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Analysis of Height in Children with and Without Malaria in the Malaria Endemic Area of Kualuh Leidong District

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Malaria is an infectious disease that remains a public health problem, especially in tropical regions such as Indonesia. Children living in malaria-endemic areas are highly susceptible to growth disorders, including stunting. One indicator of growth disorders is height that is not appropriate for age. Repeated malaria infections are known to disrupt the linear growth process of children through various mechanisms such as chronic inflammation, anemia, and nutrient malabsorption. Objective: This study aims to analyze the relationship between malaria infection status and height in children in malaria-endemic areas in Kualuh Leidong District. Method: This study used an observational analytical design with a case-control approach. The number of respondents was 134 children who were divided equally into two groups: children who had been infected with malaria and those who had not. Height data were categorized based on WHO standards into three groups: normal, short, and very short. Bivariate analysis was performed using the Chi-Square test with a significance level of 5%. Results: Most children who were not infected with malaria had normal height (95.5%), while children who had been infected with malaria were dominated by the short (31.3%) and very short (50.7%) groups. Chi-square test results showed a highly significant relationship between malaria infection status and child height ($p < 0.001$). Conclusion: Malaria infection significantly affects child height in endemic areas. Children infected with malaria are more likely to experience stunting. This study demonstrates the importance of simultaneous nutritional interventions and malaria prevention to prevent child growth disorders.
Keywords: Malaria, height, children, stunting, infection, endemic areas

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1. Introduction

Malaria remains a serious public health problem worldwide. Currently, approximately 90 countries are still facing malaria, particularly those in tropical and subtropical regions [1]. Indonesia is one of the countries with a high malaria burden and ranks second in Asia in terms of the number of malaria cases [2].

Malaria is an infectious disease caused by the Plasmodium parasite and transmitted through the bite of an infected female Anopheles mosquito. Among the various Plasmodium species, Plasmodium vivax is the most common cause of malaria in tropical countries, including Indonesia [3]. Plasmodium vivax infection not only causes acute clinical symptoms, but can also have long-term impacts on health, especially in vulnerable groups such as children and toddlers who are at higher risk of complications and growth disorders [4].

Globally, in 2020, there were an estimated 247 million cases of malaria, with approximately 625,000 deaths due to the disease [5]. Meanwhile, in Indonesia, the number of malaria cases in 2023 reached approximately 418,000 cases, a decrease compared to 2022, which reached 443,530 cases. Despite this decline, Indonesia remains the country with the second highest number of malaria cases in Asia after India [6].

In North Sumatra Province, the number of malaria cases in 2022 reached 18,361 cases [7]. One of the malaria-endemic areas in the province is North Labuhanbatu Regency. In 2023, 661 malaria cases were recorded in this regency. Of all malaria cases in Indonesia, approximately 44% occurred in children under

15 years of age, amounting to 116,311 cases, with 48,971 cases occurring in toddlers and 7,672 cases in infants. Malaria also remains the leading cause of hospitalizations at 21% and child deaths in hospitals at 42.9% in malaria-endemic areas [8].

Malaria in children not only causes clinical symptoms such as fever, chills, anemia, and weakness, but can also cause immune system disorders, increasing susceptibility to various other infectious diseases [9]. Repeated malaria infections can disrupt nutritional intake, increase the body's energy needs, reduce nutrient absorption, and cause chronic anemia. This condition can inhibit oxygen supply to body tissues, including bones, thus disrupting the child's linear growth process, which is characterized by a decrease in height for age [10][11].

The relationship between malaria and stunted growth in children has been extensively studied. A case-control study in Papua showed that children who experienced malaria before the age of one year had a 45.2% increased risk of stunting. The study also reported that the average Height-for-Age Z-score (HAZ) in children who had experienced malaria was -1.83 ± 1.24, while in children who had never experienced malaria it was -1.38 ± 1.60. Furthermore, malaria during pregnancy increased the risk of stunting in children with an OR of 1.74 (95% CI: 1.06–2.87) [12].

