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LITERATURE REVIEW

ANALYSIS OF RISK FACTORS FOR PREGNANT WOMEN INFECTED WITH MALARIA

Analisis Faktor Resiko Ibu Hamil Yang Terinfeksi Malaria

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ABSTRACT

Background: Malaria is a disease caused by protozoa infection of the genus Plasmodium transmitted through the bite of infected female Anopheles mosquitos. Malaria infection in pregnancy is detrimental to both the mother and the fetus. Several efforts to prevent and eradicate malaria have been implemented, but many pregnant women are still infected with malaria. **Purpose:** To know the risk factors for pregnant women infected with malaria. **Methods:** This study used the literature review method by searching for articles analyzing risk factors for pregnant women infected with malaria. Articles were searched from two databases, namely PubMed and Google Scholar. The keywords used are "Pregnant Women" AND "Infected Malaria". The inclusion criteria (IC) in the article search were publication year: articles published in the last 5 years from 2018-2023 with the subject of pregnant women infected with malaria; the paper should be full text, with a Cross-sectional and case-control study. **Results:** This study involves 10 articles discussing the analysis of risk factors for pregnant women infected with malaria. Some studies revealed that the host, agent, and environment highly determine the spread of malaria. The spread of malaria occurs when those three components support each other. Risk factors for malaria are pregnant women's residence, wire netting installation on ventilation, and use of mosquito nets and repellent. **Conclusion:** Based on the reviewed articles, it can be concluded that pregnant women who do not use mosquito nets and whose residences are close to standing water and bushes have a greater risk of getting malaria.

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ABSTRAK

Latar Belakang: *Malaria adalah penyakit yang disebabkan oleh infeksi protozoa dari genus Plasmodium yang ditularkan melalui gigitan nyamuk Anopheles betina yang terinfeksi. Infeksi malaria pada kehamilan dapat merugikan ibu dan janin. Berbagai upaya pencegahan dan pemberantasan malaria telah dilakukan, namun masih banyak ibu hamil yang terinfeksi malaria.* ***Tujuan:*** *Mengetahui faktor risiko ibu hamil terinfeksi malaria.* ***Metode:*** *Penelitian ini menggunakan metode tinjauan literatur dengan mencari artikel yang menganalisis faktor risiko ibu hamil yang terinfeksi malaria. Artikel dicari dari dua database, yaitu PubMed dan Google Scholar. Kata kunci yang digunakan adalah "Pregnant Women" DAN "Infected Malaria". Kriteria inklusi (IC) dalam pencarian artikel adalah tahun publikasi: artikel yang diterbitkan dalam 5 tahun terakhir dari tahun 2018-2023 dengan subjek ibu hamil yang terinfeksi malaria; makalah harus berupa teks lengkap, dengan studi cross-sectional dan kasus-kontrol.* ***Hasil:*** *Penelitian ini melibatkan 10 artikel yang membahas tentang analisis faktor risiko ibu hamil yang terinfeksi malaria. Beberapa penelitian mengungkapkan bahwa inang, agen, dan lingkungan sangat menentukan penyebaran malaria. Penyebaran malaria terjadi ketika ketiga komponen tersebut saling mendukung satu sama lain. Faktor risiko terjadinya malaria adalah tempat tinggal ibu hamil, pemasangan kawat kasa pada ventilasi, serta penggunaan kelambu dan obat nyamuk.* ***Simpulan:*** *Berdasarkan artikel-artikel yang telah direview dapat disimpulkan bahwa ibu hamil yang tidak menggunakan kelambu dan tempat tinggalnya dekat dengan genangan air dan semak-semak memiliki risiko lebih besar untuk terkena malaria.*

INTRODUCTION

Malaria is the central public health problem in tropical and subtropical countries (1). This disease still becomes a threat to society due to its high morbidity and mortality rates at reproductive age (2). Malaria is caused by protozoa infection of the genus Plasmodium transmitted through the bite of infected female Anopheles mosquitos. This disease attacks organs such as the brain, liver, and kidneys, and then parasites grow and reproduce in these organs (3). Its transmission is the same as other infectious diseases in general, namely determined by the host (humans and Anopheles mosquitoes), agent (plasmodium parasites), and environment (physical, chemical, biological, and social environment) (4,5).

