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Placental Morphometry and Newborn Outcomes in Pregnant Women Infected with Malaria

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ABSTRACT
Malaria during pregnancy is a serious health problem that can negatively affect both the mother and the fetus. Malaria infection in pregnant women can disrupt the supply of nutrients and oxygen to the fetus, potentially resulting in low birth weight. This condition is caused by changes in the infected placenta, which affect the transfer of essential nutrients to the fetus. This study aimed to analyze the effect of malaria during pregnancy on placental morphometry and newborn outcomes at Sentani Primary Health Care Center, Jayapura Regency. This study employed an observational analytic method with a cross-sectional design and was conducted over a period of three months. Sampling was carried out using purposive sampling. The study population consisted of pregnant women in labor who were infected with malaria or had a history of malaria infection during the second and third trimesters of pregnancy. The sample included 30 women in labor (15 pregnant women with malaria and 15 normal pregnant women), whose placental morphometry and newborn outcomes were measured. The statistical analysis used was the Chi-square test. The results showed that malaria during pregnancy had a significant effect on placental size in newborns (p-value = 0.023) and on newborn birth weight (p-value = 0.035), while no significant effect was found on newborn body length (p-value = 0.243). In conclusion, placental size in pregnancies complicated by malaria was smaller than in normal pregnancies, and malaria infection during pregnancy affected placental morphometry and newborn birth weight at Sentani Primary Health Care Center, Jayapura Regency.

Keywords: Malaria Infection, Placental Morphometry, Newborn, Pregnant Women.

ABSTRAK
Malaria selama kehamilan merupakan masalah kesehatan yang serius dan dapat berdampak negatif pada ibu serta janin. Infeksi malaria pada ibu hamil dapat mengganggu suplai nutrisi dan oksigen ke janin yang berpotensi mengakibatkan kelahiran bayi dengan berat badan rendah. Hal ini disebabkan oleh perubahan pada plasenta yang terinfeksi, yang berdampak pada transfer zat gizi penting ke janin. Penelitian ini bertujuan untuk menganalisis pengaruh ibu hamil dengan malaria terhadap morfometri plasenta dan outcome bayi baru lahir di Puskesmas Sentani Kabupaten Jayapura. Penelitian ini menggunakan metode Analitik Observasional dengan desain cross sectional, penelitian dilaksanakan selama 3 bulan, Pengambilan sampel secara purposive sampling. Populasi dalam penelitian ini adalah ibu hamil inpartu yang mengalami infeksi malaria atau pernah terinfeksi malaria pada saat kehamilan trimester II dan III. Sampel dalam penelitian ini sebanyak 30 ibu inpartu (15 ibu hamil dengan malaria dan 15 ibu hamil normal) yang kemudian diukur morfometri plasenta dan outcome bayi baru lahir. Uji statistik yang digunakan adalah Uji Chi-square. Hasil penelitian didapatkan ada pengaruh kehamilan dengan malaria terhadap ukuran plasenta bayi baru lahir (p-value 0,023), ada pengaruh kehamilan dengan malaria terhadap berat badan bayi baru lahir (p-value 0,035) dan tidak ada pengaruh kehamilan dengan malaria terhadap panjang Panjang badan bayi baru lahir (p-value 0,243). Kesimpulannya, ukuran plasenta pada kehamilan dengan malaria lebih kecil dari pada ukuran plasenta dengan Kehamilan normal, ada pengaruh morfometri plasenta dan berat bayi baru lahir pada ibu hamil yang terinfeksi malaria di Puskesmas Sentani Kabupaten Jayapura.

Kata Kunci: Infeksi Malaria, Morfometri Plasenta, Bayi Baru Lahir, Ibu Hamil.

