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Risk Assessment of Dog-Mediated Rabies in a Rural Indonesian Community: A One Health Approach

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ABSTRACT

Rabies remains a fatal zoonotic disease that continues to cause thousands of human deaths annually, particularly in regions where dog-mediated transmission persists. In Indonesia, rabies remains endemic in different provinces, and rural communities with frequent human-dog interactions may face an increased risk of exposure. The present study aimed to assess the risk of dog-mediated rabies transmission in a rural Indonesian community using a One Health perspective. A cross-sectional descriptive study was conducted in Sirukam Village, Solok District, West Sumatra, Indonesia, in August 2025. Data were collected through structured questionnaires administered to 96 respondents, field observations of dog populations, and semi-structured interviews with hunters, dog owners, and local health workers. Secondary data on bite incidents and post-exposure prophylaxis (PEP) completion were obtained from the local public health center. The results revealed that 56.25% of respondents had moderate knowledge regarding rabies prevention, while preventive practices, including wound washing and vaccination adherence, were inconsistent. A total of 14 dog bite cases were reported during January-December 2024. Only 10 of the 14 exposed individuals (71.43%) completed the full PEP vaccination schedule, indicating suboptimal adherence. Field observations revealed 148 free-roaming dogs in the study area, indicating frequent opportunities for human-dog interactions. Qualitative interviews with selected participants suggested that reluctance to vaccinate hunting dogs and limited awareness of rabies prevention may contribute to sustained transmission risks. However, the qualitative findings from interviews with selected participants should be interpreted cautiously due to the limited number of informants. Based on a qualitative risk assessment combining the likelihood of exposure and the potential public health impact using a semi-quantitative scoring approach, rabies was categorized as a high-risk health threat in the study area. The results highlight the importance of strengthening dog vaccination programs, improving community awareness, and enhancing multisectoral collaboration to reduce rabies transmission in rural endemic settings.

Keywords: Dog bite, Rabies, Risk assessment, Vaccination, Zoonotic disease

INTRODUCTION

Rabies is a lethal zoonotic disease caused by the rabies virus (RABV), which belongs to the genus Lyssavirus within the family Rhabdoviridae. Domestic dogs remain the main reservoir of the virus and are responsible for over 99% of human rabies infections worldwide (Hampson et al., 2015; WHO, 2023). Although rabies can be effectively prevented through mass dog vaccination and prompt administration of post-exposure prophylaxis (PEP), the disease still results in approximately 59,000 human deaths annually, with more than 95% of cases reported in Asia and Africa, where access to medical and veterinary services is often limited (WHO, 2023). Children younger than 15 years old account for a considerable proportion of rabies exposure incidents due to their frequent interaction with dogs, particularly in rural settings (Rehman et al., 2021). In Indonesia, rabies remains endemic in several provinces, including West Sumatra, where dog-mediated transmission continues to pose a public health concern. Surveillance reports indicate that animal bite cases remain a significant public health concern in Indonesia, with approximately 66,170 cases reported between January and July 2023 alone (WHO, 2023). Previous reports also estimate an average of 80,000-100,000 cases per year, highlighting the ongoing risk of rabies exposure in the country. At the regional level, West Sumatra reports hundred bite incidents annually, with 96 cases recorded during week 23 of 2024, highlighting the continued risk of rabies transmission in the area (Ministry of Health of the Republic of Indonesia, 2019; Ginuluh et al., 2024; Agricultural Quarantine Agency Class I Padang, 2024). In West Sumatra, wild boar hunting using dogs is a long-standing cultural practice that may increase rabies transmission risk due to frequent dog movement and interaction (Amanatin et al., 2019). Wild boar hunting practices in rural communities often involve the movement and aggregation of multiple dogs and hunters gathering from different areas, which may increase the likelihood of direct interactions involving bites or exposure to infected saliva, the primary routes of rabies transmission (WHO, 2023). In Sirukam, wild boar hunting practices involving the use of dogs are commonly observed (Amanatin et al., 2019), and previous studies have shown that vaccination coverage among free-roaming or hunting dogs in rural areas is often limited, increasing the risk of rabies transmission (Taylor et al., 2017; WHO, 2023). Limited vaccination coverage among hunting dogs may be influenced by

