

Analysis of Risk Factors Associated with Rabies Cases in South Timor Tengah Regency, East Nusa Tenggara, Indonesia

Lucitania Floreca Mokos¹⁾, Setro Sri Rahardjo²⁾, Bhisma Murti¹⁾,
Yulia Lanti Retno Dewi²⁾, Nur Hafidha Hikmayani²⁾

¹⁾Master's Program in Public Health, Universitas Sebelas Maret

²⁾Faculty of Medicine, Universitas Sebelas Maret

Received: Augst 15, 2025; Accepted: September 10, 2025; Available online: October 16, 2025

ABSTRACT

Background: Rabies is a zoonotic infectious disease that can be directly transmitted to humans and is fatal, leading to death in South Timor Tengah Regency. Rabies has been officially declared an outbreak in this region. This study aimed to analyze the effects of selected risk factors on rabies cases in South Timor Tengah Regency, East Nusa Tenggara Province, Indonesia.

Subjects and Method: This study used primary data and employed an analytic observational design with a case-control approach. A total of 200 participants were included, consisting of 100 rabies cases and 100 controls, drawn from a population of 4,749 cases and controls using random sampling across 32 subdistricts in South Timor Tengah Regency. The dependent variable was rabies case status. The independent variables included community knowledge, history of contact with dogs, vaccination status of pet dogs, age, sex, stray dog bites, and stray dog population density. Data were collected using a questionnaire that had been tested for validity and reliability. Path analysis was conducted using STATA version 13.

Results: The study found significant associations between rabies cases and community knowledge (OR= 0.06; 95% CI= 0.03-0.16; $p < 0.001$), stray dog population density (OR= 2.72; 95% CI= 1.30-5.70; $p = 0.008$), stray dog bites (OR = 4.59; 95% CI= 1.97-10.69; $p < 0.001$), age (OR= 0.97; 95% CI= 0.95-0.99; $p = 0.008$), and sex (OR= 0.33; 95% CI= 0.16-0.71; $p = 0.005$). In contrast, history of contact with dogs (OR= 1.30; 95% CI= 0.62-2.71; $p = 0.487$), vaccination of pet dogs (OR= 0.89; 95% CI= 0.37-2.13; $p = 0.796$), and educational level (OR = 1.31; 95% CI= 0.54-3.15; $p = 0.553$) were not statistically significant.

Conclusion: High stray dog population density and stray dog bites increase the risk of rabies, while higher community knowledge, female sex, and age ≥ 35 years serve as protective factors against rabies in the population of South Timor Tengah Regency.

Keywords: rabies, rabies vaccination, stray dog bites, outbreak

Correspondence:

Setyo Sri Rahardjo. Faculty of Medicine, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta, Central Java 57126, Indonesia. Email: setyosri@staff.uns.ac.id

Cite this as:

Mokos LF, Rahardjo SS, Murti B, Dewi YLR, Hikmayani NH (2025). Analysis of Risk Factors Associated with Rabies Cases in South Timor Tengah Regency, East Nusa Tenggara, Indonesia. J Epidemiol Public Health. 10(4): 555-565. <https://doi.org/10.26911/jepublichealth.2025.10.04.11>.



© Lucitania Floreca Mokos. Published by Master's Program of Public Health, Universitas Sebelas Maret, Surakarta. This open-access article is distributed under the terms of the [Creative Commons Attribution 4.0 International \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/). Re-use is permitted for any purpose, provided attribution is given to the author and the source is cited.

BACKGROUND

Rabies is a zoonotic disease transmitted from animals to humans through bites, scratches, or contact with the saliva of rabies-transmitting animals. It is a fatal disease that attacks the central nervous system and is caused by the Lyssavirus of the family Rhabdoviridae (Ministry of Health of the Republic of Indonesia, 2020). The World Health Organization (WHO) reports that approximately 95% of human rabies deaths result from bites by rabid dogs, with an estimated 59,000 deaths occurring globally each year (Fooks et al., 2015). Rabies cases have been reported in more than 150 countries worldwide, with the highest burden observed in Asia, where nearly 40% of cases occur among children under 15 years of age (CDC, 2017). In addition to its health impact, rabies causes substantial global economic losses, estimated at approximately USD 9 billion annually (WHO, 2023).