INTRODUCTION

Malaria is a disease caused by Plasmodium parasites and is transmitted through the bite of an infected female Anopheles mosquito (Shaw, Marcenac, & Catteruccia, 2022; Yu et al., 2022; Arora et al., 2023; Islam, Dhar, & Rahman, 2023; Alshamrni et al., 2024). Following the mosquito bite, the parasite enters the human body, resides in the liver, and subsequently infects red blood cells (Zakama et al., 2020). Malaria infection can affect individuals of all ages, including pregnant women and neonates (Lawford et al., 2021; Gaoussou et al., 2022; Obeagu, & Obeagu, 2024; Satapathy et al., 2024). Pregnant women represent a particularly vulnerable group because malaria infection during pregnancy poses serious risks not only to maternal health but also to fetal and neonatal outcomes (Purwatiningsih et al., 2022).

In Indonesia, the prevalence of malaria among pregnant women in 15 provinces remains above the national average, with most of these provinces located in Eastern Indonesia. Five provinces report the highest incidence and prevalence rates, namely Papua (28.6%), East Nusa Tenggara (23.3%), West Papua (18.4%), Central Sulawesi (12.5%), and Maluku (10.7%) (Badan Penelitian dan Pengembangan Kesehatan, 2018). Plasmodium falciparum is the most virulent malaria parasite and continues to be a major public health problem in Indonesia. Malaria infection is most commonly found among women experiencing their first pregnancy (primigravida), as immunity tends to decrease during pregnancy, particularly in the first gestation, posing significant risks to both the mother and the developing fetus. This adverse interaction occurs primarily through placental involvement (Zakama, Ozarslan, & Gaw, 2020).

Comprehensive placental examination, including morphometric measurements, is essential to support health care providers in identifying pregnancy-related complications. Simple measurements such as placental weight are easy to perform, highly accurate, and useful for assessing the relationship between pregnancy conditions and potential fetal abnormalities (Febiani, Suwiyoga, & Sanjaya, 2019). Local data from Sentani Primary Health Care Center, Jayapura Regency, showed that the number of pregnant women infected with malaria was 31 cases in 2020, 28 cases in 2021, and increased to 46 cases in 2022. Malaria during pregnancy can lead to various maternal and fetal complications, one of the most common being maternal anemia.

Pregnancy complicated by anemia may disrupt placental function, as the placenta plays a crucial role in the excretion and transportation of nutrients and oxygen from the mother to the fetus. Maternal anemia can reduce placental efficiency, thereby impairing fetal growth and development in utero. Placental structure serves as an important indicator of the intrauterine environment, and placental morphometry reflects placental development and function, which directly influences fetal condition throughout pregnancy (Reis et al., 2020).

Previous studies have demonstrated a strong association between malaria infection during pregnancy and adverse birth outcomes. A study conducted by Purwatiningsih et al. (2022) reported that P. falciparum infection increased the risk of low birth weight (LBW) by 11 times (OR 11.5; 95% CI 4.23–31.66; p-value < 0.05). Additionally, primigravida women had a 3–4 times higher risk of delivering LBW infants compared to multigravida women (OR 3.6; 95% CI 1.42–9.17; p-value < 0.05). The study concluded that malaria infection during pregnancy significantly increases the risk of LBW compared to pregnancies without malaria (Purwatiningsih et al., 2022).

Despite the established relationship between malaria infection and adverse neonatal outcomes, existing studies have predominantly focused on birth weight outcomes, with limited attention given to placental morphometric parameters as intermediary mechanisms. Moreover, although malaria cases among pregnant women at Sentani Primary Health Care Center remain high, placental morphometric measurements have never been routinely conducted during childbirth assistance. This indicates a significant research gap in understanding how malaria infection affects placental morphology and how these changes subsequently influence newborn outcomes at the local level.

Therefore, the novelty of this study lies in its comprehensive assessment of placental morphometry alongside newborn outcomes in pregnant women infected with malaria, particularly in a high-endemic area such as Sentani, Jayapura Regency. This study aims to analyze the effect of malaria infection during pregnancy on placental morphometry and newborn outcomes at Sentani Primary Health Care Center, Jayapura Regency, thereby providing evidence-based

insights to support more effective prevention and management strategies for malaria in pregnancy.