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socio-cultural beliefs and community perceptions regarding vaccination, including concerns that it may affect the physical performance of dogs used for hunting. In addition, the presence of free-roaming dogs used for hunting may increase exposure risk, although concerns regarding reduced performance after vaccination are not supported by scientific evidence (Widyastuti et al., 2015; Taylor et al., 2017). Despite the presence of multiple risk factors, including limited vaccination coverage, hunting practices involving dogs, and the presence of free-roaming dogs, no previous studies have specifically assessed rabies transmission risk in Sirukam village, Solok district, West Sumatra, Indonesia, where such factors are known to contribute to rabies transmission dynamics (Amanatin et al., 2019; Warembourg et al., 2021). National surveillance reports have documented over 80,000 animal bite cases annually in Indonesia, with vaccination coverage and PEP completion rates varying across regions, with vaccination coverage often reported below the recommended 70% threshold in several rural areas (Ministry of Health of the Republic of Indonesia, 2019; Ginuluh et al., 2024). Community practices such as hunting with dogs and allowing dogs to roam freely highlight the importance of understanding dog population dynamics and human behaviors that influence rabies exposure risk (Taylor et al., 2017; Amanatin et al., 2019; WHO, 2023).

However, specific data describing rabies transmission risk and dog population dynamics at the village level remain limited in many rural areas of West Sumatra, including Sirukam, as previous studies have mainly focused on knowledge and attitudes toward rabies rather than comprehensive risk assessments integrating human behavior, dog ecology, and environmental factors (Widyastuti et al., 2015; Taylor et al., 2017; WHO, 2023). The lack of comprehensive risk assessments integrating human behavior, dog ecology, and environmental factors highlights the need for a localized assessment of rabies transmission risk to support targeted prevention strategies (Taylor et al., 2017; WHO, 2023).

Global rabies elimination initiatives, including the Zero by 30 strategy, aim to eliminate human deaths caused by dog-mediated rabies by the year 2030 through coordinated actions such as mass dog vaccination, improved access to PEP, and strengthened surveillance systems (WHO, 2023). Achieving the global goal of eliminating human deaths caused by dog-mediated rabies by 2030 requires the implementation of a One Health approach, which promotes coordinated collaboration among human health, veterinary, and environmental sectors to address the interconnected drivers of rabies transmission (Cleaveland et al., 2014; WHO, 2023). In rural endemic settings, rabies risk is often shaped by multiple interacting factors, including dog population characteristics, human knowledge and preventive practices, patterns of human-dog interaction, and environmental conditions influencing dog movement and contact rates (Hampson et al., 2015; WHO, 2023). Cultural practices, including reluctance to vaccinate hunting dogs due to community perceptions regarding potential negative effects on their performance, as well as the common practice of allowing dogs to roam freely, may further influence rabies exposure risk (Widyastuti et al., 2015; Taylor et al., 2017). In addition, logistical barriers, including limited access to vaccination services, long distances to vaccination facilities, and inconsistent availability of vaccines, may reduce vaccination uptake and disease reporting (Hampson et al., 2015; Taylor et al., 2017; WHO, 2023). A comprehensive risk assessment is required to better understand rabies transmission dynamics in the study area, given the presence of multiple interacting factors, including hunting practices, free-roaming dog populations, limited vaccination coverage, socio-cultural beliefs, and logistical barriers (Cleaveland et al., 2014; Taylor et al., 2017). A One Health framework was employed to integrate data on human behavior (knowledge and practices), animal factors (dog population characteristics), and environmental context (interaction patterns and dog movement) to assess the risk of dog-mediated rabies in Sirukam, Solok District, West Sumatra, Indonesia. The present study aimed to assess the risk of dog-mediated rabies in a rural community of Sirukam, Solok District, West Sumatra, Indonesia.

