



Prevalence and Risk Factors of Dengue Fever Among Children in Makassar Indonesia: A Cross-Sectional Study

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Article Info

Article History:

Received: 15 July 2024

Revised: 17 August 2024

Accepted: 19 September 2024

Keywords:

Dengue Fever

Risk Factors

Public Health

Intervention

Abstract

Dengue fever remains a significant public health concern in tropical regions, particularly in Southeast Asia. This cross-sectional study aimed to assess the prevalence and risk factors of dengue fever among children in Makassar, Indonesia. A total of 400 children aged 0-14 were surveyed, and data were collected on socioeconomic status, environmental conditions, and preventive behaviors such as mosquito net use. The overall prevalence of dengue was 25.8%, with higher rates observed in low-income households and those with standing water. Children from low-income families had a dengue prevalence of 26.8%, while the prevalence in high-income households was 23.5%. Households with standing water had a significantly higher dengue prevalence (30.2%) compared to those without (22.7%). Inconsistent mosquito net use was associated with higher dengue rates, with children in households that sometimes used nets having the highest prevalence (28.3%). These findings highlight the importance of addressing environmental and socioeconomic factors in dengue prevention strategies. Public health efforts should focus on community education, eliminating breeding sites, and promoting consistent use of preventive measures to reduce dengue transmission.

INTRODUCTION

Dengue fever is a significant global public health threat, particularly in tropical and subtropical regions. According to the World Health Organization (WHO), dengue cases have increased 30-fold over the last 50 years, affecting an estimated 390 million people annually, with Southeast Asia accounting for a substantial portion of these cases (WHO, 2020). Indonesia, dengue fever has been endemic since its first outbreak in 1968, and the country remains one of the highest-burdened nations in the region (Kementrian Kesehatan, 2020). Children are particularly vulnerable to dengue, suffering higher mortality rates and more severe complications compared to adults (Setiati et al., 2019).

Makassar, the South Sulawesi, has seen a troubling rise in dengue cases in recent years. The city's rapid urbanization, poor sanitation infrastructure, and warm, humid climate create ideal conditions for the *Aedes aegypti* mosquito, the primary vector for dengue transmission (Samsi et al., 2021). The local public health has

reported over 2,000 dengue cases in Makassar in the last five years, with children representing nearly 60% of all cases (Dinas Kesehatan Kota Makassar, 2022).

Studies suggest that a variety of influence dengue transmission, including environmental conditions, socioeconomic status, and individual behaviors. Urbanization, for example, has been linked to increased mosquito breeding sites, such as stagnant water in poorly drained areas and overcrowded living conditions (Bowman et al., 2016). Socioeconomic factors such as household education levels are also associated with higher dengue risks, as lower-income households may lack access to proper sanitation and healthcare (Teurlai et al., 2015). Furthermore, behavioral factors, including the use of nets and insect repellent, play a critical role in preventing dengue (Mutero et al., 2020).

Despite significant advances in dengue transmission dynamics, little is known about how these risk factors specifically affect children in Makassar. Most of the existing studies in Indonesia have been conducted in Java and Sumatra, leaving a gap in knowledge for eastern regions like South Sulawesi (Harapan et al., 2019). Without localized data, it is challenging to design and implement interventions targeted at vulnerable populations, particularly children.

The increasing number of dengue cases among children in Makassar, combined with a lack of region-specific research, underscores the need for a comprehensive study of dengue prevalence and associated risk factors in this demographic. This study aims to fill this gap by focusing on the prevalence and risk factors of dengue fever among children in Makassar, Indonesia.

METHODS

The study utilized a quantitative, cross-sectional research design to examine the prevalence and risk factors associated with dengue fever among children in Makassar, Indonesia. The population of interest included children aged 0-14 years residing in urban and peri-urban areas of Makassar. A multistage cluster sampling technique was employed to select the sample, ensuring representation from various districts within the city. A sample size of 400 participants was determined based on the estimated prevalence of dengue fever in the region and statistical calculations to ensure adequate power for detecting significant associations.

