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Risk factors of dengue hemorrhagic fever in Biringkanaya District, Makassar City, Indonesia: A Case-Control Study

Factores de riesgo del dengue hemorrágico en el distrito de Biringkanaya, ciudad de Makassar, Indonesia: un estudio de casos y controles

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SUMMARY

Background: *Dengue Hemorrhagic Fever (DHF) is a very deadly disease and has become a global health threat, especially in tropical areas, with millions of cases occurring each year and a significant mortality rate.* **Aim:** *The research aims to analyze risk factors for the incidence of dengue hemorrhagic fever (DHF) in Biringkanaya District, Makassar City, in 2023.* **Method:** *This study is quantitative research using case-control study.* **Results:** *The results showed that the use of mosquito repellent (OR=5.254, 95 %CI=2.167-12.812), behavior of eradicating mosquito nests (OR=4.355, 95 % CI=1.807-10.876), and support from health workers (OR=5.392, 95 %CI=2.152-14.325) is a significant risk factor for the incidence of dengue fever in Biringkanaya District, Makassar City. The results of the multivariate logistic regression analysis showed that the risk factors for the behavior of eradicating mosquito nests after being controlled by the variables of using mosquito repellent and support from health workers were significant (OR=9.158, 95 %CI=3.054-27.458) on the incidence of dengue fever in Biringkanaya District, Makassar City. The probability of dengue fever occurring in those who do not use mosquito repellent, are not good at implementing mosquito nests eradication and do not receive support from health workers is 88.6 %* **Conclusion:** *The behavior of eradicating mosquito nests is the most risky factor for the incidence of dengue fever in Biringkanaya District, Makassar City, in 2023.*

Keywords: *Dengue fever, mosquito nest eradication, risk factors.*

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RESUMEN

Antecedentes: *La fiebre hemorrágica del dengue (FHD) es una enfermedad muy mortal y se ha convertido en una amenaza para la salud mundial, especialmente en las zonas tropicales, con millones de casos cada año y una tasa de mortalidad significativa.* **Objetivo:** *La investigación tiene como objetivo analizar los factores de riesgo de la incidencia de la fiebre hemorrágica del dengue (FHD) en el distrito de Biringkanaya, ciudad de Makassar en 2023.* **Método:** *Este estudio es una investigación cuantitativa mediante estudio de casos y controles.* **Resultados:** *Los resultados mostraron que el uso de repelente de mosquitos (OR = 5,254, IC del 95 % = 2,167-12,812), el comportamiento de erradicación de nidos de mosquitos (OR = 4,355, IC del*

95 % = 1,807-10,876) y el apoyo de los trabajadores de la salud (OR = 5,392, IC del 95 % = 2,152-14,325) son un factor de riesgo significativo para la incidencia de la fiebre del dengue en el distrito de Biringkanaya, ciudad de Makassar. Los resultados del análisis de regresión logística multivariante mostraron que los factores de riesgo para el comportamiento de erradicación de nidos de mosquitos después de ser controlados por las variables de uso de repelente de mosquitos y apoyo de los trabajadores de la salud fueron significativos (OR = 9,158, IC del 95 % = 3,054-27,458) en la incidencia de la fiebre del dengue en el distrito de Biringkanaya, ciudad de Makassar. La probabilidad de que se presente dengue en quienes no usan repelente de mosquitos, no son buenos en la implementación de la erradicación de nidos de mosquitos y no reciben apoyo de los trabajadores de la salud es del 88,6 %. **Conclusión:** *La conducta de erradicar nidos de mosquitos es el factor de mayor riesgo para la incidencia de dengue en el distrito de Biringkanaya, ciudad de Makassar en 2023.*