Various studies have also shown that children living in malaria-endemic areas have a greater risk of experiencing growth disorders, including stunting [13]. High frequency of malaria infection is associated with decreased nutritional status and physical growth in children [14]. However, existing research results still show variation due to the influence of geographic conditions, socioeconomic status, consumption patterns, and access to health services in each region [15]. Therefore, more specific research is needed according to the characteristics of endemic areas to obtain a more accurate picture of the relationship between malaria and children's height growth [16].

The research conducted by Ahmad Munazir entitled "Description of Community Behavior regarding Malaria in Tanjung Leidong Village, Kualuh Leidong District, North Labuhanbatu Regency" aims to describe community behavior in preventing and treating malaria. The research used a descriptive research design with a quantitative approach and was conducted on communities living in malaria endemic areas [17].

This study is related to this study because it shows that suboptimal malaria prevention behavior can increase the risk of recurrent malaria infections, especially in children [18]. Recurrent malaria infections have the potential to disrupt a child's linear growth, thus affecting height for age. However, previous studies have not directly examined the differences in height between children with and without malaria. Therefore, research on the analysis of height in children with and without malaria in the malaria-endemic area of Kualuh Leidong District is necessary to provide scientific evidence regarding the relationship between malaria status and children's height growth in malaria-endemic areas..

2. Method

This study is an analytical observational study with a cross-sectional design that aims to analyze the difference in height between children with a history of malaria and children without a history of malaria in a malaria endemic area, namely Kualuh Leidong District, North Labuhanbatu Regency. The study was conducted at the Tanjung Leidong Community Health Center in the period May–June 2025. The cross-sectional design was chosen because it allows the measurement of exposure variables and outcome variables to be carried out at the same time so that it is suitable for assessing the relationship between malaria history and children's height status [9].

The study population was all children under 18 years of age who resided in Kualuh Leidong District and were registered in the medical records of Tanjung Leidong Community Health Center. The sample was

selected using a purposive sampling technique in accordance with the established inclusion and exclusion criteria. The sample size was calculated using the Lemeshow formula with a 90% confidence level, 50% proportion, and 10% degree of accuracy, resulting in a sample requirement of 67 respondents [16].

Data collection was conducted using primary and secondary data. Primary data were obtained through anthropometric examinations in the form of height measurements using a stadiometer for children aged ≥2 years or an infantometer for children aged <2 years, then the results were compared with WHO growth standards based on height for age. Secondary data were obtained from medical records of the Tanjung Leidong Community Health Center to determine the history of malaria infection in respondents. The independent variable in this study was the history of malaria, while the dependent variable was the child's height status which was categorized as normal and short [6].

The collected data then underwent editing, coding, data entry, cleaning, and storage before statistical analysis. Univariate analysis was used to describe the characteristics of respondents and the distribution of each research variable, while bivariate analysis was conducted using the Chi-square test with a significance level of $p < 0.05$ to determine differences in height status between children with a history of malaria and children without a history of malaria. The entire research series began with administrative preparation and ethical approval, followed by data collection, analysis, and preparation of the research report [13].

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3. Results And Discussion

This study was conducted in May 2025 in Kualuh Leidong District, North Labuhanbatu Regency, specifically in the working area of the Tanjung Leidong Community Health Center. The study has obtained ethical approval from the Health Research Ethics Committee of the Faculty of Medicine, Muhammadiyah University of North Sumatra with Number 1517/KEPK/FKUMSU/2025. The study used an analytical survey design with a cross-sectional approach to analyze differences in height between children with a history of malaria and children without a history of malaria in a malaria-endemic area.

The number of respondents who participated in this study was 134 children, consisting of 67 children with a history of malaria and 67 children without a history of malaria. Data collected included respondent characteristics such as age, gender, height status, age of first malaria infection, and frequency of malaria infection. Next, the data were analyzed univariately to describe the distribution of respondent characteristics and bivariately using the Chi-square test to determine the relationship between malaria status and height in children in Kualuh Leidong District.