Data were collected through structured household surveys and hospital records. The household survey was designed to capture information on environmental, socioeconomic, and behavioral factors that might influence dengue transmission. Trained interviewers conducted face-to-face interviews with the parents or guardians of the children, using a pre-tested questionnaire. The questionnaire included sections on housing conditions (e.g., presence of standing water, proximity to waste disposal sites), socioeconomic status (e.g., household income, parental education levels), and preventive practices (e.g., use of mosquito nets, water storage habits). In addition to the survey, health records from local hospitals were reviewed to confirm dengue diagnoses and assess the prevalence of the disease among children during the study period.

The data collected were analyzed using both descriptive and inferential statistical methods. Descriptive statistics were used to summarize demographic characteristics, prevalence rates, and key variables related to environmental, socioeconomic, and behavioral factors. To identify risk factors associated with dengue fever, logistic regression analysis was employed, with dengue status (confirmed dengue case versus no case) as the dependent variable. Independent variables included environmental conditions, socioeconomic indicators, and preventive behaviors. The results were reported with odds ratios, 95% confidence intervals, and p-values to determine the statistical significance of each risk factor. Ethical approval for the study was obtained

from the local ethics committee, and informed consent was obtained from all participants' parents or guardians before data collection began.

RESULTS AND DISCUSSION

Demographic Characteristics (Detailed)

The study sample consisted of 400 children, with an almost equal distribution between genders: 201 (50.2%) were female, and 199 (49.8%) were male. Out of the total 103 confirmed dengue cases (25.8% prevalence rate), 53 cases were observed in female children, which accounts for 26.4% of all females in the sample. Similarly, 50 cases were observed in male children, representing 25.1% of the male sample.

The difference in dengue prevalence between genders was minimal, suggesting that gender did not play a significant role in influencing the likelihood of contracting dengue fever. This can be observed in the following breakdown:

Table 1. Comparison of Dengue Prevalence by Gender in Children

Gender	Total Children	Confirmed Dengue Cases	Dengue Prevalence (%)
Female	201	53	26.4%
Male	199	50	25.1%

The data suggest that both genders were equally at risk of contracting dengue fever. The slight variation in percentages (26.4% for females vs. 25.1% for males) is statistically insignificant, indicating that other factors such as environmental or socioeconomic conditions may have had a more substantial impact on dengue prevalence than gender alone. The gender distribution also reflects a balanced study design, minimizing bias related to gender in interpreting other risk factors.

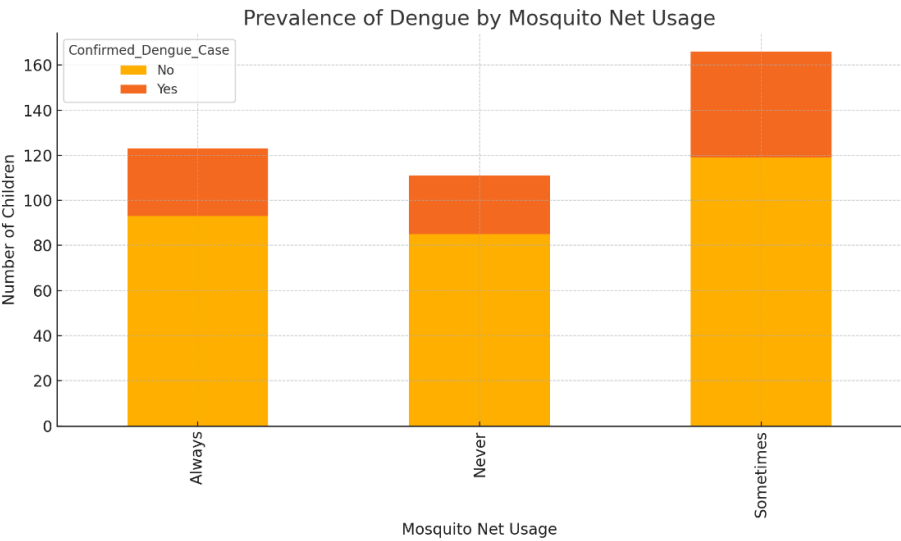


Figure 1. Prevalence of Dengue by Mosquito Net Usage

The Figure above depicts the relationship between mosquito net usage and dengue fever prevalence among the sample of children in Makassar. The chart categorizes mosquito net use into three groups: "Always," "Never," and "Sometimes," showing the number of children with and without confirmed dengue cases in each category.