Palabra clave: *Dengue, erradicación de nidos de mosquitos, factores de riesgo*

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is an *Aedes* mosquito-borne infectious disease caused by the *dengue virus* (DENV), a member of the Flaviviridae family, which produces flu-like illnesses in humans which is transmitted to humans through the bite of mosquitoes infected with the dengue virus DHF is one of the most common and rapidly spreading vector-borne tropical diseases worldwide (1). The two most common forms of disease affecting people are comparatively less severe dengue fever and more severe dengue hemorrhagic fever. This disease is endemic in over 100 African countries, East Mediterranean America, Southeast Asia, and the West Pacific. The Americas, Southeast Asia, and the Western Pacific are the worst affected, with Asia representing around 70 % of the global disease burden. Dengue fever spread to new areas, including Europe, and explosive outbreaks occurred. The largest number of dengue fever incidents ever reported globally occurred in 2019. All regions were affected, and dengue fever transmission was recorded for the first time in Afghanistan. The Americas region reported 3.1 million cases, with more than 25 000 classified as severe cases (2).

The Extraordinary Event (KLB) of dengue fever in Indonesia was first reported in 1968 in Jakarta and Surabaya, with 58 cases and 24 deaths (41.3 %). Data from the Ministry of Health shows that the incidence of dengue fever in Indonesia will fluctuate from 2021-2023. In 2021, the incidence of dengue fever in Indonesia was 27 per 100 000 population, doubling in 2022 to 59 per 100 000 population and decreasing again to 35 per 100 000 population in 2023. A fluctuating Case Fatality Rate also followed this fluctuating incidence in 2021. The 2021 Case Fatality Ratio (CFR) for dengue fever in Indonesia is 0.96 %, sloping in 2022 to 0.93 %, and 0.77 % in 2023. This death rate exceeds the 0.5 % limit set in the 2021 National *Dengue Control Strategy target* -2025 (Ministry of Health, 2023).

The proportion of dengue fever cases is almost evenly distributed in every sub-district in Makassar City. Still, Biringkanaya District is a sub-district with a very high and consistent trend of cases in the last three years. In 2021, 2 cases were found in Biringkanaya District, increasing to 33 cases in 2022, and increasing again in 2023 to 42 cases (3). The sharp increase in dengue fever cases is a serious problem because this disease can kill sufferers if not treated quickly. Consistent increases can also signal the potential for an outbreak that could spread quickly and affect many people.

One effort that can be made to control dengue fever is to know the factors that are interrelated with each other (4). Environmental factors, sociodemographic factors, and the achievements of the dengue eradication program should receive attention (5). However, relatively accurate and complete data that can explain this is not yet available. Thus, this study aims to analyze risk factors for Dengue Hemorrhagic Fever (DHF) incidence in Biringkanaya District, Makassar City, in 2023.

METHODOLOGY

Research Design: This type of research is quantitative using a case-control study design.

Population and Sample: The population in this study were residents of Biringkanaya District, Makassar City, who had suffered from dengue

fever in 2023. The sample cases in this study were residents of the Biringkanaya subdistrict, Makassar city, who had suffered from dengue fever in 2023, totaling 42 people. The control sample was residents of the Biringkanaya subdistrict, Makassar City, who had never suffered from dengue fever, and no family members had ever suffered from dengue fever. The comparison between the case and control groups used a ratio of 1:2, so the total sample for this study was 126.

Research Variables: Dengue hemorrhagic fever is the dependent variable in this study. The independent variables are mosquito repellent use, the habit of hanging clothes inside the home, the eradication of mosquito nets behavior, mosquito screen use, and health worker support. The sampling technique employed is exhaustive sampling.

Data Analysis: Data were processed using the Stata version 14 program. The association and magnitude of risk factors between dependent and independent variables were analyzed using the Chi-Square test. The logistic regression test was implemented for the multivariate analysis with a 95 % confidence level (α=0.05).

Ethical Approval

This study was approved by the Health Research Ethic Committee of Hasanuddin University with a recommendation for ethical approval number 1429/UN4.14.1/TP.01.02/2024 dated June 14, 2024.

RESULTS

Table 1 shows that most respondents in the study were in the 14–44-year age group, 50.0 % in the case group and 66.67 % in the control group. Based on gender, 57.14 % of cases and controls were female because *matching was carried out*.