Malaria is one of the most common infectious diseases found in various countries. Globally, there were 82.6 million babies born to pregnant women who are at risk of infection with Plasmodium (P) falciparum and P. vivax, which cause malaria. The incidence of malaria P. falciparum and P. vivax reaches 88.2 million (70%) out of the total 125,200,000 pregnancies (6). Of these, 54.4 million occurred in malaria-endemic areas in the Asia-Pacific region and 33 countries with moderate and high transmission in the African Region in 2020. The World Health Organization (WHO) estimated that 11.6 million (34%) out of 33,8 million pregnancies were exposed to malaria infection during pregnancy (7). Most cases of malaria were found in the African region (93%), followed by the Southeast Asian region (3.40%) and the Eastern Mediterranean region (2.10%) (8). In Indonesia, malaria cases reached 235,700 cases in 2020. The Ministry of Health reported 304,607 malaria cases in 2021 (9). In pregnancy, malaria becomes a significant cause of morbidity and mortality, causing approximately 100,000 neonatal deaths and 10,000 maternal deaths each year (10).

Malaria is an infectious disease whose control efforts are a commitment to the Sustainable Development Goals (SDGs) until 2030 (11). Malaria is a public health problem that can cause death, reduce work productivity and affect various aspects of life (11). Symptoms appear 10 to 15 days after being bitten by an Anopheles mosquito in the form of intermittent mild fever, headaches, muscle aches, chills, and feeling unwell (malaise) (12). This disease can affect all individuals regardless of age, gender, and pregnant women (3). Malaria

infection in pregnancy is detrimental to both the mother and the fetus because it can increase the incidence of morbidity and mortality (13). In mothers, malaria infection can cause anemia, pulmonary oedema, cerebral malaria, kidney failure, and even death. In the fetus, it can cause premature labour, abortion, LBW, and death (14).

Pregnant women are more susceptible to parasite infection, and this susceptibility is most closely related to the immunological changes during pregnancy. The parasites causing malaria tend to accumulate in the placenta (15). Plasmodium causes malaria and hurts pregnancy and babies (16). Malaria infection in pregnancy is detrimental for both the mother and the fetus as it can increase the morbidity and mortality of both mother and fetus (17). In pregnant women, malaria can cause fever, anemia, hypoglycemia, acute pulmonary oedema, kidney failure, increased risk of premature birth, trigger an abortion, low birth weight (LBW), fetal weight less than gestational age (IUGR), and even death (18). Pregnant women can quickly contract malaria due to immune system changes during pregnancy, including cellular and humoral immunity, and an increase in cortisol hormone. This infection can worsen pregnancy, leading to severe anemia. The parasite can also affect blood supply to the placenta, causing it to invade and disrupt the transplacental transfer of food and oxygen, potentially causing pre-term birth. (19). Without proper and immediate handling, it will continue in the delivery process, which can also cause post-partum bleeding (20). This study aims to analyze the risk factors for pregnant women infected with malaria.

METHODS

This study used the literature review method by searching articles from specific databases. This study used secondary data obtained from the results of previous studies and not through direct observation. The inclusion criteria (IC) consist of IC1 article should be published in the journal, IC2 in the article search were publication year, namely articles published in the last 5 years from 2018-2023 with the subject of pregnant women infected with malaria, IC3 with Cross-sectional study and case-control, IC4 the paper should be full text.

The article search used keywords (NOT, OR AND or AND NOT) to make searching for the required journal easier. The keywords used are "Pregnant Women" AND "Infected Malaria". Secondary data sources are articles related to the topic obtained from Google Scholar and PubMed. In IC1, published journals obtained 4,650 articles; in IC2, the researcher determined the publication year from 2018 to 2023, obtaining 4,600 articles. In IC3, the selection criteria were using the same type of method, while IC4 selected excluded journals due to duplicates and unsuitable article contents with the issue in this study. After selecting the articles according to the topic of this study, the researcher obtained 420 journals.

