International Journal of Health and Medicine
Volume 2, Nomor. 1 Tahun 2025
e-ISSN: 3047-793X, p-ISSN: 3047-7948, Page 126-138
DOI: https://doi.org/10.62951/ijhm.v2i1.217
Available online at: https://international.arikesi.or.id/index.php/IJHM

The Nutritional Status Of Toddlers Is A Risk Factor For Malaria Incidence At Kimi Health Center

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Abstrack: *Malaria remains a global health issue, particularly in tropical and subtropical regions. In Indonesia, Papua Province specifically Nabire Regency reports a high incidence of malaria, although a decline has been observed since 2010. Infants and pregnant women are the most vulnerable groups. Nutritional status, influenced by dietary patterns, environment, and access to healthcare, plays a crucial role in susceptibility to malaria. Malnourished children are more prone to severe malaria infections due to their underdeveloped immune systems. This research focuses on Kimi Health Center in Nabire Regency and aims to explore the relationship between the nutritional status of children under five and malaria incidence in 2024. The goal of this study is to determine the relationship between the nutritional status of children under five and malaria incidence at Kimi Health Center, Teluk Umar District, Nabire Regency, in 2024. The research design employs an analytical descriptive approach with a cross-sectional method to analyze the relationship between nutritional status and malaria incidence. Data was collected at one point in time and analyzed using univariate and bivariate analysis with the Kendall tau-b test through SPSS software. The results show that nutritional status significantly influences susceptibility to malaria. Children with poor nutrition are at a higher risk of experiencing severe malaria due to immune system dysfunction. Malnutrition, such as Protein-Energy Malnutrition (PEM), worsens parasitemia and anemia. Nutrient deficiencies, including iron, vitamin A, and zinc, also weaken the immune system. Therefore, improving nutritional status is a crucial effort in malaria control within endemic areas.*

Keywords*: Nutritional Status, Children Under Five, Malaria*

1. INTRODUCTION

Malaria is an infectious disease caused by *Plasmodium*, a microorganism that spreads to humans through the *Anopheles* mosquito. Alongside HIV/AIDS and tuberculosis, malaria prevention is a key component of the Sustainable Development Goals (SDGs), which aim to be achieved globally by 2030 (Kemenkes RI, 2022).

Globally, malaria remains one of the most prevalent infectious diseases, with approximately 229 million cases reported in 2019. Persistent malaria cases are mainly concentrated in the Sahel region of West Africa (De Wit et al., 2021). The World Health Organization (WHO) reported 219 million malaria cases in 2017, a slight fluctuation compared to 214 million cases in 2015 and 239 million cases in 2010. The significant decline between 2015 and 2019 was largely driven by a heavy malaria burden in 18 countries, including South Sudan (Idris et al., 2022).

In Indonesia, malaria remains a pressing public health concern. In 2020, global malaria cases reached 241 million, resulting in an estimated 627,000 deaths. In 2010, Indonesia's Annual Parasite Incidence (API) stood at 1.8 per 1,000 population, rising to 1.96 in 2011 before declining to 0.84 in 2019. However, the API increased to 0.93 in 2020, with 86% of the 250,644 cases recorded in Papua Province (Malik et al., 2023).

Received: November 18, 2024; Revised: Desember 02, 2024; Accepted: Desember 16 , 2024;

The API measures malaria morbidity by assessing the proportion of confirmed malaria cases relative to the population at risk. Between 2015 and 2020, Indonesia successfully maintained an API below 1 per 1,000 population, but it rose to 1.1 in 2021. Provinces such as Papua, West Papua, and East Nusa Tenggara reported the highest API, with Papua Province recording an alarming 80.05 per 1,000 population, contributing significantly to the national burden. Districts like Keerom, Jayapura, Mimika, Sarmi, and Boven Digoel remain malaria hotspots. The API in Nabire District reached 17 per 1,000 population, far exceeding the national average of 1 per 1,000 (Palumpun, 2021).