RESEARCH METHODS

This study employed an observational analytic method with a cross-sectional design. The study was conducted to examine the relationship between women in labor who were currently infected with malaria or had a history of malaria infection during the second and third trimesters of pregnancy and placental morphometry as well as newborn anthropometric outcomes at Sentani Primary Health Care Center.

The study was carried out at Sentani Primary Health Care Center, Jayapura Regency, from June to September 2024. Sampling was performed using a purposive sampling technique. The study population consisted of women in labor who were infected with malaria or had a history of malaria infection during the second and third trimesters of pregnancy. Exclusion criteria included women with preeclampsia, post-term pregnancy (serotinus), or chronic diseases. The sample size comprised 30 women in labor, consisting of 15 pregnant women with malaria and 15 normal pregnant women. Placental morphometric measurements and newborn outcomes were assessed for all participants.

Data collection involved both primary and secondary data. Primary data were obtained through direct measurement of placental morphometry and newborn birth weight. Secondary data were collected from maternal and child health (MCH/KIA) books, respondents' medical records, the profile of the Jayapura Regency Health Office, and relevant literature. Data were recorded using an observation checklist completed directly by the researcher. Statistical analysis was conducted using the Chi-square test to determine the relationship between malaria infection during pregnancy and placental morphometry as well as newborn outcomes.

RESULTS

Table 1. Mean Placental Morphometric Values in Malaria-Complicated and Normal Pregnancies.

Placental Morphometry	Mean	
	Malaria-Complicated Pregnancy	Normal Pregnancy
Placental weight (g)	446	512
Placental diameter (cm)	13.6	15.2
Placental thickness (cm)	2.1	2.4
Umbilical cord length (cm)	54.6	55.86
Total respondents (n)	15	15

Table 1 presents the mean values of placental morphometry in pregnancies complicated by malaria and in normal pregnancies. The mean placental weight in the malaria group was 446 g, which was lower than that observed in normal pregnancies (512 g). Similarly, the mean placental diameter in the malaria group was 13.6 cm, compared to 15.2 cm in the normal pregnancy group. The average placental thickness was also smaller in pregnancies with malaria (2.1 cm) than in normal pregnancies (2.4 cm). In addition, the mean umbilical cord length was slightly shorter in the malaria group (54.6 cm) compared with the normal pregnancy group (55.86 cm). Each group consisted of 15 respondents. Overall, these findings indicate that placental morphometric parameters tended to be lower in pregnancies affected by malaria compared to normal pregnancies.

Table 2. Effect of Malaria During Pregnancy on Placental Morphometry.

Placental Morphometry	Category	Malaria Pregnancy	Normal Pregnancy	Total	p-value
		n (%)	n (%)	n (%)	
Placental weight	≥ 470 g	6 (20.0)	13 (43.3)	19 (63.3)	0.023
	< 470 g	9 (30.0)	2 (6.7)	11 (36.7)	
Umbilical cord length	55–60 cm	13 (43.3)	12 (40.0)	25 (83.3)	1.000
	< 55 cm	2 (6.7)	3 (10.0)	5 (16.7)	
Total		15 (50.0)	15 (50.0)	30 (100)	

Table 2 illustrates the effect of malaria during pregnancy on placental morphometry. Normal placental weight (≥470 g) was observed in 19 respondents, of whom 13 were from normal pregnancies and 6 from pregnancies complicated by malaria. In contrast, placental weight <470 g was found in 11 respondents, the majority of whom were from the malaria group (n = 9), while only 2 were from the normal pregnancy group. The Chi-square test showed a statistically significant association between malaria during pregnancy and placental weight (p-value = 0.023), indicating that malaria infection significantly affects placental weight in newborns.