Further identification was carried out in more detail to determine relevant articles that meet the inclusion criteria in this literature review. Based on IC1-IC4 selection criteria, some articles were selected for further review. Then, they were reselected based on IC5, namely based on the compatibility of article titles and abstracts with the aim of this review literature, namely to have the main content related to risk factors in pregnant women infected with malaria. Finally, the researcher obtained 10 articles for further review. The process of identifying articles can be seen in Figure 1.

RESULTS

This study involved reviewing 10 articles. The author explored journals through databases based on the suitability of the predetermined criteria and keywords, namely pregnant women and infected malaria. Data search results based on the keywords set are shown in Table 1.

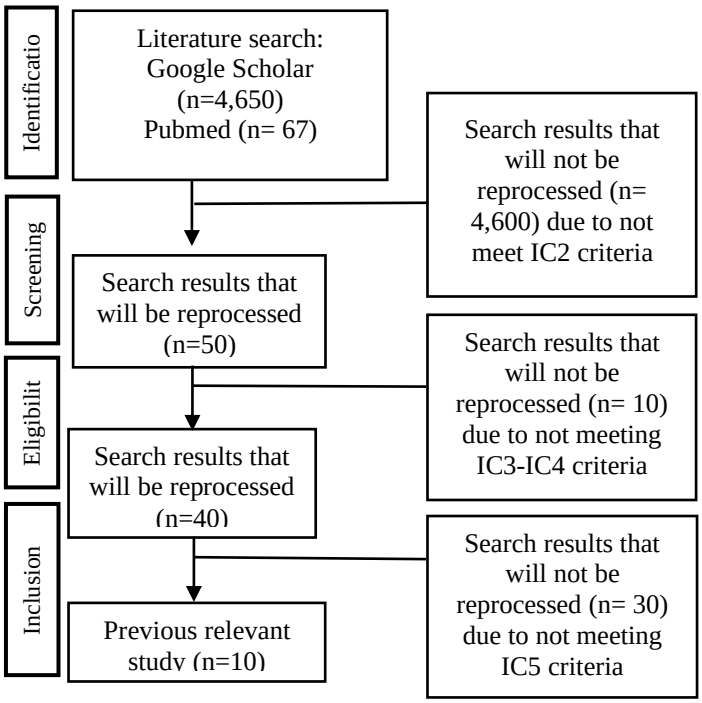

Figure 1. PRISMA Diagram

Table 1
Analysis Literature Review Results

No.	Author, Country, Year	Title	Methods	Sampling Technique	Results
1	Dismo Katiandagho, Amelia Donsu Indonesia (2018)	Analysis of Risk Factors for Malaria in Pregnant Women at Puskesmas Manganitu, Kepulauan Sangihe District	Cross-sectional	Total sampling	The study found a significant relationship between mosquito net use and the incidence of malaria in pregnant women. Not using mosquito nets while sleeping was found to be a risk factor, with a 13 times higher risk for those who do not use them. The discovery of mosquito breeding places around the house was also a risk factor, with a PR value of 9.43. The presence of bushes around the house was also a significant risk factor, with a PR value of 12.10.
2	Inggrit Rita Uli Manik, Ritha Rumansara, and Ruslan Indonesia (2022)	Risk Factors for Malaria in Pregnant Women at Puskesmas Bosnik and Marau, Biak Numfor District	Case Control	Random sampling	Sleeping without using mosquito nets (OR = 3.77 p = 0.02 95% CI 1.16-12.27) and Hb anemia <9 gr% (OR = 5.50 p = 0.01 95% CI 1.32-22.86). Meanwhile, 3 (three) variables, namely low economic status, first parity, and ≥ 4 and nutritional status, are not related to the incidence of malaria. The risk factors for malaria in pregnant women are related to sleeping habits without using mosquito nets and Hb anemia <9gr%
3	Mohammed A. Suliman, Abdelhakam G. Tamomh, Osman Y. Younis, Abdalmoneim M. Magboul, et al Sudan (2021)	Malaria infection and associated risk factors in pregnant women attending antenatal care clinics in Al Jabalian Locality, White Nile state, Sudan	Cross-sectional	Total sampling	Out of 400 pregnant women are infected with malaria, with 154 infected in the third trimester. Multigravidas have the highest infection prevalence at 54.5%. There is a significant relationship between malaria parasite infection and occupation, presence of ANC, and bed net use, but no significant association exists between education level and malaria infection.
4	Chimere O Agomo, dan Wellington A Oyib Nigeria (2022)	Factors associated with risk of malaria infection among pregnant women in Lagos, Nigeria	Cross-sectional	Random Sampling	The study found low malaria prevalence in the studied population due to increased malaria interventions, high competence in microscopy, urban residences, young mothers, and not using insecticide sprays, as well as the urban nature of the participants.