MATERIALS AND METHODS

Ethical approval

Ethical approval for the study was obtained from the Ethics Committee of the State University of Padang (Approval No: 123/UNP/FK/EC/2025). Additional research permission was granted by the Solok District authorities. All participants provided written informed consent prior to data collection. No identifiable personal information was recorded, and all data were anonymized to ensure confidentiality. All participants were informed about the purpose of the study, the voluntary nature of participation, and their right to withdraw at any time without consequence. No personally identifiable information was recorded, and all data were anonymized to ensure confidentiality. Permission to conduct the study was also obtained from the relevant local authorities

Study area

The study was conducted in Sirukam Village, Solok District, West Sumatra Province, Indonesia, in August 2025. Sirukam consists of four sub-villages with an estimated population of approximately 5,654 inhabitants based on data from the (BPS-Statistics Solok Regency, 2024). Most residents are engaged in agriculture and traditional hunting activities. Primary healthcare services are provided by the Sirukam Public Health Center which serves as the main facility for rabies PEP. Veterinary services are available in Solok District, located approximately 15 km from the village, which may limit timely access to dog vaccination and rabies control measures. In addition, geographic and logistical

factors such as travel distance and transportation availability may influence access to both healthcare and veterinary services. The presence of free-roaming dogs and frequent human-dog interactions further increases the potential risk of rabies transmission in rural communities.

Study design

The current study employed a cross-sectional descriptive design conducted in August 2025 to assess the risk of dog-mediated rabies using a One Health perspective. The study integrated human, animal, and environmental factors influencing disease transmission (Destoumieux-Garzón et al., 2018; WHO, 2023). Data were collected using a structured questionnaire, field observations of dog populations, and semi-structured interviews with selected key informants. The questionnaire was developed based on previously published rabies knowledge, attitudes, and practices (KAP) studies and adapted to the local context (Sambo et al., 2014; Widyastuti et al., 2015). It was designed by the research team and reviewed by a public health officer from the Solok District Health Office with experience in rabies control. The One Health approach in the study considers the interactions between human behavior, dog population dynamics, and environmental conditions that may contribute to rabies transmission in rural communities. Quantitative data were obtained from 96 respondents selected through purposive sampling across four sub-villages in Sirukam. The number of respondents from each sub-village was proportionally determined based on the estimated number of households with frequent dog contact. Qualitative data were collected from three key informants selected based on their roles in the community, including a hunter, a community leader, and a public health officer. Data collection was conducted by the research team through face-to-face interviews using structured questionnaires and semi-structured interview guides. The sample size for the quantitative component was determined based on feasibility considerations, field accessibility, and the estimated population of households with regular dog exposure in the study area.

Participants and sampling

A total of 96 respondents were included in the study using a purposive sampling approach, consistent with methods used in previous rabies knowledge, attitudes, and practices (KAP) studies (Sambo et al., 2014; Widyastuti et al., 2015; WHO, 2023). The sample size was determined based on the estimated number of households with frequent dog contact in the study area and the feasibility of conducting face-to-face interviews within the study period. Purposive sampling was applied to ensure that participants had direct experience with dogs and potential exposure to rabies risk. Eligible participants included dog owners, hunters, farmers, and community members who frequently interacted with dogs in their daily activities. The distribution of respondents by occupation and dog ownership status is presented in Table 1. Inclusion criteria were adults aged 18 years or older who were willing to participate and able to complete the questionnaire. Individuals who declined participation or provided incomplete responses were excluded during the data cleaning process prior to analysis. Respondents were recruited with the assistance of local community leaders and village authorities who helped identify residents with regular contact with dogs in the four sub-villages of Sirukam. At the time of the study, participants were actively engaged in activities involving dogs, either through ownership or regular interaction. In addition to the questionnaire survey, qualitative data were obtained through semi-structured interviews with three key informants, including a hunter, a community leader, and a public health officer.