In Indonesia, rabies remains a serious public health problem, with its spread reaching 36 provinces by 2019 (Ministry of Health of the Republic of Indonesia, 2020). Between 2015 and 2018, more than 500,000 cases of rabies-transmitting animal bites were reported, with 836 confirmed human rabies cases (Directorate General of Disease Prevention and Control, 2018). In 2023 alone, 31,113 bite cases and 11 rabies-related deaths were recorded, primarily due to bites from rabid dogs. Dogs account for approximately 98% of rabies transmission in Indonesia, while the remaining cases are transmitted by monkeys and cats (Ministry of Health of the Republic of Indonesia, 2020). These data indicate that rabies continues to pose a serious public health threat despite ongoing prevention efforts.

East Nusa Tenggara Province, particularly South Timor Tengah Regency, represents one of the regions with the highest

rabies burden and has been officially designated as experiencing a rabies outbreak. This designation followed reported rabies-related deaths resulting from dog bites in Fenum Village, South Amanatun District, in 2023, along with a rapid increase in cases over three consecutive days (South Timor Tengah District Health Office, 2023). According to data from the South Timor Tengah District Health Office, as of February 2025, a total of 4,749 rabies-transmitting animal bite cases and 18 deaths had been reported across 32 subdistricts. The high incidence of rabies suggests that prevention measures, such as dog vaccination programs and community education, have not yet been optimally implemented.

Rabies transmission is influenced by multiple risk factors related to both animal reservoirs, particularly dogs, and human populations. Previous studies have identified community knowledge as a significant risk factor for rabies in Ambon (OR= 3.1), while poor dog ownership practices were associated with a substantially higher risk (OR= 8.6) (Wattimena and Suharyo, 2015). In Maputo and Matola, Mozambique, rabies risk was associated with age under 15 years, bites from stray dogs, deep wounds, bites to the head, bites from vaccinated dogs, lack of wound washing with soap and water, and absence of post-exposure prophylaxis (Salomao et al., 2017). In Pulau Morotai Regency, individuals aged 25–49 years accounted for the highest proportion of rabies-transmitting animal bites (53.3%), with females representing the majority of cases (53.3%) (Tebekew et al., 2023). Furthermore, high dog population density (96 dogs per km²) has been identified as a key risk factor for rabies occurrence among dogs in Bali (Mahardika, 2016). Free-roaming dog ownership practices were associated with a significantly increased risk of rabies transmission (OR = 5.62) due to

increased human–dog contact (Sudarnika et al., 2020). Educational level has also been shown to influence rabies prevention behaviors among schoolchildren and teachers (Tenzin et al., 2021).

Rabies is classified as a neglected tropical disease, predominantly affecting impoverished and remote communities. The disease is almost invariably fatal once clinical symptoms appear, as no effective curative treatment is currently available. Prevention efforts rely primarily on vaccination and the administration of rabies immunoglobulin following exposure (CDC, 2024). Limited access to health services and low community awareness present major challenges to rabies control in endemic areas such as South Timor Tengah Regency.

Given the high incidence of rabies, the substantial social and economic burden it imposes and the lack of comprehensive studies examining rabies risk factors in South Timor Tengah Regency, further investigation is warranted. This study aims to identify and analyze the effects of key risk factors, including community knowledge, history of contact with dogs, age, sex, stray dog bites, vaccination status of pet dogs, dog population density, and educational level, on rabies cases. The findings are expected to provide evidence-based support for the development of more effective rabies prevention and control strategies in South Central Timor Regency.

SUBJECTS AND METHOD

1. Study Design

This study employed an analytic observational design with a case–control approach. The research was conducted in South Timor Tengah Regency, East Nusa Tenggara (NTT) Province, an area recognized as endemic for rabies. Data collection was carried out from April to May 2025.

2. Population and Sampel

The case population consisted of all individuals in the South Central Timor Regency who were at risk of exposure to rabies, while the control population comprised individuals who were not exposed to rabies. Sample selection was conducted using a fixed disease sampling approach based on disease status. The sample size was determined using Roscoe's theory, resulting in 100 case samples and 100 control samples. Participants in each group were selected through random sampling

3. Study Variables

The dependent variable was rabies infection. The independent variables included community knowledge, age, sex, history of contact with dogs, vaccination status of pet dogs, stray dog bites, dog population density, and educational level

4. Variable Operational Definition

Rabies is a viral disease caused by *Lyssavirus* of the family *Rhabdoviridae*, which is present in the saliva of rabies-transmitting animals. The virus has a characteristic bullet-shaped morphology and is transmitted primarily through dog bites or through saliva that comes into direct contact with mucosal surfaces or open skin wounds among communities in the South Central Timor (TTS) Regency. Clinical symptoms include fever, lethargy, loss of appetite, sleep disturbances, hallucinations, decreased consciousness and a burning sensation at the bite site. Data were obtained from medical records, with measurements conducted through observation and interviews. The measurement scale was dichotomous.