Table 1
Characteristics of Respondents in Biringkanaya District, Makassar City, 2023

Respondent Characteristics	Case		Control	
	n=42	%	n=84	%
Age Group				
1-5 Years	3	7.14	0	0.00
6-14 Years	15	35.71	3	3.57
15-44 Years	21	50.00	56	66.67
≥45 Years	3	7.14	25	29.76
Gender				
Male	18	42.86	36	42.86
Female	24	57.14	48	57.14
Level of education				
Not in school/Not completed elementary	11	26.19	3	3.57
Elementary School/Equivalent	4	9.52	0	0.00
Middle School/Equivalent	4	9.52	13	15.48
High School/Equivalent	16	38.10	41	48.81
Academy/Diploma	3	7.14	3	3.57
College	4	9.52	24	28.57
Employment Status				
No/Not Yet Employed	28	66.67	24	28.57
Entrepreneur/Trader	1	2.38	14	16.67
Government employees	3	7.14	9	10.71
Private employees	7	16.67	10	11.90
Army/Police	1	2.38	1	1.19
Farmer/Laborer	0	0.00	1	1.19
Other	2	4.76	26	30.59
Total	42	100.00	84	100.00

Source: Primary Data, 2024

The highest proportion of education levels studied was high school/equivalent education levels, with a percentage higher in the control group (48.81 %) than in the case group (38.10 %).

Based on occupation, respondents in this study were dominated by those who did not/had not worked. The percentage of respondents who did not/had not worked was higher in the case group (66.67 %) than in the control group (28.57 %).

The bivariate analysis in Table 2 shows significant variables, including the use of mosquito repellent (OR=5.254; 95 % CI=2.167-12.812), the habit of hanging clothes (OR=4.144; 95 % CI=1.722-10.339), behavior eradication of mosquito nests (OR=4.355; 95 % CI=1.807-10.876), use of mosquito netting (OR=2.890; 95 % CI=2.152-8.069), support from health workers (OR=5.392; 95 % CI=2.152-14.325).

All variables have a p-value<0.25, including the use of mosquito repellent (p=0.0001), the habit of hanging clothes (p=0.0004), the behavior of eradicating mosquito nests (p=0.0003), the use of mosquito screen (p=0.00162), and support from health workers (p=0.0001).

Table 2

Bivariate Analysis of Risk Factors for Dengue Hemorrhagic Fever Incidence in Biringkanaya District, Makassar City in 2023

	dengue fever		Non-DHF		OR	P-Value	95 %CI
	n=42	%	n=84	%			
Anti-Mosquito Use							
Use	18	42.86	67	79.76	5,254	0.0001*	2,167-12,812
Not Use	24	57.14	17	20.24			
Habit of Hanging Clothes							
No	11	26.19	50	59.52	4,144	0.0004*	1,722-10,339
Yes	31	73.81	34	40.48			
Behavior Eradication of Mosquito Nests							
Good	11	26.19	51	60.71	4,355	0.0003*	1,807-10,876
Less	31	73.81	33	39.29			
Use of Mosquito Screen							
Mosquito Screen in Good Condition	8	19.05	34	40.48	2,890	0.0162*	1,124-8,06
No Gauze/Gauze in Poor Condition	34	80.95	50	59.52			
Health Worker Support							
There is a Health Worker Support	9	21.43	50	59.52	5,392	0.0001*	2,152-14,325
No Health Worker Support	33	78.57	34	40.48			
Total	42	100.00	84	100.00			

* Candidate variables (p<0.25) that will proceed to multivariate analysis.

Table 3 shows the results of multivariate analysis with logistic regression analysis of three variables with p-value of <0.05, including the use of mosquito repellent (p=0.0001), mosquito nests eradication behavior (p=0.0001), and support from health workers (p=0.002). This means that these three variables are related to dengue hemorrhagic fever incidence.

Based on the adjusted odds ratio (AOR) values of the three variables, the behavior of eradicating mosquito nests is the biggest risk factor, with an AOR value of 9,158 and a CI 95 % LL-UL value of 1,847-13,987. The AOR value obtained is significant. This means that those who fail to eradicate mosquito nests are at risk of contracting dengue fever 9,158 times more than those who succeed in eradicating mosquito nests.

