologists (including 3 subspecialists), 15 OB/GYN residents, and 35 midwives, and on average there are 3,355 births per year according to data from hospital management information system.

The Medical records of malaria infected parturient presented from March 10, 2024 to March 9, 2025 was reviewed during a period of March 10, 2025 to April 8 2026.

4.2. Study design

An Institutional-based Cross-Sectional Study was employed.

4.3. Population

4.3.1. Source Population

Medical records of all parturients who attend the Wallaga University Comprehensive Specialized Hospital for ANC, Medical OPD, Delivery, Or post-natal services.

4.3.2. Study population

Medical records of malaria infected parturient diagnosed at Wallaga University Comprehensive Specialized Hospital from March 10, 2024 to March 9, 2025

4.4. Eligibility criteria

4.4.1. Inclusion

All Medical records of Malaria infected parturients diagnosed at Wallaga University Comprehensive Specialized Hospital from March 10, 2024 to March 9, 2025 were included.

4.4.2. Exclusion

Those Medical records with incomplete record (absence of major variable like diagnosis, outcome) was excluded from the study.

4.5. Sample Size Determination

The sample size was determined by single proportion assumption and considering the 95% confidence level;

$$n = \frac{(z_{\alpha/2})^2 p(1-p)}{d^2} = \frac{(1.96)^2 * 0.197 * (0.803)}{0.05^2} = 243$$

Where, **n**= sample size

p= proportion of malaria infection outcome (LBW) from a study conducted in Nigeria (which is 19.7%) (42).

z= Is the standard normal value at level of confidence 95% confidence level

d=desired margin of error (5%)

By considering 10% of incomplete and missing charts which is 25, the final sample size was **268**. This is the minimal required sample size; however investigator is capable to review all medical charts during the one-year period, even if it is more than the calculated sample size. This may maximize the representativeness of the sample.

4.6. Sampling procedure

Medical record numbers (MRNs) from the wards' admission registers and Delivery logbook at Labor ward, Operation theatre, and Maternity ward was used to locate and retrieve medical records of all admissions and deliveries between March 10, 2024 to March 9, 2025. Then, the information was extracted from the patients' medical records using Microsoft Excel.

4.7. Variables

4.7.1. Dependent Variables

Adverse fetal and neonatal outcomes of malaria infection

4.7.2 Independent Variables

Socio-demographic characteristics (age, residence), clinical factors (gravidity, parity, co-morbid medical illness, previous adverse fetal outcomes, maternal nutritional status, Type of treatment, Type of malaria species, Gestational age at malaria diagnosis, Hemoglobin level at diagnosis, Malaria prevention method, Onset of labor, Mode of delivery)

4.8. Operational definitions

Maternal anemia refers to Hemoglobin concentration less than 11.0 g/dL in the third trimesters (74).

Preterm delivery is defined as babies born alive before 37 completed weeks of estimated gestational age (75).

Stillbirth is defined as a death of fetus occurring at or greater than 28 weeks gestation or a birth weight ≥ 1000 grams (76).

Low birth weight has been defined as weight at birth of a baby which is <2500 grams (77)

Low fifth minutes Apgar score is 5th minutes apgar score of <7 (78).

Small for Gestational Age: Birth weight below the 10th percentile of a gender-specific reference for gestational age (79).

Adverse fetal and neonatal outcomes: Cases with one or more of the following: still birth, preterm birth, low birth weight, small for gestational age, congenital anomalies, low 5th minutes APGAR Score, NICU admission (74-79).

Incomplete medical record: A record without birth weight, without APGAR score, and without newborn evaluation.

Comorbid medical condition: The presence of one or more non-malaria illnesses (such as diabetes mellitus, asthma, or chronic hypertension) occurring in the same patient.

NICU admission: refers to any newborn with a recorded medical chart who is formally admitted to the Neonatal Intensive Care Unit for the management of medical conditions requiring advanced care.

4.9. Data collection procedure

Data were collected using a semi-structured questionnaire. Relevant information was extracted from the medical records (charts) of pregnant women diagnosed with malaria. Data collectors reviewed the charts and recorded the required variables accordingly. After completion of data collection, all medical records were returned to the card room properly.