Community knowledge refers to the extent to which individuals in South Timor Tengah Regency understand rabies, including its causes, signs and symptoms, potential dangers, awareness of rabies-transmitting dogs, proper dog ownership practices and preventive measures. Data were

collected using a structured questionnaire through observation and interviews. The measurement scale was initially continuous and subsequently categorized into a dichotomous scale.

History of contact refers to any prior physical interaction between individuals and dogs, including bites, scratches, or contact with dog saliva that may potentially transmit rabies among residents of the South Timor Tengah Regency. Data were collected using a questionnaire through observation and interviews and the variable was measured on a dichotomous scale.

Vaccination status of pet dogs refers to whether owned dogs in South Timor Tengah Regency had received rabies vaccination as a preventive measure to reduce the risk of rabies virus transmission. Vaccination induces immune effectors and stimulates the host immune system and memory cells. Data were collected using a questionnaire through observation and interviews. The measurement scale was initially continuous and then categorized into a dichotomous scale.

Age refers to the chronological age of individuals in the community, categorized into two groups based on a predefined cutoff that may influence rabies occurrence in South Timor Tengah Regency. Data were collected using a questionnaire through observation and interviews. The measurement scale was initially continuous and subsequently dichotomized.

Sex refers to the biological classification of individuals and is examined in relation to the risk of developing rabies following exposure to rabies-transmitting dog bites in South Timor Tengah Regency. Data were collected using a questionnaire through observation and interviews, and the variable was measured on a dichotomous scale.

Stray dog bites refer to bites inflicted by dogs of unknown rabies infection status that

are not owned and have direct contact with residents of South Timor Tengah Regency. Data were collected using a questionnaire through observation and interviews. The measurement scale was initially continuous and then categorized into a dichotomous scale.

Dog population density refers to the number of dogs within a specific geographic area per unit area (km²), classified according to a predetermined threshold in South Timor Tengah Regency. Data were collected using a questionnaire through observation and interviews. The measurement scale was initially continuous and subsequently dichotomized.

Educational level refers to the highest level of formal education completed by individuals, which may influence their understanding and behaviors related to rabies. Data were collected using a questionnaire through observation and interviews. The measurement scale was initially continuous and later categorized into a dichotomous scale.

5. Study Instruments

The research instrument consisted of a closed-ended, structured questionnaire that had been tested for validity and reliability. The questionnaire included items on respondents' characteristics and questions related to risk factors associated with rabies cases. Secondary data, including case samples, vaccination records, dog population density, and history of contact with dogs, were obtained from medical records at health care facilities, as well as reports from the South Timor Tengah District Health Office and the District Livestock Service.

6. Data Analysis

Univariate analysis was conducted to describe the frequency distributions and percentages of all study variables. Bivariate analysis was performed to examine the associations between independent and

dependent variables using simple logistic regression. Multivariate analysis employed path analysis to assess both direct and indirect effects of risk factors on rabies cases. Path analysis was conducted through several steps, including model specification, model identification, assessment of model fit, parameter estimation and model respecification when necessary.

7. Ethical Consideration

This study adhered to ethical principles, including informed consent and confidentiality, which were carefully addressed throughout the research process. Ethical

approval was obtained from the Research Ethics Committee of Dr. Moewardi Hospital, Surakarta, Indonesia (No. 761-IV/HREC/2025), dated 26 April 2025.

RESULTS

1. Sample Characteristics

A total of 200 study participants were interviewed, comprising 100 case samples and 100 control samples. The mean age of the participants was 35.05 years, with a standard deviation of 18.19. Detailed characteristics of the continuous variables are presented in Table 1.