Table 1. Sociodemographic characteristics of respondents in Sirukam, Solok District, West Sumatra, Indonesia, August 2025

Variable	Category	Frequency (n)	Percentage
Gender	Male	61	63.50
	Female	35	36.50
Age group	< 20 Years	20	20.83
	21-30 Years	23	23.96
	31-40 Years	25	26.04
	> 40 Years	28	29.17
Education	No formal education	3	3.10
	Primary school	10	10.40
	Junior high school	13	13.50
	Senior high school	41	42.70
	University	25	30.20
Occupation	Farmer	13	13.54
	Hunter	23	23.96
	Housewife	13	13.54
	Trader	18	18.75
	Employee	16	16.67
	Others (students, laborers, drivers)	13	13.54
Dog ownership	Yes	41	43.75
	No	55	57.29
History of dog bites	Yes	13	13.54
	No	83	86.50

n: Number of respondents, %: Percentage of total respondents (N = 96). Occupation categories represent the main self-reported livelihood of respondents. The Others category includes respondents with occupations that did not fit into predefined categories and were reported in small proportions (each < 5% of the total sample), such as students, laborers, drivers, and other informal occupations.

Data collection

Structured questionnaires

A structured questionnaire was used to assess community knowledge, attitudes, and practices (KAP) related to rabies and dog bite risks. The full questionnaire is provided as Supplementary File 1, including both the English version for publication and the original Bahasa Indonesia version used during data collection. The questionnaire consisted of 25 items divided into five domains, including knowledge about rabies (5 items), perception of dog bite risk (5 items), attitudes toward bite management (5 items), perceptions of dog populations in the environment (5 items), and interactions with free-roaming dogs (5 items). The questionnaire was administered through face-to-face interviews to ensure clarity and completeness. Dog ownership status was self-reported by respondents during the household survey. Dog ownership was defined as respondents who reported owning at least one dog at the time of the survey. Items were measured using a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). The questionnaire was adapted from previously published rabies knowledge, attitudes, and practices (KAP) studies and international as well as national public health survey instruments, including guidelines from the World Health Organization (WHO), World Organization for Animal Health (WOAH), and national instruments from the Ministry of Health of the Republic of Indonesia (WHO/FAO/WOAH, 2018; Ministry of Health of the Republic of Indonesia, 2021). Prior to the main survey, the questionnaire was pilot-tested among 10 residents in a neighboring village to evaluate the clarity and relevance of the questions. Minor revisions were made based on participant feedback, particularly in the knowledge and attitudes sections, including clarification of question wording, simplification of technical terms, and adjustment of response options to improve clarity and comprehension. Content validity was assessed through expert review by a public health officer from the Solok District Health Office with experience in rabies control, while the pilot testing results were reviewed by the research team to identify unclear items and ensure clarity, relevance, and internal consistency of the questionnaire. Face-to-face interviews were conducted by trained personnel, including experienced researchers and a local public health officer involved in rabies control, to ensure clarity and completeness of responses. Data collection was conducted over a two-week period in August 2025. Responses were recorded manually using structured questionnaire forms and later entered into a digital database for analysis. Their familiarity with local conditions facilitated effective communication with respondents while maintaining standardized interview procedures to minimize interviewer bias. For scoring, each response was assigned a value from 1 to 4, resulting in a maximum possible total score of 100. Total scores were calculated by summing all item responses and were categorized into three levels, namely high (≥ 75% of the maximum score), moderate (50-74%), and low (< 50%). Each domain score was calculated by summing the responses to the items within that domain. Because each domain consisted of five items scored from 1 to 4, domain scores ranged from 5 to 20. For descriptive interpretation, knowledge scores were categorized as low (5-11), moderate (12-15), and high (16-20). Attitude scores ranged from 5 to 15 and were categorized as negative (6-10) and positive (11-15). Practice scores ranged from 5 to 15 and were categorized as poor (5-10) and good (11-15). All interviews were conducted in the local language to ensure that respondents clearly understood the questions. Negatively worded items were reverse-scored before calculating the total score, meaning that response values were inverted (with strongly agree = 1 and strongly disagree = 4) so that higher scores consistently reflected more favorable knowledge, attitudes, or practices. The score categorization thresholds were adapted from previously published rabies KAP studies and were used to facilitate interpretation of community knowledge, attitudes, and practices (Sambo et al., 2014; Monje et al., 2020; Rehman et al., 2021). Because the current study employed a descriptive design with purposive sampling, inferential statistical tests to examine associations between sociodemographic factors and KAP outcomes were not conducted. The study employed a descriptive design and did not include inferential statistical analysis to assess associations between variables.