4.10. Data collection methods

4.10.1. Data collection instruments

Data was collected by using a checklist developed from different literatures (31, 40, 47, 48, 49, 51, 52). This checklist includes socio-demographic characteristics, obstetric and clinical factors of study participants and adverse fetal outcomes.

4.10.2. Data collectors and supervisors

Data collection was conducted by three trained BSc midwives, while one General Practitioner supervised the overall data collection process.

4.11. Data quality control

Training was given for data collectors and supervisor by investigator for one day. The training included discussion on the objectives of the study, the contents of the questionnaire, procedures, data collection techniques and ethical issues. Every day after data collection, questionnaires were reviewed and checked for completeness by the supervisor. Pilot study was conducted among 27 (10%) of study population at Nekemte comprehensive specialized Hospital Two weeks prior to actual data collection to check

for checklist reliability. Modifications were taken accordingly. Double data entry was done by two data clerks to minimize errors during data entry. Inconsistencies were checked and appropriate corrections taken.

4.12. Data Processing and Analysis

The collected data was coded and entered in to Microsoft Excel and sent to SPSS version 27 for analysis. Bivariate analysis was employed to identify the explanatory variables having association with the outcome variable and independent factors with p-value < 0.25 was qualified for the final model. On a multi-variable logistic regression model, the presence and strength of association was measured by adjusted odd ratio (95% CI). P-value < 0.05 was considered as statistically significant for all the independent variables in the final model. Model fitness was checked by using the Hosmer and Lemeshow test and the assumption was fulfilled (as the p-value was > 0.05). Multicollinearity was checked for the overall model by the variance inflation factor (VIF) and VIF were < 10 for all independent variables

4.13. Ethical consideration

Research Ethics Committee of Institute of Health Sciences at Wallaga University approved the protocols and ethical clearance was issued (Ref.No REC/ 031/202). An official support letter was written from the College of Medicine and Health Sciences of Wallaga University and submitted to WUCSH. Subsequently, a permission letter was obtained from the head of the hospital. During data collection for the sake of privacy and confidentiality, personal identifiers such as names, address and any private information was collected. Data was handled confidentially during all phases of research activities by using anonymous medical registration numbers as identifiers.

4.14. Dissemination of results

The result will be submitted to Wallaga University, College of Medicine and Health Sciences, School of Medicine as requirement for fulfillment of graduate study. The findings will be distributed in hard copy for WUCSH. Finally, it will be presented on conferences and published on reputable journals.

5. RESULTS

5.1. Socio-demographic characteristics of study participants

Out of 3594 total deliveries during one-year period, 279 were identified as they have malaria infection. Eight medical records with incomplete records were excluded. A total of 271 pregnant women with malaria infection were included in the final analysis. The mean age ($\pm$ standard deviation) of study samples is 22.85 ($\pm$ 4.541) years. Out of 271 study samples, n=154 (56.8%) were found in the age group between 20 and 28years; all (100%) of them were married and n=222 (81.9%) were rural residents (Table 1).

Table 1: Socio-demographic and economic characteristics of malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

Variable	Category	Frequency	Percent
Age category in years	<20	80	29.5
	20-28	154	56.8
	$\geq$ 29	37	13.7
Residence	Urban	49	18.1
	Rural	222	81.9

5.2. Obstetric characteristics of study participants.

Out of 271 samples, n=127 (46.9%) of them are primigravida; n=245 (90.4%) of them have no previous adverse outcome and n=197 (72.7%) of them have no more than four ANC contact (Table 2).

Table 2: Obstetric characteristics of malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

Variable	Category	Frequency	Percent
Gravida	Primigravida	127	46.9
	Multigravida (II-IV)	99	36.5
	Grand -multigravida ($\geq$ V)	45	16.6
Previous adverse outcome	No	245	90.4
	Yes	26	9.6
ANC contact	No	6	2.2
	1-4	197	72.7

	≥ 5	74	27.3
GA at time of malaria	≥ 37 weeks	151	55.7
diagnosis	< 37 weeks	120	44.3

5.3. Maternal medical conditions of study participants.

Among 271 study samples, n= 120 (44.3%) of them were diagnosed before completed 37 weeks of gestation; n=15 (5.5%) of them have co-morbid medical condition; n=41(15.1%) have severe anemia; n=49 (18.1%) of them have used insecticide treated nets; n=193 (71.2%) were infected by plasmodium falciparum species and n=124 have been given Artemether-Lumefantrine for the treatment of malaria (Table 3).