Table 3

Multivariate Logistic Regression Modeling of Risk Factors for Dengue Hemorrhagic Fever (DHF) in Biringkanaya District, Makassar City in 2023

Risk Factors for DHF	p-value	OR	95 %CI	
			LL	UL
Anti-Mosquito Use	0.0001	6,900	2,422	19,651
Mosquito Nest Eradication Behavior	0.0001	9,158	3,054	27,458
Health Worker Support	0.002	5,084	1,847	13,987

Source: Primary Data, 2024

In accordance with the results of the previous analysis, the variables that influence the incidence of dengue fever are the use of mosquito repellent, behavior to eradicate mosquito nests, and support from health workers. So, the regression equation is

$y = \text{const} + \text{coef}_{(x1)} + \text{coef}_{(x2)} + \text{coef}_{(x3)}$

$y = -3.719288 + 2.214706 + 1.626119 + 1.931555$

$y = 2.053092$

After obtaining the y value, the next step is to calculate the probability of the subject using the formula:

$P = 1 / (1 + \exp^{(-y)})$

$P = 1 / (1 + \exp^{(-2,053092)})$

$P = 0\ .88625968$

Based on this value, the probability of dengue fever occurring in those who do not use mosquito repellent, are not skilled at implementing mosquito nests eradication and do not receive support from health workers is 88.6 %.

DISCUSSION

This study analyzed the risk and protective factors associated with the Dengue Hemorrhagic Fever (DHF) incidence in Biringkanaya District, Makassar City, in 2023. Our findings showed that more respondents who did not use mosquito repellent suffered from dengue fever. The OR test results show mosquito repellent is the most significant risk factor for dengue fever in Biringkanaya District, Makassar. These results are in line with Yerrilakshmi (6), the highest case fatality rate (CFRin Sri Sathya Sai District, Andhra Pradesh, India, who demonstrated that 77.09 % of dengue fever incidents occurred in those who rarely used repellent, with a risk of 6.1 times. Meanwhile, Awan et al. (7) in a Pakistani city, the opposite results were found, indicating that mosquito repellent is not a risk factor for dengue fever.

There are no effective vaccines against mosquito-borne diseases except those against Japanese encephalitis and yellow fever (8). Therefore, prevention of mosquito bites remains the most common strategy to control or minimize the incidence of mosquito-borne diseases, including febrile illnesses (9). Repellants are commonly used for personal protection against mosquito bites due to their effectiveness, availability, and ease of use (10). However, the findings showed that most respondents did not or rarely used mosquito repellent because their rooms had a fan or air conditioner. They also believe they don't need special protection in the morning and evening because they are busy with daily activities. Apart from that, some respondents felt uncomfortable using mosquito repellent because the smell was strong and uncomfortable on the skin.

Regarding the habit of hanging clothes, most dengue fever cases occur in those who hang clothes in the house. Bivariate analysis indicates that the habit of hanging clothes is a significant risk factor for the incidence of dengue fever. However, the results of the multivariate analysis show that the habit of hanging clothes is not a

risk factor for the incidence of dengue fever in Biringkanaya District, Makassar City, in 2023. These results are in line with Ferial (11) who show that hanging clothes is statistically not a risk factor for dengue fever in Depok City, West Java. This is because the age group that is most infected with dengue fever is the 15-44-year-old age group, which is classified as a productive age group. At this vulnerable age, the amount of outdoor activity is still very high, which will increase the risk of exposure to dengue fever. This study also aligned with Erwin et al. (12) in Sikka, Indonesia. On the contrary, Ilham et al. (13) stated that respondents who had the habit of hanging clothes had a 3 519 times greater risk of contracting dengue fever than respondents who did not.

