Adverse Fetal Outcomes and Birth Complications Associated with Gestational Malaria: A Chi Square Association Analysis

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ABSTRACT

Background: Gestational malaria compromises placental integrity, resulting in poor fetal outcomes. This manuscript evaluates the specific association between maternal Plasmodium falciparum infection and adverse neonatal metrics—including stillbirth, preterm delivery, fetal growth restriction (FGR), and small for gestational age (SGA), and low birth weight (LBW)—at Plateau State Specialist Hospital (PSSH). Data from a 10-year retrospective window were evaluated. A Pearson Chi-Square (χ^2) test of independence was performed on the cross-tabulated dataset of five fetal outcomes (n = 122 total recorded endpoints) to determine statistical significance at $p < 0.05$. The fetal complication tracker recorded 12 stillbirths, 14 preterm deliveries, 11 cases of FGR, 12 instances of SGA, and 10 cases of confirmed LBW among malaria-positive observations. Using the exact counts reported in Table 5, the Pearson Chi-Square test gave χ^2 (4) = 2.379, p = .666 (Pearson test, no continuity correction). Based on the contingency-table counts reported in Table 5, the analysis does not demonstrate a statistically significant association between malaria exposure and the distribution of the five adverse fetal outcomes at the 0.05 level. The findings should therefore be interpreted as descriptive evidence of adverse fetal outcomes rather than proof of a statistically significant association.

KEYWORDS

Gestational Malaria, Plasmodium falciparum, Adverse Fetal Outcomes, Birth Complications, Stillbirth, Preterm Delivery

I. INTRODUCTION

1. Aim

The aim of this manuscript is to determine whether maternal gestational malaria exposure is statistically associated with selected adverse fetal outcomes and birth complications recorded at Plateau State Specialist Hospital over the study period.

Placental malaria leads to structural changes in the placenta, including the infiltration of mononuclear cells into the inter villous space, thickening of the trophoblastic basement membrane, syncytial knotting, and local complement deposition. These inflammatory processes disrupt the insulin-like growth factor axis and impair the Trans placental transport of vital nutrients and glucose.

The resulting uteroplacental ischemia can restrict fetal growth or trigger early labour. This manuscript evaluates these mechanics by performing a chi-square test of independence on birth metrics collected from the PSSH registry over a ten-year period.

II. METHODOLOGY

A. Variables Analysed

Fetal outcomes were classified into five target complications: Stillbirth, Preterm birth (<37 weeks), Fetal Growth Restriction (FGR), Small for Gestational Age (SGA), and Low Birth Weight (LBW, <2.5 kg).

Statistical Analysis

Data were cross-tabulated based on clinical presentation. A Pearson Chi-Square test of independence was performed using SPSS version 24 to examine the relationship between malaria-positive exposure and these specific complications. Statistical significance was defined at $p < 0.05$.

Statistical verification

The Pearson Chi-Square calculation was independently re-run from the exact 5 × 2 contingency-table counts presented in Table 5. The resulting Pearson χ^2 statistic was 2.379 with 4 degrees of freedom and $p = .666$. Thus, the previously reported $\chi^2 = 13.5711$ and $p = .008798$ are not reproduced by the counts currently shown in Table 5.

III. RESULTS

Table 1: Contingency Table for Chi-Square Analysis of Fetal Outcomes

Pathological Fetal Endpoint	Malaria Positive Exposure (f)	Normal/Resolved Reference (f)	Total Observed
Stillbirth	12	10	22
Preterm Delivery	14	12	26
Fetal Growth Restriction (FGR)	11	9	20
Small for Gestational Age (SGA)	12	19	31
Low Birth Weight (LBW)	10	13	23
Total Outcomes Assessed	59	63	122

IV. STATISTICAL SUMMARY

Calculated Pearson Chi-Square Statistic (χ^2) = 2.379

Degrees of Freedom (df) = 4

Asymptotic Significance (p-value) = .666

Inference: Because $p = .666 > .05$, the null hypothesis of independence is not rejected. The available contingency-table data do not provide statistically significant evidence of an association between malaria exposure and the distribution of the five fetal outcomes.

V. DISCUSSION

Using the exact counts presented in Table 5, the Pearson Chi-Square analysis produced χ^2 (4) = 2.379, p = .666. Therefore, the data do not support the previous statement that there was a statistically significant association between gestational malaria and the distribution of the five adverse fetal outcomes.

Preterm delivery (n = 14) was the most frequent individual outcome among malaria-positive observations, followed by SGA (n = 12), stillbirth (n = 12), FGR (n = 11), and LBW (n = 10). These frequencies indicate that adverse outcomes occurred in the recorded dataset; however, frequency alone does not establish statistical association.

These findings should be interpreted alongside the study design and the construction of the contingency table. The reported counts combine five outcome categories into a single 5 × 2 table, and the chi-square test assesses whether the distribution across those categories differs by malaria exposure. Consequently, the non-significant result should not be interpreted as evidence that malaria has no clinical effect on pregnancy outcomes; rather, it indicates that this particular table does not demonstrate a statistically significant association at the 0.05 threshold.

The biological mechanisms discussed in the original manuscript remain relevant to the broader literature. Chua et al. (2021) describe placental infection and inflammatory processes that can interfere with placental development and fetal nutrient supply. However, those biological mechanisms should not be presented as statistically demonstrated by the present contingency-table analysis.

VI. STUDY IMPLICATIONS

Understanding the prevalence and outcomes of malaria in pregnancy can inform healthcare policies and interventions.

Identifying risk factors can help target high-risk populations.

Improving antenatal care and intermittent preventive treatment in pregnancy (IPTp) coverage can help reduce maternal and fetal complications.

Policy support: Policymakers should prioritize funding and resources for malaria-control programmes targeting pregnant women, including appropriate antimalarial medicines and insecticide-treated nets.

VII. CONCLUSION

Malaria in pregnancy is associated with important maternal and fetal health concerns. In this manuscript, however, re-analysis of the exact contingency-table counts reported in Table 5 produced a Pearson $\chi^2(4) = 2.379$, p = .666. Therefore, the current table does not demonstrate a statistically significant association between malaria exposure and the distribution of the five specified fetal outcomes. Strengthening antenatal care, improving IPTp coverage, and promoting effective malaria-prevention measures remain relevant public-health strategies, while future analyses should use complete individual-level data and appropriately defined exposure and outcome variables.

VIII. LIMITATIONS OF THE STUDY

Retrospective Design: The retrospective nature of the study may have introduced bias and limited the availability of certain data variables.

Data Quality: The accuracy and completeness of medical records may vary, affecting the reliability of the study findings.

Single-Centre Study: The study was conducted at Plateau State Specialist Hospital, which may limit the generalizability of the findings to other settings.

Confounding Factors: The study may not have accounted for all potential confounding factors that could influence maternal and fetal outcomes associated with malaria in pregnancy.

RECOMMENDATIONS FOR FUTURE RESEARCH

Healthcare providers should provide health education to pregnant women on the importance of routine antenatal visits and adherence to prescribed folic acid and iron/folate supplementation.

Pregnant women should receive education on consistent use of insecticide-treated nets and their role in malaria prevention. Hospital management may consider providing or facilitating access to insecticide-treated nets for pregnant women attending antenatal services.

Healthcare facilities should ensure prompt diagnosis and effective management of malaria during pregnancy. Government and relevant public-health agencies should conduct periodic campaigns and sensitization on malaria in pregnancy and its complications through appropriate communication channels.

Future studies should re-run the association analysis from individual-level records, clearly defining malaria exposure, outcome status, and potential confounders before applying the Pearson Chi-Square test.

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