In Nabire, malaria cases in 2016 totaled 52,511 clinical cases, with 10,345 confirmed positive. In 2017, cases rose to 86,265, but confirmed cases dropped to 5,126, while 2018 recorded 26,135 clinical cases, with 2,481 positives (Manihuruk, 2022). By 2022, malaria screenings revealed 1,061 pregnant women (31.19%) and 603 children under five (3.56%) were tested. Of these, 48 cases (7.96%) were confirmed among children and 5 cases (0.47%) in pregnant women. The highest child malaria incidence was recorded at Kimi Health Center (17.52%), while Puskesmas SP 1 Kalibumi reported the highest among pregnant women (1.51%) (Bidang P2M & P2P, 2022; Kinansi & Wurisastuti, 2020).

Malaria transmission in infants under one year can occur through blood transfusion or congenital pathways via the placenta when the mother is infected. Children under five initially have reduced risk but lose passive immunity over time, increasing their vulnerability. Severe malaria is most common in children aged 1–4 years due to their immature immune systems (Kinansi & Wurisastuti, 2020).

The factors contributing to malaria include human behavior, the mosquito vector, the parasite, and the environment. Malnourished children face a higher risk of severe malaria, which can cause permanent disabilities such as paralysis and cognitive impairment due to brain damage caused by *Plasmodium*. Malaria in young children can also result in low birth weight and hinder physical growth and development (Kinansi & Wurisastuti, 2020). Social habits, such as nighttime outdoor activities and travel to malaria-endemic regions, heighten exposure risks. Poor environmental sanitation, inadequate housing, stagnant water, and overgrown vegetation further exacerbate malaria transmission (Madayanti, 2022).

Malaria causes red blood cell destruction, leading to anemia and potentially fatal complications such as coma, multi-organ failure, and death. In pregnant women, untreated malaria can result in miscarriage, preterm birth, low birth weight, and stillbirth (Manihuruk, 2022).

Community-driven malaria prevention strategies include promoting clean and healthy lifestyles through environmental management, such as eliminating mosquito breeding sites. Comprehensive approaches combine individual protection (e.g., mosquito nets, repellents) with vector control and educational programs to raise awareness of malaria prevention and recurrence (Apay et al., 2022). Increased mosquito density is often linked to stagnant water bodies like ditches, swamps, and ponds, while better housing structures, such as sealed walls, can reduce malaria incidence (Madayanti et al., 2022).

Early childhood is a critical period requiring adequate nutrition for optimal growth and development (Popang et al., 2022). Nutritional status reflects the balance between nutrient intake and metabolic needs, which vary by age, gender, activity level, and weight (Popang et al., 2022; Nopihartati et al., 2023; Fitriyatun & Putriningtyas, 2021).

Nutritional deficiencies impact malaria susceptibility due to weakened immune responses. Malnourished children, particularly those under 15 years, are more prone to malaria infections. Severe cases are more prevalent in younger children due to their immature immune systems, while older individuals may face vulnerability from declining immunity and comorbid conditions (Ramdany & Samaran, 2019). Research by Munizar et al. (2015) confirms the link between poor nutritional status and heightened malaria vulnerability in endemic regions.

Malaria remains a critical public health challenge, especially for high-risk groups such as malnourished children. Given the high incidence of malaria and malnutrition in Nabire District, particularly at Kimi Health Center, this study seeks to explore the relationship between nutritional status and malaria incidence among children under five in 2024.

2. METHODE

The type of research conducted is descriptive-analytic using a cross-sectional approach. The study took place at Kimi Health Center, Teluk Kimi District, Nabire Regency, from April to July 2024. The population in this study consisted of all children under five (804 children) within the working area of Kimi Health Center. The sample size was determined using the purposive sampling method. The sample consisted of mothers with children under five who were willing to complete the provided questionnaire at Kimi Health Center, Teluk Kimi District. The instruments used for data collection in this research were a questionnaire and laboratory results for DDR malaria testing with positive outcomes. In this study, bivariate analysis was used to determine the relationship between knowledge about the nutritional

status of children under five and malaria incidence. Data analysis was conducted using the Kendall tau-b test (ordinal data) through SPSS software.