Direct observation of dog populations

Free-roaming dogs were defined as dogs observed moving freely in public areas without physical restraint or direct human supervision. Observations focused on dog density, roaming behavior, and proximity to human settlements, which are important indicators of rabies transmission risk. Field observations were conducted to estimate the number and spatial distribution of free-roaming dogs across the four sub-villages of Sirukam during the study period in August 2025. Observations were performed during both morning and late afternoon periods, when dog activity is typically higher. Multiple observation points were used to reduce the likelihood of double-counting and to obtain a more representative estimate of dog presence in the study area. Repeated observations at different times of the day were conducted to reduce potential bias and improve the reliability of the dog population estimate. Observations were conducted by two trained observers over a two-week period, with each observation session lasting approximately 30-45 minutes. A structured observation guideline was applied, developed based on established international methodologies for surveying free-roaming dog populations, including direct observation along representative areas, repeated counts, and standardized counting protocols (WSPA, 2014; WOAH, 2022). To ensure consistency, both observers were trained prior to data

collection, and discrepancies between repeated observations were resolved through comparison and consensus between observers, considering observation time, location, and the potential for double-counting.

Semi-structured interviews

Semi-structured interviews were conducted with three key informants representing different stakeholder groups in the community. The key informants included one local hunter, one community leader, and one public health officer responsible for rabies control at the Sirukam Public Health Center. The interviews were conducted by members of the research team with experience in community-based data collection. Key points from the interviews were documented through detailed written notes during the discussions. To enhance accuracy, responses were clarified with participants during the interview process when needed.

The key informants were purposively selected based on their direct involvement in dog ownership practices, community decision-making, and zoonotic disease control in the study area. The interview guide was developed based on study objectives and relevant literature and was reviewed prior to data collection to ensure clarity and relevance. Secondary data on animal bite incidents, PEP completion, and vaccination records (2022-2024) obtained from the Sirukam Public Health Center, Solok District, West Sumatra, Indonesia, were used to complement field observations and to provide contextual information on rabies exposure and prevention practices in the study area.

Data analysis

Risk assessment was conducted using a semi-quantitative approach by evaluating two main components, namely the likelihood of exposure and the potential public health impact. Each component was assessed based on field observations, questionnaire data, and qualitative interviews. Scores were assigned using predefined criteria adapted from previous rabies risk assessment frameworks, and the overall risk level was determined by combining these components. The classification was conducted by the research team based on consensus.

Quantitative data were analyzed descriptively using frequency distributions and percentages to summarize respondents' knowledge, perceptions, and attitudes related to rabies risk. Quantitative data were organized and analyzed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Because the study employed a descriptive exploratory design with purposive sampling, inferential statistical tests were not applied. The descriptive exploratory design with purposive sampling is appropriate for studies aiming to describe patterns and identify potential risk factors rather than to establish causal relationships. Instead, the analysis focused on identifying patterns of community perceptions and behavioral risk factors associated with dog-mediated rabies exposure. Rabies risk was categorized using a qualitative risk matrix combining two parameters, namely probability of exposure and potential impact on public health. Each parameter was scored on a three-level scale (low, moderate, high) based on field observations, community practices, and reported bite incidents. The overall risk level was determined from the intersection of probability and impact categories in the matrix (Ginuluh et al., 2024). Qualitative data obtained from semi-structured interviews were analyzed thematically to identify recurring cultural and behavioral factors influencing rabies exposure and community risk perceptions. Given the small number of key informants, data saturation was considered achieved when no new themes emerged during analysis. Qualitative data were manually organized and coded by the research team to identify recurring patterns.