Table 1. Sample characteristics (continous data)

Variable	Mean	SD	Min	Max
Age (years old)	35.51	18.19	2	85

The characteristics of the study sample are presented in Table 2, which summarizes the categorical variables, including rabies case status, community knowledge, history of contact with dogs, vaccination status of pet

dogs, age, sex, stray dog bites, dog population density, and educational level. The study included an equal number of rabies cases and non-cases, with 100 participants in each group (50%).

Table 2. Sample characteristics (categorical data)

Sample characteristics	Category	n	%
Rabies infection	Case	100	50.0%
	Control	100	50.0%
Knowledge	Low	118	59.0%
	High	82	41.0%
Contact history	Yes	97	48.5%
	No	103	51.5%
Rabies vaccination	No	125	62.5%
	Yes	75	37.5%
Age (years old)	<35 years old	113	56.5%
	≥35 years old	87	43.5%
Sex	Male	102	51.0%
	Female	98	49.0%
Stray dog bites	Yes	112	56.0%
	No	88	44.0%
Dog population density	High	109	54.5%
	Low	91	45.5%
Education level	<Senior high school	84	42.0%
	≥Senior high school	116	58.0%

Most participants demonstrated a high level of knowledge about rabies, accounting

for 118 individuals (59.0%), compared with those with low knowledge. A slight majority

of participants reported no history of contact with dogs (103 participants; 51.5%). Regarding pet dog vaccination, a larger proportion of participants reported that their pet dogs had not been vaccinated against rabies (62.5%) compared with those whose dogs had received vaccination.

In terms of age distribution, most participants were in the <35-year age group, with 113 individuals (56.5%), compared with those aged ≥35 years. Male participants slightly outnumbered females, with 102 males (51.0%). More than half of the participants reported having been bitten by stray dogs, accounting for 112 individuals (56.0%). Additionally, the majority of participants resided in areas with high dog population density (109 participants; 54.5%). Regarding educa-

tional attainment, a higher proportion of participants had completed senior high school or higher education (≥ senior high school), representing 58.0% of the sample, compared with those with lower educational levels (< junior high school).

2. Bivariate analysis

Table 3 presents the results of a simple logistic regression analysis examining risk factors associated with rabies cases. The analysis identified several variables with statistically significant associations. Community knowledge was significantly associated with rabies incidence, indicating a protective effect (OR = 0.10; 95% CI = 0.02–0.14; p < 0.001). In contrast, no significant association was observed between vaccination of owned dogs and rabies cases.

Table 3. The results of the simple logistic regression analysis examining factors associated with rabies cases

Independent variables	OR	95% CI		P
		Lower limit	Upper limit	
Knowledge	0.10	0.02	0.14	<0.001
Contact history	1.30	0.62	2.71	0.487
Rabies vaccination	0.89	0.37	2.13	0.796
Age (years old)	0.46	0.22	0.98	0.045
Sex	0.33	0.16	0.71	0.004
Stray dog bites	5.36	2.17	13.24	<0.001
Dog population density	2.90	1.36	6.18	0.006
Education	1.31	0.54	3.15	0.553
N observation = 200				
-2 log likelihood= 89. 82				
Nagelkerke R 2 = 97.6%				

Age was significantly associated with rabies cases (OR = 0.46; 95% CI = 0.22–0.98; p = 0.045), suggesting a lower risk in older age groups. Sex also showed a significant association (OR = 0.33; 95% CI = 0.16–0.71; p = 0.004). Individuals who experienced bites from stray dogs had a substantially higher risk of rabies (OR = 5.36; 95% CI = 2.17–13.24; p < 0.001). Additionally, higher dog population density was significantly asso-

ciated with an increased risk of rabies (OR= 2.90; 95% CI= 1.36–6.18; p= 0.006).

Conversely, educational level was not significantly associated with rabies cases. On the other hand, educational attainment did not show a statistically significant association with rabies cases, suggesting that differences in education level were not a determining factor in the occurrence of rabies within the studied population.

3. Multivariate analysis

Multivariate analysis using path analysis was conducted to examine both direct and

indirect effects on rabies cases among the community in South Timor Tengah Regency.