(*Continued*)

Table 1
Continued

No.	Author, Country, Year	Title	Methods	Sampling Technique	Results
5	Emalia M. B. P. Masengi, John J. E. Wantania, Suzanna P. Mongan Indonesia (2019)	Incidence and Outcome of Malaria in Pregnancy in Some Hospitals in North Sulawesi	Cross-sectional	Total Sampling	The number of cases of malaria in pregnancy from January 2013 to October 2018 was 11 cases. The most common type of malaria found was tertian malaria (55%), followed by tropical malaria (45%). Maternal outcomes in tropical malaria found anemia of 40%, and in tertian malaria found anemia of 33%. Meanwhile, perinatal outcomes in tertian malaria of 33% of premature infants. There is no mortality, premature, or asphyxia outcomes in tropical malaria.
6	Rahmawaty, Rismayanti, Dian Sidik. A Indonesia (2019)	Risk Factors for Malaria in Pregnant Women in the Working Area of Puskesmas Prafi Manokwari, West Papua	Cross-sectional	Quota sampling	Malaria is more likely to strike pregnant women 35 years of age and older than those between the ages of 20 and 35, those with less education, and those who have had several pregnancies. The incidence of malaria in pregnant women is not significantly increased by ANC visits. Malaria risk is increased by not using mosquito nets, prophylactics, repellant, and gauze on ventilation. Malaria risk is increased by a habit of going out at night at least twice a week. There is no statistical significance in these risk variables.
7	Mariestéfany Romero, Elízabeth Leiba, Fh abián S. Carrión-Nessi, Diana C. Freitas-De Nobrega, Serris Kaid-Bay, et al Venezuela (2021)	Malaria in pregnancy complications in Southern Venezuela	Cross-sectional	Total sampling	Malaria P. vivax mainly occurs in pregnant women, referring to the distribution of malaria parasite species in Venezuela. The high prevalence of maternal-fetal complications found in the population studied has potentially negative effects on the newborn. This suggests careful medical follow-up during prenatal care, including routine malaria testing for timely malaria diagnosis and antimalarial treatment. Preventive measures for pregnant women, such as using mosquito nets and mosquito repellent.

(*Continued*)

Table 1
Continued

No.	Author, Country, Year	Title	Methods	Sampling Technique	Results
8	Kelechi, C. N., & Omuemu, V. O, Nigeria (2022)	Prevalence and Risk Factors of Malaria among Pregnant Women Receiving Antenatal Care in a Health Facility in Delta State, Southern Nigeria	Cross-sectional	Systematic sampling	Three evidence-based strategies for the prevention and treatment of malaria in pregnancy are to encourage the routine use of insecticide-treated nets, increase the preventive treatment of intermittent malaria in pregnancy with sulfadoxine-pyrimethamine in the second and third trimesters of pregnancy, and appropriately manage malaria cases through prompt and effective diagnosis and treatment of malaria.
9	Felix Amate Elime1, N. Rene Nkenyi, Luis Ako-Egbe, Ann Njunda and Dickson Nsagha Cameroon (2019)	Malaria in Pregnancy: Prevalence and Risk Factors in the Mamfe Health District, Cameroon	Cross-sectional	Random sampling	The chance of contracting malaria is higher for pregnant women whose residents are close to breeding sites than for those without breeding sites (adjusted OR=0.07, 96%CI; 0.02-0.27, p=0.01). This is in line with other studies in Cameroon, Uganda, Ethiopia, and Sri Lanka that show an increased risk of contracting malaria among people living near mosquito breeding sites.
10	Made Agus Nurjana, Samarang, Octaviani, dan Ningsi Indonesia (2022)	Malaria in Vulnerable Groups in Indonesia	Cross-sectional	Total sampling	The positive vulnerable group for malaria is 0.84% (20/2391) toddlers and 0.38% pregnant women (2/524) based on RDT examination. Factors related to the incidence of malaria in children under 5 are gender, while in pregnant women, wastewater disposal, use of mosquito nets, use of electric mosquito coils, and mosquito nets (p-value <0.05).