Regarding umbilical cord length, normal length (55–60 cm) was observed in 25 respondents, including 13 from the malaria group and 12 from the normal pregnancy group. Umbilical cord length <55 cm was found in 5 respondents, comprising 3 from normal pregnancies and 2 from malaria-complicated pregnancies. The Chi-square analysis revealed a p-value of 1.000, indicating no significant association between malaria during pregnancy and umbilical cord length in newborns.

Table 3. Effect of Malaria Infection During Pregnancy on Newborn Outcomes.

Newborn Outcome	Category	Malaria Pregnancy	Normal Pregnancy	Total	p-value
		n (%)	n (%)	n (%)	
Birth weight	≥ 2500 g	8 (26.7)	14 (46.6)	22 (73.3)	0.035
	< 2500 g	7 (23.3)	1 (3.3)	8 (26.7)	
Birth length	≥ 48 cm	8 (26.7)	12 (40.0)	20 (66.7)	0.245
	< 48 cm	7 (23.3)	3 (10.0)	10 (33.3)	
Total		15 (50.0)	15 (50.0)	30 (100)	

Table 3 shows the effect of malaria infection during pregnancy on newborn outcomes. Normal birth weight (≥2500 g) was observed in 22 newborns, of whom 14 were born to mothers with normal pregnancies and 8 to mothers with malaria. Low birth weight (<2500 g) was found in 8 newborns, the majority of whom were born to mothers with malaria (n = 7), while only 1 case occurred in the normal pregnancy group. The Chi-square test demonstrated a statistically significant association between malaria during pregnancy and newborn birth weight (p-value = 0.035), indicating that malaria infection increases the risk of low birth weight.

In terms of birth length, normal length (≥48 cm) was observed in 20 newborns, including 12 from normal pregnancies and 8 from malaria-complicated pregnancies. Short birth length (<48 cm) was found in 10 newborns, with a higher proportion in the malaria group (n = 7) compared to the normal pregnancy group (n = 3). However, the Chi-square test showed no statistically significant association between malaria during pregnancy and newborn length (p-value = 0.243).

DISCUSSION

Effect of Malaria During Pregnancy on Placental Morphometry

The results of this study showed that placental morphometry, particularly placental weight, was significantly affected by malaria during pregnancy. Statistical analysis using the Chi-square test revealed a p-value of 0.023, indicating a significant effect of malaria-complicated pregnancy on newborn placental weight. In contrast, umbilical cord length was not significantly affected, with a p-value of 1.000, suggesting no association between malaria during pregnancy and umbilical cord length in newborns.

These findings are partly consistent with a study conducted by Arinugraha (2019) entitled Comparison of Normal Placenta and Malaria Placenta in Mothers Delivering Low Birth Weight Infants. The study reported that independent t-test analysis showed no significant difference in placental structural expression between normal placentas and malaria placentas among mothers delivering low birth weight infants (p=0.581). Similarly, Spearman correlation analysis demonstrated no significant correlation between low birth weight and placental structural expression in both normal and malaria placentas (p = 0.664). However, the study concluded that there were significant differences in placental structural expression between normal placentas and malaria placentas in mothers who delivered low birth weight infants (Arinugraha, 2019).

The placenta plays a crucial role in fetal growth, development, and survival. Any disturbance in placental formation or growth may impair its normal function, ultimately affecting fetal well-being (Febiani, Suwiyoga, & Sanjaya, 2019). Placental structure reflects the intrauterine environment, and placental morphometry serves as an indicator of placental development and function, both of which have direct implications for fetal condition (Netra & Purnawan, 2021).

Placental morphometry includes measurements of placental weight, diameter, thickness, and umbilical cord length. A normal placenta typically has a diameter of 15–25 cm, a thickness of 2–3 cm, and an average weight of approximately 470 g. Several factors may influence placental size, including maternal nutritional status, interpregnancy interval, parity, and anemia during pregnancy (Rahmah, 2018).