Table 3: Maternal medical conditions of malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

Variable	Category	Frequency	Percent
Co-morbid medical condition	Absent	256	94.5
	Present	15	5.5
Hemoglobin status	Normal (≥ 11 g/dl)	154	56.8
	Mild anemia(10.0-10.9 g/dl)	30	11.1
	Moderate anemia(7.0-9,9g/dl)	46	17.0
	Severe anemia(< 7.0 g/dL)	41	15.1
Use of insecticide treated net	No	222	81.9
	Yes	49	18.1
Malaria species	Plasmodium Falciparum	193	71.2
	Plasmodium Vivax	78	28.8
Type of drug given	Artesunate	93	34.3
	Artemether-Lumefantrine	124	45.8
	Artesunate & Artemether-Lumefantrine	54	19.9

5.4 .Onset of labor of study participants

Among 271 study samples, 231 (85.2%) of them had spontaneous onset of delivery (Figure 2).

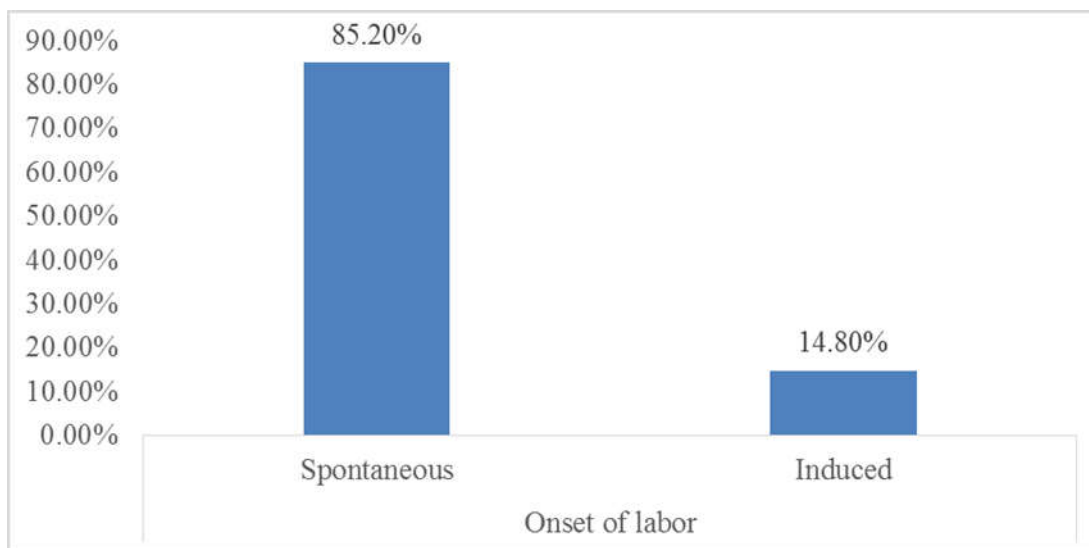


Figure 2: Labor related factors of malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

5.5. Modes of Delivery among study participants

Among 271 study samples, 216 (79.7%) of them gave birth with vaginal delivery (Figure 3)