RESULTS

Sociodemographic characteristics

A total of 96 respondents participated in the study. Most respondents were male (63.50%). Respondents were distributed across four age groups, with the largest proportion aged over 40 years (29.17%), followed by 31-40 years (26.04%), 21-30 years (23.96%), and younger than 20 years (20.83%). In terms of occupation, hunters represented the largest group (23.96%), followed by traders (18.75%), employees (16.67%), farmers (13.54%), and housewives (13.54%). Dog ownership was reported by 43.75% of respondents, while 13.54% had experienced dog bites. Detailed sociodemographic characteristics are presented in Table 1.

Knowledge, attitudes, and practices regarding rabies

The assessment of KAP related to rabies prevention revealed varying levels among respondents. None of the participants was classified in the low knowledge category. Moderate knowledge was observed in 56.25% of respondents, while 43.75% demonstrated high knowledge. Regarding attitudes toward rabies prevention, 62 respondents (64.58%) indicated positive attitudes, while 34 respondents (35.42%) expressed negative attitudes. Preventive practices were less consistent; poor practices were observed in 55 respondents (57.29%), whereas 41 respondents (42.71%) demonstrated good preventive practices. Detailed KAP scores are shown in Table 2.

Table 2. Knowledge, attitudes, and practices regarding rabies among residents of Sirukam, Solok District, West Sumatra, Indonesia, August 2025

Domain	Category	Score interval	Frequency (n)	Percentage
Knowledge	Low	5 - 11	0	0.00
	Moderate	12 - 15	54	56.25
	High	16 - 20	42	43.75
Attitudes	Negative	6 - 10	34	35.42
	Positive	11 - 15	62	64.58
Practices	Poor	5 - 10	55	57.29
	Good	11 - 15	41	42.71
Total respondents (N)			96	100

Dog bite incidents and post-exposure prophylaxis

A total of 14 dog bite cases were recorded in Sirukam, Solok District, West Sumatra, Indonesia, during the 2024 surveillance period (January-December 2024). All bite victims initiated PEP by receiving the first dose of the anti-rabies vaccine (VAR1). Completion of the full vaccination schedule varied, with only 10 cases (71.43%) completing all recommended doses (VAR1-VAR3), while 4 cases (28.57%) did not complete the full vaccination series primarily due to missed follow-up doses and loss to follow-up before receiving subsequent vaccine doses. Incomplete vaccination occurred due to missed follow-up doses or loss to follow-up before receiving the third dose. Immediate wound washing was also not consistently reported among several bite cases. Detailed information on the biting dogs, including vaccination status and observation history, was not consistently available in the surveillance records. Due to the limited number of reported cases, seasonal patterns of dog bite incidents could not be reliably assessed. Data on dog bite incidents and PEP were collected retrospectively for the period January-December 2024 based on respondent recall and available local records during the 2025 survey. Monthly variations in bite incidents and vaccination completion are summarized in Table 3.

Table 3. Reported dog bite cases and post-exposure prophylaxis completion in Sirukam, Solok District, West Sumatra, Indonesia

Date (2024)	Number of bite cases	Wound washing	VAR dose 1	VAR dose 2	VAR dose 3	Notes
March	1	Yes	Yes	Yes	Yes	Completed on schedule
April	3	Yes (2/3)	Yes (3/3)	Yes (3/3)	Yes (2/3)	1 case incomplete (missed VAR3)
June	1	Yes	Yes	Yes	Yes	Completed
July	1	No	Yes	Yes	Yes	Wound not washed
August	2	Yes (1/2)	Yes (2/2)	Yes (2/2)	Yes (2/2)	1 case did not wash the wound
September	1	No	Yes	Yes	-	Lost to follow-up before VAR3
October	2	Yes (1/2)	Yes (2/2)	Yes (1/2)	-	1 case received VAR1 only
November	1	Yes	Yes	-	-	Only VAR1 received
December	1	Yes	Yes	Yes	Yes	Completed

VAR1: First dose of anti-rabies vaccine, VAR2: Second dose, VAR3: Third dose, PEP: Post-exposure prophylaxis. Data were collected from January to December 2024 (N = 14).