3. RESULT

Characteristics of Toddlers

Table 1. Characteristics of Toddlers

Characteristics Of The Toddler	n	%
Age		
Baduta (12-24 Month)	54	45.8
Balita (25-60 Month)	64	54.2
Sex		
Male	66	55.9
Female	52	44.1
Birt Weight History		
Low Birth Weight (<2500 gr)	14	11.9
Normal (>=2500 gr)	104	88.1
Birth Length History		
Short (<45 cm)	3	2.5
Normal (45-50 cm)	115	97.5

Based on Table 1, it was found that among the toddlers in this study, 54 children (45.8%) were aged 12-24 months, and 64 children (54.2%) were aged 25-60 months. The characteristics of the toddlers based on gender were as follows: 66 boys (55.9%) and 52 girls (44.1%). Regarding birth weight history, 14 toddlers (11.9%) were born with low birth weight (LBW), while 104 toddlers (88.1%) were born with normal birth weight (above 2500 grams). For birth length history, 3 toddlers (2.5%) had a history of short birth length (<45 cm), and 115 toddlers (97.5%) had a normal birth length (45-50 cm).

Parent Characteristics

Age of the Toddler's Mother

Table 2. Characteristics of the Age of Toddler's Mothers

Characteristics of the Mother	n	%
Age		
< 20 Year	2	1.7
20-35 Year	101	85.6
>35 Year	15	12.7
Education		
Elementary School	7	5.9
Junior High School	23	19.5
Senior High School	77	65.3

Diploma & Bachelor	11	9.3
Employemnt		
Not Working	96	81.4
Farmers	1	0,8
Private Employess	14	11.9
Small Bussines	3	2.5
Civil Servant/Army/Police	4	3.4
Income		
<2 milion IDR/month	37	31.4
2-4 milion IDR/month	40	33.9
4-7 milion IDR/month	34	28.8
>7 milion IDR/month	7	5.9
Housing Type		
Permanent	21	17.8
Semi-Permanent	59	50.0
Woden	38	32.2

Based on the data presented in Table 2, it can be concluded that the majority of mothers of toddlers at Kimi Health Center are aged between 20-35 years (85.6%), with the predominant education level being high school or its equivalent (65.3%). Most mothers (81.4%) are not working or are housewives. Regarding family income, the majority of respondents (33.9%) earn between 2-4 million IDR per month, and most families live in semi-permanent houses (50%).

Research Variables

Table 3. History of Malaria in Children Under Five Years Old (Balita) in the Last Year

Variable	N	%
Malaria		
Yes	45	38.1
No	73	61.9
Nutritional Status		
Poor	3	2.5
Insufficient	21	17.8
Good	85	72.0
At Risk of Overnutrition	6	5.1
Overnutrition	2	1.7
Obesity	1	0.8

Based on Table 3, it is shown that the history of malaria among children under five years old (balita) in the past year was 45 (38.1%). nutritional status based on weight-for-height (BB/TB) is as follows: good in 85 cases (72%), insufficient in 21 cases (17.8%),

poor in 3 cases (2.5%), at risk of overnutrition in 6 cases (5.1%), overnutrition in 2 cases (1.7%), and obesity in 1 case (0.8%).

Analysis of the Relationship Between Nutritional Status of Toddlers and the History of Malaria Incidence

Table 4. Relationship Between Nutritional Status and History of Malaria

Nutritional Status	Malaria				P Value
	Yes		No		
	n	%	n	%	
Poor	3	6.6	0	0	
Insufficient	17	37.7	4	5.5	0.000
Good	21	46.6	64	87	
At Risk of Overnutrition	3	6.6	3	4.1	
Overnutrition	0	0	2	2.3	
Obesity	2. 2		1. 1		

Based on the results of the Pearson Chi-Square Test analysis, it was found that with a 95% confidence interval (CI), a p-value <0.05 was obtained, indicating a significant relationship between nutritional status based on weight-for-height (BB/TB) and malaria incidence.

4. DISCUSSION

The nutritional status of toddlers is a significant risk factor for malaria incidence, particularly in regions like West Africa and the Sahel. Malnutrition, especially protein-energy malnutrition and micronutrient deficiencies, compromises immune function and increases susceptibility to malaria infection. This relationship is further complicated by the cyclical nature of malnutrition and malaria, where each exacerbates the other, leading to severe health outcomes for affected children. The following section outlines key aspects of this relationship.

Nutritional status plays a fundamental role in determining health and susceptibility to disease. Optimal nutrient intake is not only essential for growth and development but also crucial for maintaining an effective immune system (Calder, 2020). Good nutritional status supports the optimal development and function of the immune system. Conversely, malnutrition can weaken the body's defenses, increase susceptibility to infections, and worsen disease prognosis (Bourke, Berkley, & Prendergast, 2016).