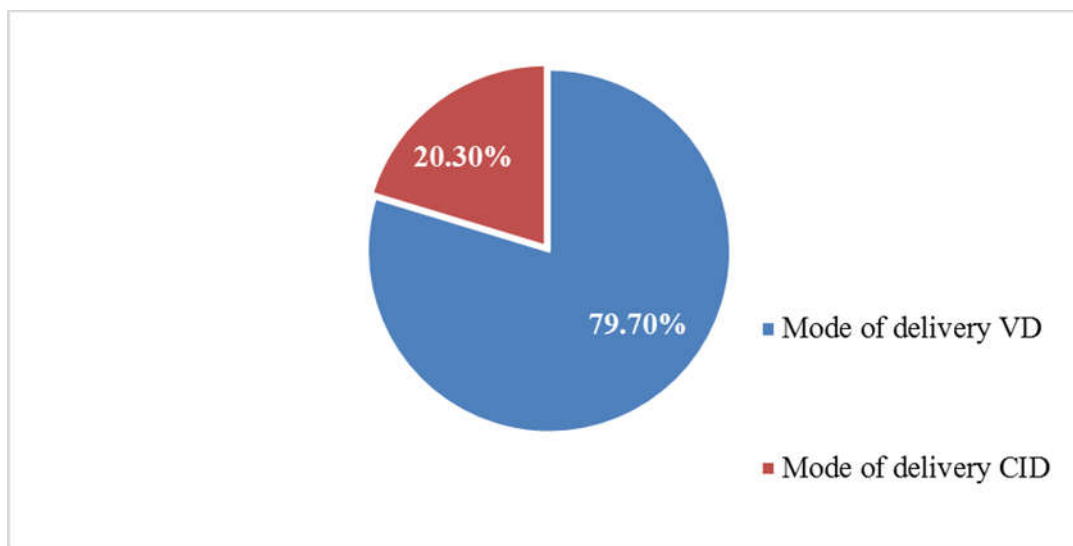


Figure 3: Delivery details of malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

5.6 Adverse fetal outcomes among study participants

Among the total of 271 samples, 37.27% (95 C.I; 32.0%-42.9%) of them gave birth to newborns with adverse fetal outcome. Low birth weight was the most commonly encountered adverse fetal outcome (Figure 3).

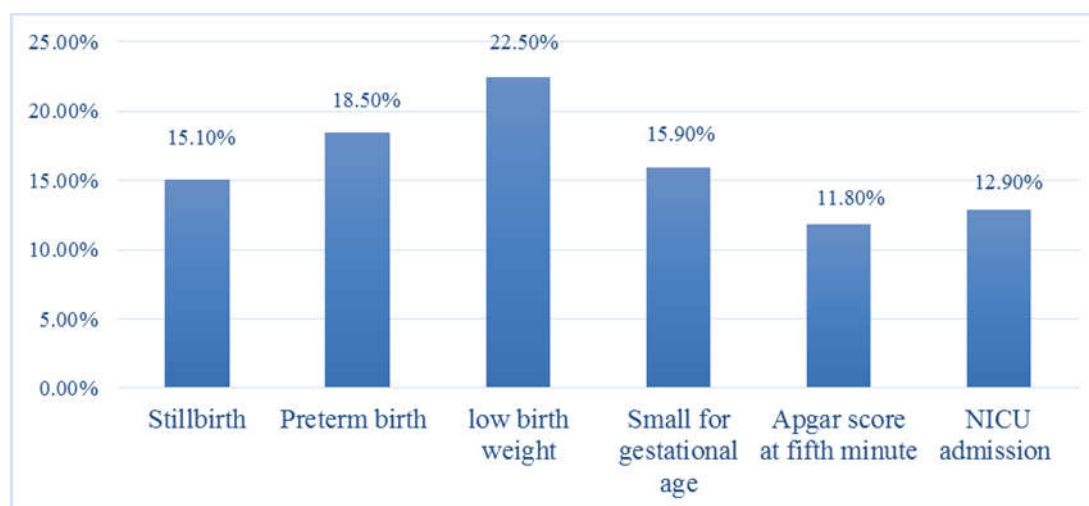


Figure 4: Adverse fetal outcomes of malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

5.7. Factors associated with adverse fetal and neonatal outcomes among study participants

On bivariable logistic regression analysis, 10 variables namely residence, gravidity, previous adverse outcome, ANC attendance, gestational age at time of malaria diagnosis, co-morbid medical condition, hemoglobin status, use of insecticide treated net, onset of labor and type of malaria treatment given were significantly associated with Adverse fetal outcomes with 95% confidence interval and p-value<0.25.

These variables were taken to multivariable logistic regression analysis and finally variables including residence, gravidity, number of ANC contact and hemoglobin status were significantly associated with Adverse fetal and neonatal outcomes with p-value<0.05.

Regarding residence, odds of experiencing Adverse fetal and neonatal outcome were 4.97 times higher among those living at rural area as compared to their counterparts (AOR=4.97; 95% CI, 1.92-12.90), keeping the effect of other variables constant.