Dog population and human-dog interaction

Field observations recorded 148 free-roaming dogs distributed across four sub-villages in Sirukam, based on repeated direct observations conducted at multiple observation points. The highest number of dogs was observed in Kubang Duo sub-village, with 80 dogs (54.05%) of the total observed population recorded in the area. Based on an estimated human population of 5,654 individuals, the human-to-dog ratio was approximately 38:1. The presence of free-roaming dogs in residential areas indicated frequent opportunities for contact between humans and dogs in the study area. The estimation of dog numbers was based on direct field observations conducted across multiple observation points. Information on the vaccination status of the observed dogs was not available. Observations also indicated that many dogs were freely roaming in public and residential areas without restraint. Detailed dog population distribution across sub-villages is presented in Table 4.

Cultural and behavioral factors related to dog management and rabies risk

Semi-structured interviews with three key informants (one hunter, one public health officer, and one community leader) identified several cultural practices related to dog management that may influence rabies risk in the study area. Among interviewed respondents, the hunter reported reluctance to vaccinate hunting dogs due to concerns that

vaccination might reduce the dogs' stamina during hunting activities. The dog owner informant reported allowing dogs to roam freely for guarding farms and households. Free-roaming practices observed in residential areas may increase opportunities for human–dog contact in the community.

Table 4. Dog population and human-to-dog ratio in Sirukam Sub-villages, Solok District, West Sumatra, Indonesia, August 2025

Sub-village (Jorong)	Number of dogs	Human population*	Human: Dog ratio
Koto Tingga	18	565	1: 31
Kubang Duo	91	2262	1: 25
Lubuak Pulai	19	1131	1: 65
Gantiang	20	1696	1: 87
Total	148	5,654	1: 38

* Human population data; Source: BPS-Statistics Solok Regency (2024).

DISCUSSION

The study suggests that dog-mediated rabies may indicate a potential public health concern in Sirukam, based on observed patterns of community knowledge, preventive practices, and the presence of free-roaming dogs. The identification of 148 free-roaming dogs and a human-to-dog ratio of approximately 38:1 suggested frequent opportunities for human-dog interactions, which may facilitate rabies transmission. The observed variation in the number of free-roaming dogs across sub-villages may be influenced by differences in human population density, land use, and dog management practices, including the use of dogs for hunting and the tendency to allow dogs to roam freely. For example, sub-villages with higher numbers of dogs relative to the human population may reflect a greater reliance on dogs for hunting activities, whereas sub-villages with lower dog numbers may be associated with higher population density and more restricted dog ownership practices. Similar findings have been reported in rabies-endemic regions where free-roaming dog populations contribute to sustained exposure risks, including studies in Indonesia that documented the role of free-roaming dog populations and limited vaccination coverage in sustaining rabies transmission (Hampson et al, 2015; Subrata et al., 2020). Although most respondents demonstrated moderate to high knowledge about rabies, preventive practices remained inconsistent. The observed gap between knowledge levels and preventive practices suggested that knowledge alone may not be sufficient to ensure appropriate rabies prevention behaviors. The discrepancy between relatively high knowledge levels and inconsistent preventive practices has also been reported in previous studies, where higher levels of knowledge were not consistently accompanied by appropriate preventive practices (Rehman et al., 2021; Kardikayasa et al., 2023). In particular, incomplete wound washing or PEP was observed in 4 of 14 reported bite cases (29%), representing a substantial proportion of exposures. Inadequate wound management and incomplete vaccination are recognized risk factors for rabies transmission following dog bites (WHO, 2023). The concentration of free-roaming dogs in certain sub-villages highlighted the importance of dog population management in rabies control. Global rabies control programs emphasize that vaccinating at least 70% of the dog population is necessary to disrupt transmission cycles (Hampson et al., 2015; WHO, 2023). However, specific cultural beliefs and practical barriers may limit participation in dog vaccination programs in the study area. Qualitative findings from the study indicated that some hunters were reluctant to vaccinate their dogs due to concern that vaccination might reduce stamina or hunting performance. In addition, free-roaming practices reported by dog owners may complicate vaccination coverage and monitoring. The absence of respondents in the low knowledge category may reflect relatively good baseline awareness in the community or potential social desirability bias during data collection. The low proportion of respondents in the low knowledge category, which may reflect relatively good baseline awareness or potential social desirability bias during data collection, should be interpreted cautiously and may indicate the need for further validation of the questionnaire in similar settings. Similar barriers related to perceptions of dog health and utility have been reported in other rabies-endemic regions (Gebeyaw and Teshome, 2016; Rehman et al., 2021). Although the Ethiopian context differed from Indonesia, they highlight that perceptions of dog function may influence vaccination behavior in rural communities.