In addition to affecting linear growth, repeated malaria infections can also worsen a child's nutritional status through long-term systemic inflammatory mechanisms. Activation of pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α), interleukin-1 (IL-1), and interleukin-6 (IL-6) during malaria infection is known to inhibit new tissue formation, increase protein catabolism, and suppress growth hormone production. This condition causes children to grow at a slower rate than children who do not experience malaria infection. If this condition occurs repeatedly without improvement in nutritional status and adequate treatment, growth disorders can become permanent until adulthood [21][22].

Growth disorders in children who have had malaria are also influenced by chronic anemia, a complication of the disease. The destruction of red blood cells due to Plasmodium infection causes hemoglobin levels to decrease, thus suboptimal oxygen distribution to body tissues. Oxygen deficiency in bone tissue inhibits growth plate activity, slowing the development of longitudinal bones. Furthermore, chronic anemia also reduces physical activity and appetite in children, worsening nutritional status and ultimately increasing the risk of stunting [23][24].

Environmental factors are also suspected to play a role in the high proportion of stunted children in the malaria-affected group. Kualuh Leidong District is a malaria-endemic area with geographical characteristics such as coastal areas, swamps, and forests that are ideal habitats for Anopheles mosquitoes. These conditions cause the risk of malaria exposure to remain high, especially for children who have outdoor activities or live in environments with inadequate sanitation. In addition to environmental factors, poor access to health services, delayed diagnosis, and treatment adherence can also increase the likelihood of recurrent malaria infections, thus impacting children's growth status [25][26].

Although this study found a significant association between malaria and child height, it is important to understand that stunting is a multifactorial condition. In addition to malaria infection, child growth is influenced by various other factors such as family socioeconomic status, parental education level, parenting patterns, history of exclusive breastfeeding, adequate energy and protein intake, other infectious diseases, environmental sanitation, and access to clean water. Therefore, malaria is not the sole cause of stunting, but is a factor that can exacerbate growth disorders when occurring in conjunction with other risk factors [27][28].

The strength of this study lies in the use of a comparison group with a balanced number of respondents, including children infected with malaria and children not infected with malaria, allowing for a more objective comparison of height differences. Furthermore, malaria history data was obtained from community health center medical records, minimizing recall bias. Height measurements were also conducted directly using standardized anthropometric instruments, increasing the validity of the study results [29].

However, this study has several limitations. The cross-sectional design cannot directly explain causal relationships because the exposure and outcome variables were measured simultaneously. This study also did not control for several confounding factors such as nutritional status, history of infectious diseases other than malaria, socioeconomic conditions, or children's consumption patterns that can affect height growth. Therefore, further research is recommended to use a cohort design or longitudinal study to better explain the temporal relationship between malaria and growth disorders [30][31].

Overall, the results of this study provide evidence that children with a history of malaria are more likely to be short in stature than children without a history of malaria. These findings support the theory that malaria is an infectious disease that can affect children's linear growth through mechanisms of chronic inflammation, anemia, metabolic disorders, and reduced nutrient intake. Therefore, malaria control efforts not only play a role in reducing morbidity but also play a crucial role in preventing stunting and improving the quality of child growth and development in malaria-endemic areas.

4. Conclusion

Based on the results of research conducted on 134 respondents in Kualuh Leidong District, it can be concluded that there is a significant difference between malaria status and height of children in malaria endemic areas, as indicated by the results of the Chi-square test with a p value <0.001. Respondent characteristics show that the largest age group is 11–15 years old with 48 respondents (35.8%), with an equal number between the malaria and non-malaria groups. Based on gender, most respondents were male with 73 people (54.5%), while based on height status, the majority of children had normal height with 76 people (56.58%). In addition, most children who had a history of malaria were first infected at the age of under one year (25.4%) and more experienced recurrent infections more than three times (26.1%).

The distribution results show that of the 76 children with normal height, 64 children (47.76%) had no history of malaria and only 12 children (8.82%) had a history of malaria. Conversely, of the 58 children with short height category, 55 children (41.04%) were from the group who had been infected with malaria, while

only 3 children (2.23%) were from the group who had never been infected. These findings indicate that children with a history of malaria have a greater tendency to experience height growth disorders than children without a history of malaria, so malaria is one of the factors that plays a role in the occurrence of linear growth disorders in children in endemic areas.

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