With regard to gravidity, odds of experiencing Adverse fetal and neonatal outcome were 5.41 times higher among Primigravida samples as compared to Grand-multigravidas (AOR=5.41; 95% CI, 1.95-15.05). Multigravida samples have 3.82 times higher odds of experiencing Adverse fetal and neonatal outcome compared to Grand-multigravidas (AOR=3.82; 95% CI, 1.34, 10.85), keeping other variables constant.

The odds of experiencing Adverse fetal and neonatal outcome were 3.25 times higher among samples with moderate anemia as compared to those with normal hemoglobin status (AOR=3.25; 95% CI, 1.46-7.25) and individuals having severe anemia have 4.89 times higher odds of experiencing Adverse fetal and neonatal outcome as compared to those with normal hemoglobin status (AOR=4.89; 95% CI, 1.95-12.29), keeping other variables constant.

With regard to ANC attendance, study samples with no more than four ANC contact have 5.70 times higher odds of experiencing Adverse fetal and neonatal outcome compared to their counterparts (AOR=5.70; 95% CI, 2.56-12.72), keeping other variables constant.

Table 4: Bi-variable logistic regression analysis of factors associated with Adverse fetal and neonatal outcomes among malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

Variable	Category	AFO		COR (95% C.I.)	p-value
		Yes	No		
Residence	Rural	128	94	4.41 (1.90, 10.24)	.00
	Urban	42	7	1	
Gravidity	Primigravida	69	58	3.36 (1.50, 7.56)	.00
	Multigravida	65	34	2.09 (0.90, 4.85)	
	Grand –multigravida	36	9	1	
Previous adverse fetal outcome	Yes	12	14	2.12 (0.94, 4.78)	.07
	No	158	87	1	
ANC contact	≤4	108	89	4.26 (2.16, 8.39)	.00
	≥5	62	12	1	
GA at time of malaria diagnosis	≤37wks	61	59	2.51 (1.52, 4.16)	.00
	≥37wks	109	42	1	
Co-morbid medical condition	Present	5	10	3.63 (1.20, 10.93)	.02
	Absent	165	91	1	
Hemoglobin status	Mild anemia(10.0-10.9 g/dl)	19	11	1.83 (0.80, 4.20)	.15
	Moderate anemia(7.0-9,9g/dl)	21	25	3.76 (1.89, 7.49)	
	Severe anemia(< 7.0 g/dL)	13	28	6.81 (3.20, 14.48)	

	Normal(≥ 11 g/dl)	117	37	1		
Use of insecticide treated net	No	133	89	2.06 (1.02, 4.17)		.04
	Yes	37	12	1		
Onset of labor	Induced	22	18	1.46 (0.74, 2.88)		.23
	Spontaneous	148	83	1		
Type of malaria treatment given	Artesunate	54	39	1.57 (0.90, 2.76)		.11
	Artesunate & Artemether-	31	23	1.62 (0.84, 3.13)		.15
	Lumefantrine					
	Artemether-Lumefantrine	85	39	1		

NB: AFO: Adverse fetal outcomes; COR: crude odds ratio; AOR: Adjusted odds ratio; CI: Confidence interval GA: Gestational age

Table 5: Multi-variable logistic regression analysis of factors associated with Adverse fetal and neonatal outcomes among malaria infected parturient at Wallaga University Comprehensive Specialized Hospital, 2025 (n=271)

Variable	Category	AFO		AOR (95% C.I.)	p-value
		Yes	No		
Residence	Rural	128	94	4.97 (1.92, 12.90)	.00
	Urban	42	7	1	
Gravidity	Primigravida	69	58	5.41 (1.95, 15.05)	.00
	Multigravida	65	34	3.82 (1.34, 10.85)	.01
	Grand –multigravida	36	9	1	.01