Addressing barriers to dog vaccination, including concerns about reduced hunting performance, free-roaming dog management practices, and limited participation in vaccination programs, may require targeted strategies such as community-based education involving local hunters, awareness programs emphasizing that vaccination does not impair dog performance, and improved access to veterinary services to facilitate routine vaccination. The rabies risk assessment was conducted based on several observed factors, including the occurrence of dog bite incidents, incomplete adherence to post-exposure prophylaxis, and the presence of free-roaming dogs within the community. Similar risk factors

contributing to rabies transmission have been reported in other endemic regions (Hampson et al., 2015; WHO, 2023). Similar epidemiological patterns have been reported in rabies-endemic countries, including Indonesia, Tanzania, and Ethiopia, where dog-mediated rabies continues to impose substantial public health and economic burdens (Hampson et al., 2015; WHO, 2023). A One Health approach has been widely recognized as essential for rabies control in endemic settings, as it facilitates coordination between veterinary services, public health authorities, and community stakeholders in addressing interconnected transmission drivers (Destoumieux-Garzón et al., 2018; WHO, 2023).

CONCLUSION

The study assessed factors associated with the risk of dog-mediated rabies transmission in Sirukam, West Sumatra, Indonesia. Rabies exposure risk in the study area is influenced by multiple interacting factors, including frequent human-dog interactions, the presence of a substantial free-roaming dog population, inconsistent wound management practices, and cultural perceptions influencing vaccination of hunting dogs. The combination of the identified risk factors highlights the importance of integrated approaches involving both veterinary and public health sectors to address rabies transmission. Rabies prevention in the study area may benefit from expanding community-based dog vaccination programs, increasing public awareness of immediate wound washing and timely post-exposure prophylaxis, and promoting responsible dog ownership practices, including limiting free-roaming and improving participation in vaccination programs. The study was limited by its cross-sectional design and the absence of direct data on the vaccination status of the observed dog population. In addition, potential associations between knowledge, attitudes, and practices, as well as between attitudes and dog ownership, were not analyzed, as such analyses were beyond the scope of this descriptive study. Future studies incorporating longitudinal surveillance and detailed assessment of dog vaccination coverage are needed to provide a more comprehensive understanding of rabies transmission risk in similar rural settings.

DECLARATIONS

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Authors' contributions

Widia Safitri conceptualized the study, conducted data collection, performed data analysis, and drafted the manuscript. Rita Suzana contributed to the study design, supervised the research process, and reviewed the manuscript. Olivia Afriyanti contributed to data analysis and manuscript revision. Anggi Pratama assisted with data collection and data interpretation. All authors read and approved the final version of the manuscript.

Availability of data and materials

The datasets used and analyzed in the study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that there is no conflict of interest regarding the publication of the study.

Ethical consideration

The authors confirm that the current manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. All sources have been appropriately cited, and the manuscript has been checked for plagiarism. Artificial intelligence (AI) tools (ChatGPT, OpenAI) were used for language editing and manuscript refinement. No AI tools were used for data analysis, data interpretation, or the generation of scientific conclusions. All scientific content remains the responsibility of the authors.

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