DISCUSSION

The spread of malaria is determined by the host, agent, and environment (21). The spread of malaria occurs when these three components support each other. Risk factors for malaria are:

Residence

Many pregnant women infected with malaria and recurrent malaria are partly caused by the environment and home conditions (22). One of the causes of the home environment is standing water around the house. Anopheles mosquitoes can lay their larvae in the water as deep as 1 cm (23). Rural residence is a risk factor for malaria, with a 3.24 times greater risk of contracting malaria than urban residences (24). The distribution of Anopheles mosquitoes carrying malaria is influenced by one factor, namely the environment (25). Urban and rural areas have different environmental forms, such as mosquito habitats, which affect the density of mosquitoes carrying the Plasmodium parasite (26). The next factor, based on the six articles that have been reviewed, the risk factor that can cause pregnant women to become infected with malaria is residence that the chance of getting malaria is found to be higher in pregnant women whose residence near the breeding sites than those without the breeding sites (27). The factors associated with developing malaria in pregnancy are mosquito breeding sites and bushes around the house (28).

Installation of wire mesh on the ventilation

The most dominant factor contributing to malaria incidence is the presence of wire mesh in ventilation (29). Houses without mosquito screens will make it easier for mosquitoes to enter the house to bite humans (11). Ventilation not covered with wire mesh will cause mosquitoes to enter the house because some anopheles mosquitoes are endophytic (bite inside the house). Installing mosquito screens on house ventilation is a risk factor for malaria. Houses without wire mesh on the ventilation have a relationship with malaria incidence, with a 3.6 times greater risk of contracting malaria than houses with wire mesh on the ventilation.

Using mosquito nets

Using mosquito nets when sleeping is a preventative behavior against malaria in pregnant women. Mosquito nets are adequate to prevent and avoid contact between Anopheles mosquitoes while sleeping at night because the Anopheles mosquitos look for blood at night. Most of the women are pregnant who suffer from malaria do not use mosquito nets when sleeping. Pregnant women often do not use a mosquito net when sleeping because their mothers feel hot and not feeling uncomfortable. Therefore, using a mosquito net at night can prevent or protect against Anopheles sp bites.

Using mosquito repellent (coil/electric/spray)

The use of mosquito repellent is a risk factor for malaria. Thus, various efforts can be made to reduce the incidence of malaria, such as using mosquito repellents. Not using mosquito repellent has a 6.8 times greater risk of contracting malaria than using mosquito repellent. The public needs to know the impact of mosquito repellent on health, especially for those who frequently use it. The use of mosquito repellent can be risky for health as the smoke contains carcinogens that can cause severe damage to the human nose, throat and lung tissue. Changes in the lungs after exposure to mosquito coils and electric mosquito coils for 6 hours result in wasting the lungs.

CONCLUSION

Based on the review's results, it can be concluded that pregnant women who do not use mosquito nets and whose residences are close to standing water and bushes are at a greater risk of contracting malaria.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest in this research.

AUTHOR CONTRIBUTIONS

WR the main conceptual idea and proof outline, HA data collection and search literature review, PC draft manuscript, TKS final version of manuscript

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