Previous adverse fetal outcome	Yes	12	14	2.37 (0.82, 6.83)	.11
	No	158	87	1	
ANC contact	≤4	108	89	5.70 (2.56, 12.72)	.00
	≥5	62	12	1	
GA at time of malaria diagnosis	≤37wks	61	59	1.70 (0.88, 3.25)	.11
	≥37wks	109	42	1	
Co-morbid medical condition	Present	5	10	3.58 (0.93, 13.78)	.06
	Absent	165	91	1	
Hemoglobin status	Mild anemia(10.0-10.9 g/dl)	19	11	1.25 (0.48, 3.31)	.65
	Moderate anemia(7.0-9.9g/dl)	21	25	3.25 (1.46, 7.25)	.00
	Severe anemia(< 7.0 g/dL)	13	28	4.89 (1.95, 12.29)	.00
	Normal(≥11g/dl)	117	37	1	.00
Use of insecticide treated net	No	133	89	2.01(0.82, 4.91)	.13
	Yes	37	12	1	
Onset of labor	Induced	22	18	1.70 (0.73, 3.96)	.22
	Spontaneous	148	83	1	
Type of malaria treatment given	Artesunate	54	39	1.99 (0.96, 4.14)	.07
	Artesunate & Artemether-Lumefantrine	31	23	1.60 (0.67, 3.81)	.29
	Artemether-Lumefantrine	85	39	1	.

6. DISCUSSION

Overall, this study aimed to determine the prevalence and identify associated factors of adverse fetal and neonatal outcomes of malaria-infected parturient at Wallaga University Comprehensive Specialized Hospital. The study found that 37.27% (95 C.I; 32.0%-42.9%) of them delivered newborns with adverse fetal outcomes. This finding was in line with study conducted in Tanzania, 32% (52), Amhara region, 33.1% (60) and Awi Zone, 41.1%,(61).

However, the finding is lower than the studies conducted in Somali region of Ethiopia, 51.9.0% (62) and Nigeria, 52.6% (58). The possible explanations for this variation might be socio-cultural variations, study setups, higher sample size used by these studies, difference of inclusion criteria and study population.

On the other hand, this finding is higher than the studies conducted in Guinea (53), Nigeria (54), Columbia (55), Cameroon (56) and India (57) which shows the prevalence of 14.0%, 19.7%, 12.8%, 21.8% and 29.26%, respectively. The possible explanation for this discrepancy might be socio-cultural variations, study setups, study designs, difference in sample size, inclusion criteria and study population.

With regard to associated factors, malaria-infected mothers those living at rural area have about five-times higher odds of experiencing Adverse fetal outcomes as compared to urban resident mothers. This agrees with study conducted in china (80), Brazil (81), Canada (82), Wag Himra Zone (83), and Arba Minch (84). The possible explanation for this association is that rural resident mothers have lower socioeconomic status, limited access to healthcare and they are less likely to have awareness of the warning signs and potential complications related to pregnancy, labor, and childbirth (85). Moreover, rural cultural norms may play a major role in shaping women's nutritional health through the restriction of vital dietary items (86).

Primigravida and multigravida samples have higher odds of experiencing Adverse fetal outcomes when compared to Grand-multigravidas. The finding is consistent with study conducted in Tanzania (87), Gambia (71) and Systematic Review of studies Sub-Saharan Africa (24). This could be explained by the fact that first-time pregnant women lack prior immunity. As the number of pregnancies increases, women gradually acquire protective immunity, making them less susceptible due to improved inflammatory response and

reduced parasitemia (88). It implies that exposure during pregnancy leads to the development of variant-specific immune responses (89).

It is evident from the current study that pregnant mothers with anemia had more than three-folds odds of facing adverse fetal outcomes as compared to their counterparts. This finding was coincident with previous studies conducted in Bangladesh (90) and Canada (91). This may be attributable to the fact that anemia reduces the blood's oxygen-carrying capacity and hinders delivery of essential nutrient supplementation to the placenta for the developing fetus. This may lead to hypoxia and oxidative stress, which potentially increase the risk of premature rupture of membranes, low birth weight and preterm birth (92, 93)

In the current study, women with no more than four ANC contacts have nearly six-folds higher odds of experiencing Adverse fetal outcome compared to their counterparts. This was in line with the studies conducted in Wag Himra Zone (83) and Southern Ethiopia (94). This association may be because antenatal care (ANC) provides an opportunity for the early identification and management of pregnancy-related complications (95). Additionally, it enables women to obtain information related to pregnancy danger signs, prepare for childbirth, and decide on a suitable place of delivery. Furthermore, Women those attending prenatal care are more likely to be assisted by skilled birth attendants, thereby ensuring their newborns receive essential newborn care and, when necessary, neonatal resuscitation (85).