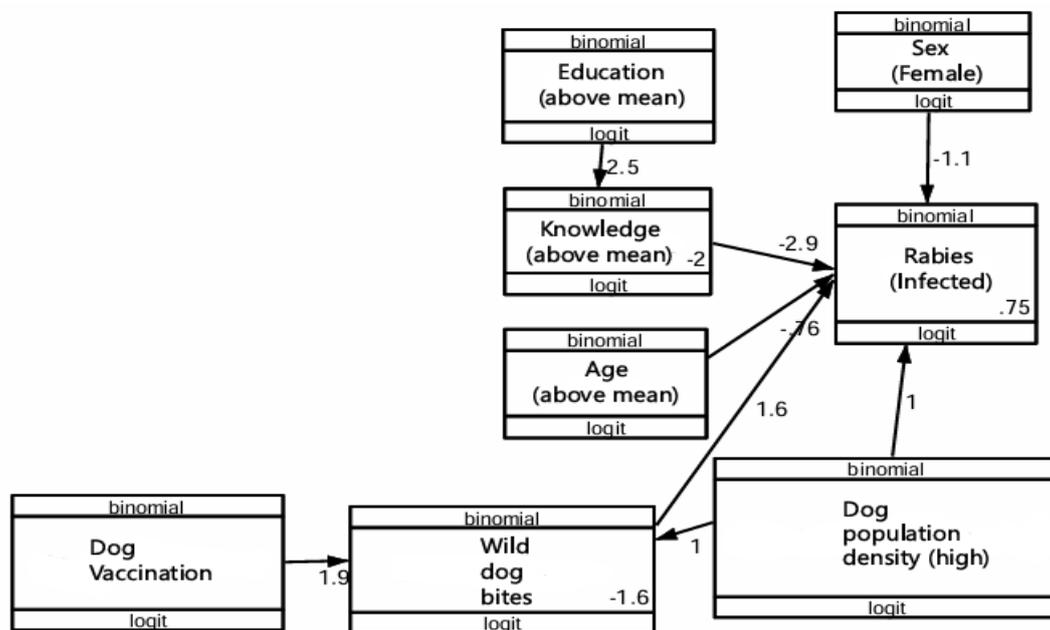


Figure 1. Path diagram illustrating factors influencing rabies cases in South Timor Tengah Regency

The path diagram in Figure 1 illustrates the direct and indirect relationships between sociodemographic factors, knowledge, and environmental factors influencing rabies infection. Education affects rabies risk indirectly through its influence on knowledge, while age, sex, knowledge, wild dog bites, and dog population density show direct effects on rabies cases. Dog vaccination is indirectly associated with rabies through its effect on wild dog bites.

The results presented in Table 4 indicate that higher community knowledge acts as a protective factor, reducing the risk of rabies by 0.06 times compared with individuals with lower knowledge levels (OR= 0.06; 95% CI= 0.03–0.16; $p < 0.001$). Female sex was also identified as a protective factor, with women having a 0.33 times lower risk of rabies compared with men (OR= 0.33; 95% CI = 0.16–0.71; $p=$

0.005). In addition, individuals aged 35 years or older in South Timor Tengah Regency had a lower risk of rabies compared with those younger than 35 years (OR= 0.97; 95% CI= 0.95–0.99; $p= 0.008$).

Conversely, individuals who experienced bites from stray dogs had a substantially higher risk of rabies, with a 4.59-fold increase compared with those who were not bitten (OR= 4.59; 95% CI= 1.97–10.69; $p < 0.001$). Living in areas with high dog population density was also associated with an increased risk of rabies, with a 2.72-fold higher risk compared with areas with low dog population density (OR= 2.72; 95% CI= 1.30–5.70; $p= 0.008$).

Furthermore, the path analysis results show that education influences rabies knowledge, while dog vaccination status and dog population density affect the occurrence of stray dog bites. Detailed

estimates of the direct effects of these risk factors on rabies cases in South Timor

Tengah Regency are presented in Table 4.