This research shows that eradicating mosquito nests behavior is a significant risk factor for dengue fever in Biringkanaya District, Makassar City, in 2023. Families with poor mosquito nests eradication are at a 9.158 times greater risk of being exposed to the dengue virus than those good at implementing mosquito nests eradication. These results align with Darma et al. (14), who found that poor mosquito breeding behavior can increase the risk of dengue fever by 2.97 times. *Aedes aegypti* mosquitoes can breed in clean water containers, so draining these containers should be done at least once a week. Suppose the draining habit is carried out more than once a week. In that case, this provides an opportunity for mosquito eggs to hatch and develop into adult mosquitoes because the cycle from egg, larva, and pupa to adult takes approximately one week. In dense environments, environmental cleanliness does not only depend on one household but requires cooperation from the entire community. The environmental impact can be felt if one household neglects to eradicate mosquito nests. For example, a puddle of water in a yard or public area can become a nest for mosquitoes, which affects many people around it (14,15).

This study shows that most dengue cases occur in those with houses without screens or with poor ventilation screens. Bivariate analysis also indicates that the use of mosquito netting is a significant risk factor for the incidence of dengue fever. However, the results of the multivariate analysis show that using gauze is not a risk factor for the incidence of dengue fever in Biringkanaya District, Makassar City, in 2023. These results align with Sacramento et al. (16) in Tapera, Northeast Brazil, who found that the use of insect protection at home was not related to the incidence of dengue fever. This is because there is no specific antiviral treatment or vaccine against dengue fever; the main options available for preventing and controlling dengue fever are controlling the larval habitat in and around the home and workplace and reducing human-vector contact through personal protection. Meanwhile, Zulfikar (17) indicated a significant relationship betwen wire mesh and dengue fever incidence in the Kebayakan Community Health Center working area, 2017.

Ventilation screens effectively prevent *Aedes aegypti* mosquitoes, the primary vector of dengue hemorrhagic fever, from entering the house. Ventilation screens that are damaged, have holes or are poorly maintained can reduce their effectiveness in preventing the entry of mosquitoes, thereby increasing the risk of dengue fever (18). Therefore, installing ventilation screens and carrying out routine checks and maintenance is important to ensure that protection against dengue fever remains optimal.

The present study indicates that support from health workers is a significant risk factor for the incidence of dengue hemorrhagic fever in Biringkanaya District, Makassar City. Respondents who did not receive support from health workers were 5,084 times more likely to contract dengue fever. Nurcahya et al. (19) showed similar results, since they found that support from health workers was a risk factor for the incidence of dengue fever in the Simpang Teritip Community Health Center Working Area, West Bangka Regency. Health workers act as facilitators in outreach and educate the community about how to eradicate mosquitoes. They can also carry out home visits to ensure that people understand and participate in activities to eradicate mosquito nests. Health workers also function as mobilizers and supervisors in these activities and distribute abate powder when carrying out Periodic Larvae Inspections (PJB).

The results of this study are not in line with Pertiwi and Sudaryati, Medan City, who found

no relationship between health workers' support and dengue fever incidence (20,21). Liestyana (22) also contradicts this conclusion, stating that there was no significant relationship between the incidence of dengue fever and health workers' support.

Support from health workers is very important as a risk control factor for dengue fever. Without their active role in prevention and education, the public may not fully understand the importance of maintaining environmental cleanliness and eradicating mosquito nests. As mobilizers and supervisors, health workers ensure that health programs are implemented well and reach all levels of society. Therefore, their presence and support are key in reducing the risk of increasing dengue cases and protecting public health.

The results of this study indicate that the behavior of eradicating mosquito nests is the most dominant factor in the incidence of dengue hemorrhagic fever. PSN behavior in densely populated urban areas is often less effective due to limited time and busy daily lives. Urban residents generally have busy lifestyles, so many do not have enough time or attention to regularly eradicate mosquito nests, such as cleaning bathtubs, tightly closing water reservoirs, or throwing rubbish in its proper place. As a result, urban environments become more susceptible to mosquito breeding, which increases the risk of dengue fever cases.

CONCLUSION

The use of mosquito repellent, the behavior of eradicating mosquito nests, and the support of health workers are risk factors related to the incidence of dengue fever in Biringkanaya District, Makassar City. It is recommended that the community implement 3M behavior (draining, closing water reservoirs, and recycling used items that can hold water) and that health workers carry out environmental interventions by identifying and eliminating potential mosquito nests, such as puddles of water and water reservoirs open before dengue cases appear.

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