7. LIMITATIONS

This study provides preliminary finding of prevalence and associated factors of adverse fetal outcomes of malaria-infected parturient at Wallaga University Comprehensive Specialized Hospital. However, since the study relied on chart review, the selection of variables was depended on the limited available data. Related to its cross-sectional nature, it was also unable to establish a causal relationship between variables.

8. CONCLUSION

Nearly four of ten malaria-infected parturient at Wallaga University Comprehensive Specialized Hospital face adverse fetal outcomes. This study identified several significant factors associated with adverse fetal outcomes including residence, gravidity, ANC attendance and hemoglobin status.

8.1. Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. For Health Professionals

Healthcare providers should intensify efforts to improve antenatal care (ANC) utilization among pregnant women. In addition, special attention should be given to primigravida women, as they are at higher risk of adverse outcomes.

2. For WUCSH, East wollega Zonal Health Department

Health institutions and relevant stakeholders should strengthen malaria prevention and control strategies. This includes ensuring close monitoring and timely intervention for pregnant women diagnosed with malaria, in order to reduce associated maternal and fetal complications.

3. For Future Researchers

Further research using longitudinal study designs is recommended to establish causal relationships between malaria infection and fetal adverse outcomes. Future studies should also prospectively incorporate socio-demographic and clinical variables, using direct interviews with study participants to improve data quality and comprehensiveness.

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10. APPENDICES

Questionnaire

Code _____

Part 1: Socio-demographic characteristics

I. Patient information:

1. Medical record number (MRN)-----
2. Age of the mother (in years)--
3. Marital status (A. Married B. Divorced C. Widowed D. Single)
4. Residence (urban/rural)

II. Obstetric history:

5. Gravida---
6. Parity--
7. History of previous adverse fetal outcomes (e.g., Stillbirth, Preterm birth, LBW, ENND, RPL)
8. History of malaria infection in previous pregnancies

III. Current pregnancy information:

9. ANC attendance status (Yes, No ANC), if yes number of ANC Contact---

IV. Maternal medical conditions:

10. Malaria infection status (diagnosis confirmed? Yes/No)
11. Type of malaria species (PF, PV, or Mixed)
12. Gestational age at malaria diagnosis
13. History of other medical conditions (e.g., HIV status, Hypertension, Anemia, DM, Asthma, Cardiac disease, Renal disease, Syphilis, Liver disease)
14. MUAC in Cm--
15. Hemoglobin level during diagnosis
16. Malaria prevention and treatment: (Awareness, Bite prevention, Chemoprophylaxis:- Doxycycline, Chloroquine, Primaquine Malarone, Mefloquine).
17. Use of insecticide-treated bed nets (ITN) during pregnancy (yes/no)
18. Receipt of intermittent preventive treatment in pregnancy (IPTp) with Sulfadoxine-pyrimethamine (SP) (doses received)
19. Antimalarial drug treatment regimen provided (Artemether-Lumefantrine, Artesunate, Artemeter, Chloroquine, Primaquine).

IV. Labor and delivery details:

- 20. Onset of labor (Spontaneous/Induced)
- 21. Mode of delivery (Vaginal Delivery, Cesarean Delivery, Operative Vaginal Delivery, Destructive Vaginal Delivery)
- 22. Duration of labor (In hours)---
- 23. Status of placenta (normal/abnormal findings)----

Part 2: Adverse fetal and neonatal outcomes

I. Fetal outcome details:

- 24. Stillbirth (yes/no)
- 25. If yes, time of fetal demise (before or during labor), Grade of maceration(Grade 1, Grade 2, Grade 3.
- 26. Preterm birth (delivery before 37 weeks gestation) (yes/no)
- 27. If yes, gestational age at delivery
- 28. Low birth weight (LBW) (yes/no)
- 29. If yes, actual birth weight (in grams)
- 30. Small for gestational age (SGA) (yes/no)
- 31. Congenital anomaly (yes/no)

II. Newborn assessment:

- 32. Apgar score at First and Fifth minutes
- 33. Signs of congenital malaria (yes/no)
- 34. Admission to neonatal intensive care unit (NICU) (yes/no)
- 35. Neonatal death (death within 28 days of birth) (yes/no)