Table 4. Estimated results of the path analysis examining the direct effects of risk factors on rabies cases in South Timor Tengah Regency

Dependent variables	Independent variables	OR	95% CI		p
			Lower limit	Upper limit	
Direct effect					
Rabies infection	← Knowledge about rabies	0.06	0.03	0.16	<0.001
	← Sex (female)	0.33	0.16	0.71	0.005
	← Age (years old)	0.97	0.95	0.99	0.008
	← Stray dog bites	4.59	1.97	10.69	<0.001
	← Dog population density	2.72	1.30	5.70	0.008
Indirect effect					
Knowledge about rabies	← Education	12.11	5.67	25.88	<0.001
Stray dog bites	← Rabies vaccination	6.96	3.54	13.69	<0.001
	← Dog population density	2.84	1.46	5.51	0.002
N observation = 200					
Log likelihood = -314.09					

DISCUSSION

The findings of this study indicate that community knowledge, dog population density, stray dog bites, age, and sex are statistically significant risk factors associated with rabies incidence. These results are consistent with the Theory of Planned Behavior proposed by Ajzen (1991), which underpins this study and posits that disease prevention behaviors are influenced by attitudes, subjective norms, and perceived behavioral control. Adequate knowledge enhances individuals' ability to recognize risks, adopt preventive actions, and reduce the likelihood of rabies exposure. Conversely, low levels of knowledge may increase risk due to limited awareness of preventive measures, such as vaccinating domestic dogs and avoiding contact with stray dogs.

High dog population density was found to increase the risk of rabies, in line with the findings of Kayali et al. (2023), who reported that areas with high dog density were significantly associated with increased

rabies incidence (OR= 2.98; 95% CI= 1.90–4.70; p= 0.002). Dense dog populations complicate effective monitoring and control, increase interactions between dogs and humans and consequently elevate the likelihood of rabies virus transmission. Stray dog bites were also identified as a significant risk factor, supporting previous research by Tenzin et al. (2021), which demonstrated that bites from stray dogs increased the risk of rabies by 3.12 times compared with bites from non-stray dogs. This finding underscores the importance of strengthening stray dog vaccination programs and population control measures.

This study further revealed that individuals living in areas with high dog population density had a 2.84-fold higher risk of experiencing dog bites compared with those residing in areas with low dog density. This finding aligns with the study by which reported that increased dog density raised the risk of stray dog bites by up to 5.32 times. The elevated risk is likely attributable

to a higher number of unvaccinated and uncontrolled dogs, which increases opportunities for human–dog interaction and rabies transmission. In addition, individuals owning unvaccinated dogs were found to have a 6.96-fold higher risk of experiencing stray dog bites compared with those owning vaccinated dogs. This risk is further exacerbated by the common practice of allowing dogs to roam freely without supervision, thereby increasing the frequency of contact.

Education was identified as a significant determinant of community knowledge regarding rabies, consistent with previous findings by Sarjana et al. (2018), who reported a strong association between educational level and knowledge (OR= 4.24). Higher education levels may enhance individuals' capacity to access and utilize health facilities and information sources, leading to improved knowledge and preventive behaviors.

Regarding age, the results suggest that increasing age is associated with a reduced risk of rabies, which may be explained by greater experience and higher levels of caution among adults compared with children and adolescents. Female sex was identified as a protective factor, indicating potential differences in behavior, patterns of interaction with animals, and levels of vigilance between men and women. In contrast, history of contact, dog vaccination status, and educational level were not significantly associated with rabies in the simple logistic regression analysis. This lack of association may be attributed to an even distribution of these variables between case and control groups, as well as the presence of unmeasured confounding factors.

The strengths of this study include its focus on rabies cases in South Timor Tengah Regency, an area where such research has been limited, and the examination of eight risk factors influencing rabies incidence.

However, several limitations should be noted. The case–control design does not allow for direct estimation of disease incidence, as the study began with individuals who had already developed the disease. The analysis was limited to eight variables, and the study population focused primarily on community members and the animal reservoir (dogs). Data collection relied on structured questionnaires and interviews, which may be subject to recall bias inherent in case–control studies.

In conclusion, this study demonstrates that high dog population density and stray dog bites are key factors that increase the risk of rabies, while higher community knowledge, female sex, and age ≥ 35 years serve as protective factors. These findings emphasize that community knowledge, dog population density, and stray dog bites are the primary determinants of rabies cases. Rabies control efforts should therefore prioritize improving community knowledge through health education, strengthening stray dog population control, increasing vaccination coverage, formulating supportive public health policies at the local government level and promoting multisectoral collaboration in their mentation.

AUTHOR CONTRIBUTION

Lucitania Floreca Mokos served as the principal investigator, responsible for formulating the research title, conducting data collection, and drafting the manuscript. Setyo Sri Rahardjo provided methodological guidance and critically reviewed the manuscript. Bhisma Murti performed the data analysis and contributed to the review of the manuscript. Yulia Lanti Retno Dewi offered substantive input and editorial revisions. Nur Hafidha Hikmayani contributed constructive suggestions and assisted in improving the manuscript.