This study concludes that there is a relationship between nutritional status and malaria incidence. This finding aligns with research conducted by Vanessa Tigta Jugba et al. (2023), which stated that there is a significant relationship between nutritional status and malaria incidence, where children with poor or insufficient nutritional status are at higher risk of malaria infection.

Malnutrition increases susceptibility to infections. Infections can further worsen nutritional status by reducing food intake, impairing nutrient absorption, increasing metabolic demands, and causing direct nutrient loss, such as through diarrhea (Musoke, Gondi, & Feeney, 2022). Nutritional status plays an essential role in modulating vulnerability and severity of malaria infection. The mechanisms underlying this interaction are complex and involve various physiological and immunological aspects. Nutritional status affects the development and function of the immune system, which is critical for defense against malaria infection.

Protein-Energy Malnutrition (PEM) has been shown to increase susceptibility to malaria infection and worsen clinical outcomes. Children with PEM experience higher parasitemia and more severe anemia during malaria infection. PEM is associated with reduced production of pro-inflammatory cytokines, which are essential for controlling early parasite infection (Verma et al., 2021).

In addition to protein and energy deficiencies, the relationship between iron status and malaria is complex. Iron deficiency can provide partial protection against malaria infection, possibly because the parasite requires host iron for its growth (Muriuki et al., 2019; WHO, 2016). However, iron deficiency anemia is also associated with poorer outcomes in infected patients (Das, D., et al., 2022). Iron supplementation must be carefully administered in malaria-endemic areas, taking individual malaria status into account (World Health Organization, 2016).

Vitamin A deficiency is associated with increased susceptibility to malaria and worse clinical outcomes (World Health Organization, 2016). Vitamin A supplementation has been shown to reduce malaria incidence in children in several studies (Irarrazabal, Raqib, & Ley, 2021; Zeba et al., 2008). Zinc deficiency is also linked to an increased vulnerability to malaria infection (Zeba et al., 2008). Zinc supplementation has shown potential in reducing malaria incidence in children, although results vary across studies (Shankar et al., 2000; Dao et al., 2020).

Excessive nutrient intake, manifested as obesity, is also related to malaria incidence. While most research focuses on malnutrition, obesity can also influence susceptibility to

malaria (Dao, D. Q., Bui, T., Vu, T. X., et al., 2020). Some studies have shown that obesity can increase susceptibility to malaria infection and worsen clinical outcomes (Wyss et al., 2017). This may be related to changes in immune responses and chronic low-grade inflammation associated with obesity (Kalra, Aggarwal, & Khandelwal, 2018).

Malnutrition, particularly stunting and underweight, is common among young children in malaria-endemic areas, with research showing that stunted children have higher levels of malaria parasitemia and severe anemia (Sumbele et al., 2015). In Burkina Faso, moderate underweight has been associated with an increased incidence of malaria, indicating that nutritional deficiencies can heighten vulnerability to malaria (Wit et al., 2021).

Targeted nutritional interventions, such as micronutrient supplementation and community-based nutrition programs, are critical in reducing the dual burden of malnutrition and malaria (Maina, 2024). Improving dietary practices and nutrition education can enhance health outcomes, as evidenced by the correlation between caregiver education and children's nutritional status (Ojuro, 2014). While evidence shows a strong link between poor nutritional status and an increased risk of malaria, some studies suggest that severe stunting may not always correlate with higher malaria incidence, highlighting the need for further research to clarify this complex interaction (Wit et al., 2021; Sumbele et al., 2015).

5. CONCLUSSION

This study shows a significant relationship between nutritional status and the occurrence of malaria in toddlers. Toddlers with poor or inadequate nutritional status are at higher risk of malaria infection. Malnutrition can weaken the immune system and worsen infections, including malaria. Good nutritional status supports optimal immune function, while deficiencies in nutrients such as protein and energy can increase vulnerability. Micronutrients such as iron, vitamin A, and zinc also affect susceptibility to malaria. Obesity, as a manifestation of excess nutrition, can also increase the risk of malaria. Therefore, maintaining a balanced diet is crucial for preventing malaria, especially in endemic areas. Interventions to improve nutritional status, along with monitoring malaria risk, can enhance child health and reduce malaria incidence in the community.

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