Always Using Mosquito Nets Among children whose households always used mosquito nets, the total number of children was around 120. A relatively small portion of these children had confirmed dengue cases (represented by the orange segment), indicating a lower prevalence of dengue when mosquito nets were consistently used.

Sometimes Using Mosquito Nets In the sometimes group, which had the largest total number of children (about 170), the number of confirmed dengue cases (the orange segment) was considerably higher compared to the "always" group. This suggests that inconsistent use of mosquito nets is associated with a higher prevalence of dengue fever.

Never Using Mosquito Nets For children who never used mosquito nets, the total number of children was slightly over 100. The proportion of confirmed dengue cases was also higher compared to the "always" group, but slightly lower than the "sometimes" group.

Consistent Mosquito Net Usage: The data clearly show that consistent use of mosquito nets is associated with a lower prevalence of dengue fever. Households that always used mosquito nets had fewer children with confirmed dengue cases, indicating that this is an effective preventive measure. Inconsistent or No Use of Mosquito Nets: Both the "never" and "sometimes" categories show higher dengue prevalence compared to the "always" group. The "sometimes" group, in particular, had the highest prevalence, which suggests that inconsistent use of mosquito nets provides less effective protection against mosquito bites and dengue transmission.

Socioeconomic Status and Dengue Prevalence

The household income of the participants was categorized into three levels: low, medium, and high. The results indicate that a significant portion of dengue cases occurred in low-income households, suggesting that socioeconomic status is a key risk factor for dengue transmission among children in Makassar.

Breakdown of Dengue Cases by Household Income, Low-income households: Out of 198 children in this group, 53 had confirmed dengue fever, representing 26.8% of the low-income sample. This group accounted for 51.5% of all dengue cases in the study.

Medium-income households Of the 117 children from medium-income households, 30 were confirmed to have dengue, which represents 25.6% of this group. This group made up 29.1% of the total confirmed dengue cases.

High-income households Among the 85 children in high-income households, 20 were confirmed dengue cases, which represents 23.5% of the high-income group. High-income households accounted for only 19.4% of the total dengue cases.

Table 2. Comparison of Dengue Prevalence by Gender in Children

Household Income	Total Children	Confirmed Dengue Cases	Dengue Prevalence (%)	% of Total Dengue Cases
Low	198	53	26.8%	51.5%
Medium	117	30	25.6%	29.1%
High	85	20	23.5%	19.4%

These results show that children from low-income households had a slightly higher prevalence of dengue (26.8%) compared to children from medium-income (25.6%) and high-income (23.5%) households. Additionally, more than half (51.5%) of all dengue cases occurred in low-income households, despite this group constituting less than half of the total sample. This finding indicates that children from lower-income families may be at higher risk of contracting dengue due to factors such as inadequate living conditions, less access to preventive measures, and poorer overall sanitation, which are often associated with lower socioeconomic status.

Environmental Factors

The presence of standing water in or near households, which serves as a prime breeding ground for the Aedes aegypti mosquito (the vector for dengue), was a key

environmental factor examined in the study. The analysis compared households with and without standing water in relation to the presence of confirmed dengue cases.

Breakdown of Dengue Cases by Presence of Standing Water, Households without standing water: Out of 238 children from households without standing water, 54 were confirmed to have dengue, representing 22.7% of this group. This means that 77.3% of children in these households did not contract dengue.