FUNDING AND SPONSHORSHIP

This study was self-funded and received no external financial support

ACKNOWLEDGMENT

The authors would like to express their sincere appreciation to Setyo Sri Rahardjo, Bhisma Murti, Yulia Lanti Retno Dewi, Nur Hafidha Hikmayani, and all individuals who contributed to the completion of this manuscript. The authors also acknowledge the use of bibliographic databases, including Google Scholar, ScienceDirect and PubMed, which supported the literature review process.

CONFLICT OF INTEREST

The authors declare that this research was conducted in the absence of any conflicts of interest.

REFERENCE

- Ajzen I (1991). The theory of planned behavior. *J. Organ Behav Hum Decis Process.* 50(2): 179–211. doi: 10.1016/0749-5978(91)90020-T.
- CDC (2017). Rabies in the United States: Protecting Public Health. Accessed from <https://www.cdc.gov/rabies/php/protecting-public-health/index.html> on September 26, 2024.
- CDC (2024). Rabies. CDC Yellow Book: Health Information for International Travel. Accessed from <https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/rabies.html> on September 26, 2024.
- Directorate General of Disease Prevention and Control (2018). Information: Center for Health Data and Information (in Indonesia). Rabies situation in Indonesia.
- Fooks AR, Banyard AC, Horton DL, Johnson N, McElhinney LM, Jackson AC (2015). Current status of rabies and prospects for elimination. *J. Lancet*, 384: 1389–1399. doi: 10.1016/S0140-6736(13)62707-5.
- Kayali U, Mindekem R, Yemadji N (2023). Incidence of canine rabies in N'Djamena. *Chad J Prev Vet Med*, 61(3): 227-233. doi: 10.1016/j.prevet-med.2003.07.002.
- Mahardika GN (2016). Factors contributing to the occurrence of rabies among dogs in villages in Bali (in Indonesia). *J. Veteriner Indonesian*, 12(1): 45-55. doi: 10.19087/jveteriner.2016.17.2.274.
- Ministry of Health of the Republic of Indonesia. (2020). Rabies flipchart. Directorate General of Disease Prevention and Control, Ministry of Health of the Republic of Indonesia.
- Sarjana IK, Mahardika IGN, Suharyo S (2018). The relationship between knowledge level and attitudes with rabies prevention practices among residents in the service area of Kuta II Community Health Center (in Indonesia). *E-Journal Medika Udayana*, 7(2): 105-113. doi: 10.13057/smj.v1i1.-24184.
- Salomao C, Nacima A, Cuamba L, Gujral L, Amiel O, Baltazar C, Cliff J, Gudo SE (2015). Epidemiology, clinical features and risk factors for human rabies and animal bites during an outbreak of rabies in Maputo and matola cities, Mozambique, 2014: Implications for Public Health Interventions for Rabies Control. *PLoS Negl Trop Dis.* 11(7). doi: 10.1371/journal.pntd.0005787.
- Sudarnika E, Wibawa H, Artanto S, Setiawaty R (2020). Factors influencing the occurrence of rabies in dogs: A case-control study in Fifty Kota Regency (in Indonesia). *MT Veterinary Sci*, 18(2): 75-85. <http://repository.ipb.ac.id/handle/123456789/104>

- 204.
- Tebekew Y, Belayneh T, Alemayehu G (2023). Understanding Dog Owners' Willingness to Pay for Rabies Vaccination and its Determinants in Ethiopia: Application of the Theory of Planned Behavior. *PLOS Glob Public Health*, 3(2). doi: 10.1371/journal.pgph.0003974.
- Tenzin S, Dhand NK, Rai BD, Ward MP (2021). Dog Demography and Rabies Knowledge Attitude Practice in Bhutan: A Cross-Sectional Study. *BMC Public Health*. 12: 975. doi: 10.1186/1471-2458-12-975.
- Wattimena J ch, Suharyo (2015). Several risk factors are associated with rabies occurrence in dogs in Ambon. *J Kesehatan Masyarakat*, 6(10): 24-29. doi: 10.15294/kemas.v6i1.1748.
- World Health Organization (2023). WHO pilots workshop to increase One Health collaboration for rabies control.