In the present study, placental morphometric measurements were performed immediately after placental delivery. The mean placental weight in malaria-complicated pregnancies was 446 g, compared to 512 g in normal pregnancies. The average placental diameter was 13.6 cm in the malaria group and 15.2 cm in the normal pregnancy group. Placental thickness averaged 2.1 cm in the malaria group and 2.4 cm in the normal group. The mean umbilical cord length was 54.6 cm in malaria-complicated pregnancies and 55.86 cm in normal pregnancies.

Based on the researchers' assumptions, placental size in malaria-complicated pregnancies tends to be smaller than in normal pregnancies. This difference may be influenced by several factors, particularly a history of malaria infection during pregnancy. Pregnant women infected with malaria during the second trimester or early third trimester are more likely to develop anemia. Maternal anemia may result in reduced placental size, a condition known as placental insufficiency. Anemia can induce morphological changes in the placenta, affecting placental exchange and hemodynamic processes. According to existing theory, placental insufficiency occurs when the placenta is unable to deliver adequate oxygenated blood and nutrients to the fetus (Aprilianti et al., 2023). Consequently, the fetus may not receive sufficient resources required for optimal growth and development.

Effect of Malaria During Pregnancy on Newborn Outcomes

The results of this study demonstrated that normal birth weight (≥2500 g) was observed in 22 newborns, of whom 14 were born to mothers with normal pregnancies and 8 to mothers with malaria. In contrast, low birth weight (<2500 g) was identified in 8 newborns, the majority of whom were born to mothers with malaria (n = 7), while only one case occurred in the normal pregnancy group. Statistical analysis using the Chi-square test revealed a p-value of 0.035 for birth weight, indicating a significant effect of malaria during pregnancy on newborn birth weight. However, no significant association was found between malaria during pregnancy and newborn length, with a p-value of 0.243.

These findings are supported by a study conducted by Purwatiningsih (2022), which reported that Plasmodium falciparum infection during pregnancy increased the risk of low birth weight by 11 times (OR 11.5; 95% CI 4.23–31.66; p-value < 0.05). In addition, primigravida women were found to have a 3–4 times higher risk of delivering low birth weight infants compared to multigravida women (OR 3.6; 95% CI 1.42–9.17; p-value < 0.05). The study concluded that malaria during pregnancy is significantly associated with an increased risk of low birth weight (Purwatiningsih et al., 2022).

From a theoretical perspective, malaria infection during pregnancy can adversely affect fetal outcomes, with low birth weight being the most commonly observed complication (Lestari, 2023). Low birth weight may result from preterm delivery and impaired fetal growth. These conditions can occur due to malaria infection during pregnancy, which disrupts the supply of nutrients and oxygen from the mother to the fetus. This disruption may lead to intrauterine growth restriction, preterm labor, or a combination of both (Machrumnizar, 2019).

Pregnant women suffering from malaria are at increased risk of adverse fetal outcomes, particularly low birth weight (Machrumnizar, 2019). Low birth weight may result from preterm birth and fetal growth restriction, both of which can arise from impaired nutrient and oxygen transfer caused by malaria infection during pregnancy (Milner, 2018). Impaired uteroplacental circulation occurs due to sequestration of infected erythrocytes, increased glucose and oxygen consumption by parasitized erythrocytes, thickening of the syncytiotrophoblast membrane, and maternal

anemia (Zakama, Ozarslan, & Gaw, 2020). In addition, inflammatory processes mediated by Th1 cytokines in response to malaria parasitic infection may directly interfere with fetal growth and development. In severe cases, malaria during pregnancy may result in abortion or stillbirth (Reis et al., 2020).

CONCLUSION

This study concludes that placental size in malaria-complicated pregnancies is smaller than in normal pregnancies. Malaria infection during pregnancy has a significant effect on placental morphometry and newborn birth weight among pregnant women at Sentani Public Health Center, Jayapura Regency. Based on these findings, it is strongly recommended that healthcare providers enhance health education regarding malaria during pregnancy and implement routine malaria screening for pregnant women. These efforts are essential to support healthy pregnancies and to reduce or minimize the adverse effects of malaria infection on placental development and newborn outcomes.

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