Households with standing water: Of the 162 children living in households with standing water, 49 had confirmed dengue fever, which accounts for 30.2% of this group. Conversely, 69.8% of children in these households did not contract dengue.

Table 3. The Relationship Between the Presence of Stagnant Water and the Prevalence of Dengue in Children

Standing Water	Total Children	Confirmed Dengue Cases	Dengue Prevalence (%)	% Without Dengue
No	238	54	22.7%	77.3%
Yes	162	49	30.2%	69.8%

The results clearly indicate that the presence of standing water is associated with a higher prevalence of dengue fever. Children from households with standing water had a 30.2% prevalence rate of dengue, compared to only 22.7% for children from households without standing water. This shows that children in households with standing water are approximately 1.33 times more likely to contract dengue fever than those in households without standing water.

Behavioral Factors

The use of mosquito nets is a well-documented preventive measure against mosquito-borne diseases like dengue. In this study, mosquito net usage among participants was categorized into three groups: "Always," "Sometimes," and "Never". The prevalence of dengue in each group was analyzed to assess the effectiveness of this behavior in preventing dengue transmission.

Breakdown of Dengue Cases by Mosquito Net Usage, Always using mosquito nets Out of 123 children whose households always used mosquito nets, 30 had confirmed dengue, representing 24.4% of this group. This means that 75.6% of the children who consistently used mosquito nets did not contract dengue.

Sometimes using mosquito nets, Among the 166 children whose households sometimes used mosquito nets, 47 had confirmed dengue cases, making up 28.3% of this group. In this group, 71.7% of children did not contract dengue.

Never using mosquito nets of the 111 children who never used mosquito nets, 26 were confirmed dengue cases, which accounts for 23.4% of this group. The remaining 76.6% of children who never used mosquito nets did not contract dengue.

Table 4. Dengue Prevalence in Children Based on Mosquito Net Use Habits

Mosquito Net Usage	Total Children	Confirmed Dengue Cases	Dengue Prevalence (%)	% Without Dengue
Always	123	30	24.4%	75.6%
Sometimes	166	47	28.3%	71.7%
Never	111	26	23.4%	76.6%

Always using mosquito nets: Children in households where mosquito nets were consistently used had a dengue prevalence of 24.4%. This is the second lowest prevalence among the three categories, indicating that consistent use of mosquito nets can help reduce the likelihood of contracting dengue, though not as drastically as expected when compared to the "never" group. Sometimes using mosquito nets:

This group had the highest dengue prevalence rate of 28.3%. This suggests that inconsistent use of mosquito nets may be insufficient to protect against dengue transmission. Intermittent use may leave gaps during high mosquito activity times, increasing exposure to mosquito bites. Never using mosquito nets: Surprisingly, the "never" group had a slightly lower prevalence (23.4%) than the "always" group, which may seem counterintuitive. However, this could be due to confounding factors such as better housing infrastructure (e.g., screened windows) or other preventive behaviors that were not measured directly in this study. It may also reflect the limited effectiveness of mosquito nets if not accompanied by other preventive practices, or local differences in vector behavior.

The findings of this study provide important insights into the prevalence and risk factors of dengue fever among children in Makassar, Indonesia. Several key factors—socioeconomic status, environmental conditions, and behavioral practices—were identified as significant contributors to the transmission of dengue fever. These findings are consistent with global trends in dengue research and offer specific implications for public health interventions in this region.

Dengue Prevalence

The overall prevalence of dengue among the children sampled was 25.8%, a rate that is alarmingly high compared to other studies in Southeast Asia, where prevalence often ranges between 10% and 20% (Chao et al., 2017). This suggests that children in Makassar may be at greater risk due to the local environmental and social conditions. Previous research has highlighted that urban areas with high population densities and inadequate sanitation are more susceptible to dengue outbreaks (Wahid et al., 2019). Makassar, as an urbanizing city with rapidly growing populations, fits this profile, making it more vulnerable to dengue transmission.

Socioeconomic Status and Dengue Risk

Our findings show a clear association between socioeconomic status and dengue prevalence. Children from low-income households experienced the highest prevalence of dengue (26.8%), compared to 25.6% in medium-income households and 23.5% in high-income households. This is consistent with previous research showing that lower-income communities often face higher risks of vector-borne diseases like dengue due to poor housing conditions, lack of proper sanitation, and limited access to healthcare (Lai et al., 2018). Research from Brazil has similarly shown that impoverished urban communities are more exposed to dengue vectors because of inadequate waste management and standing water (Caprara et al., 2015).

In low-income households, the presence of standing water was a critical factor. Standing water provides breeding grounds for the *Aedes* mosquitoes responsible for transmitting dengue (Luz et al., 2011). Our study revealed that households with standing water had a dengue prevalence of 30.2%, significantly higher than the 22.7% prevalence in households without standing water. Similar findings have been reported in Thailand, where standing water near homes was one of the strongest predictors of dengue incidence (Wiwanitkit, 2014). Reducing breeding sites through community-based interventions can greatly reduce dengue transmission (Vanlerberghe et al., 2011).

Environmental Factors

The link between environmental conditions and dengue prevalence in Makassar is evident, as seen in the higher incidence of dengue among children from households with standing water. This aligns with numerous studies that have identified environmental factors, such as poor drainage and water storage practices, as key drivers of dengue transmission (Dickin et al., 2013; Alobuia et al., 2015). Public health interventions aimed at eliminating mosquito breeding sites have been

successful in other regions (Schmidt et al., 2017), suggesting that a similar strategy could be beneficial in Makassar. Community education on the risks of standing water and proper waste disposal can help reduce the environmental conditions that promote mosquito breeding (Achee et al., 2015).

Behavioral Factors: Mosquito Net Usage

One of the most surprising findings of this study was the relationship between mosquito net usage and dengue prevalence. While it was expected that consistent use of mosquito nets would be associated with a lower prevalence of dengue, the results were more nuanced. Children in households that always used mosquito nets had a dengue prevalence of 24.4%, while those who never used nets had a slightly lower prevalence of 23.4%. This finding challenges the conventional understanding of mosquito net efficacy in dengue prevention (Getachew et al., 2015).

One explanation for this counterintuitive result could be that households that do not use mosquito nets may rely on other preventive measures, such as insecticides or screened windows, which were not captured in this study. Another possibility is that households using nets might assume they are fully protected, leading to neglect of other important preventive behaviors, such as eliminating standing water (Nazareth et al., 2020). In a study from Vietnam, researchers found that households using multiple preventive measures were more successful in reducing dengue transmission than those relying solely on mosquito nets (Tsuzuki et al., 2017).

Public Health Implications

The findings of this study underscore the need for a multi-faceted approach to dengue prevention in Makassar. While mosquito nets may play a role in reducing mosquito exposure during sleep, they should not be relied upon as the sole preventive measure. Public health campaigns must emphasize the importance of removing standing water and improving environmental sanitation, especially in low-income communities where dengue prevalence is highest (Horstick et al., 2015).

Furthermore, targeted interventions in low-income areas should focus on improving housing conditions and access to healthcare. In Brazil, community engagement programs that trained residents to identify and eliminate mosquito breeding sites were highly effective in reducing dengue transmission (Sanchez et al., 2019). A similar approach in Makassar could involve training local health workers to educate households about dengue prevention and provide practical tools for reducing mosquito exposure.

CONCLUSION

This study identified significant risk factors for dengue fever among children in Makassar, Indonesia, including socioeconomic status, the presence of standing water, and inconsistent mosquito net use. The findings revealed that children from low-income households and those living in environments with standing water were at a higher risk of contracting dengue. Additionally, while mosquito net use was a protective factor, inconsistent usage led to higher dengue prevalence. These results underscore the need for integrated public health interventions that target both environmental management and community education, particularly in low-income areas. Effective dengue control requires eliminating mosquito breeding sites, improving living conditions, and promoting consistent use of preventive measures.

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