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A Cross-Sectional Study on the Prevalence and Risk Factors of Rabies in Kandahar Province

Abdul Fahim Sarwary[✉1], Mohammad Dawood Bawer[2], Mahboobullah Ahmadi[3], Aminullah Noor[4], Ahmadullah Zahir[5]

[1, 2]Department of Para Clinic, Faculty of Veterinary Science, ANASTU University, Kandahar, Afghanistan
[3, 4]Department of Pre-clinic, Faculty of Veterinary Science, ANASTU University, Kandahar, Afghanistan
[5]Department of Food Science, Faculty of Veterinary Science, ANASTU University, Kandahar, Afghanistan
✉E-mail: dr.fahimsarwary2020@gmail.com (corresponding author)

ABSTRACT

Rabies is an acute and fatal viral zoonotic disease transmitted to humans primarily through the bites of infected animals. Globally, approximately 60,000 human deaths occur annually, and the mortality rate in humans approaches 100% once clinical symptoms appear. In Afghanistan, rabies-related morbidity and mortality remain significant. A cross-sectional study was conducted from 2020 to 2024 to assess rabies prevalence in Kandahar City and surrounding areas. During this period, 524 human dog-bite cases suspected of rabies exposure were recorded in Kandahar Province, with 16.7% from urban areas and 83.3% from rural communities. Males accounted for over 71% of cases, and 75.1% were individuals aged 5 or older, while 24.2% were children under 5. All exposures were from dog bites; no cases involved other animals. Key risk factors identified included limited knowledge (20% unaware of rabies), difficulty accessing vaccination services, presence of unvaccinated dogs and cats, and limited healthcare availability in rural areas. Rural communities and young children were at the highest risk. These findings underscore the urgent need for enhanced public education, expanded animal vaccination programs, and improved healthcare access, particularly in underserved regions. Targeted interventions to address knowledge gaps, promote preventive practices, and improve healthcare availability are critical to reducing rabies incidence in Kandahar Province.

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INTRODUCTION

Rabies is one of the oldest and deadliest zoonotic diseases, transmitted primarily through the bites of an infected animal (Bilal, 2021). The disease is caused by Lyssavirus type 1, a member of the Rhabdoviridae family, characterized as a bullet-shaped RNA virus (Adedeji et al., 2010). Human infection most often occurs following contact with rabid dogs, which account for nearly 99% of global transmission (World Health Organization [WHO], 2023; Gongal &

Wright, 2011). In addition to bites, the virus can enter the body when saliva from an infected animal comes into contact with broken skin or mucous membranes, such as the eyes or mouth (WHO, 2023). Once clinical signs appear, rabies is almost fatal (Takayama, 2008). The incubation period of rabies typically ranges from 1 to 3 months. However, it can range from as short as 1 week to over 1 year, depending on factors such as viral load, the bite site, and its proximity to the central nervous system (Chen et al., 2025). Early nonspecific symptoms, including fever, headache, malaise, itching or tingling at the wound site, are followed by progressive neurological manifestations, including encephalitis, paralysis, hydrophobia, photophobia, aerophobia, hallucinations, and muscle spasms, ultimately leading to death (Rupprecht & Dietzschold, 2017; Gautam et al., 2024).

Rabies is present on all continents except Antarctica, with more than 95% of human deaths reported from Asia and Africa (WHO, 2023). Each year, the disease claims an estimated 60,000 lives worldwide, the majority in South Asia, where countries such as India, Pakistan, Afghanistan, Nepal, and Bangladesh bear the highest burden (Acharya et al., 2021). India alone accounts for nearly 20,000 deaths annually, largely due to its large stray dog population (Gill et al., 2012). Children under 15 years are particularly vulnerable, representing nearly half of global fatalities (WHO, 2022).

The susceptibility of animals to rabies varies by species. Dogs and cats serve as the primary reservoirs of the virus in many settings, acting as the main source of human infections. At the same time, wild animals such as foxes, raccoons, skunks, coyotes, and bats function as important vectors, contributing to the transmission of rabies in other regions (Rocha et al., 2017). By contrast, rabies is rarely documented in rodents, ferrets, and small pigs, and animals such as birds, reptiles, amphibians, fish, and insects are not susceptible at all (Oertli, 2019; Hareza et al., 2023).

Despite its fatality, rabies is entirely preventable through timely vaccination in both humans and animals (Abela, 2015). In high-income countries, mass dog vaccination campaigns, population control of free-roaming dogs, and strict movement restrictions have dramatically reduced the disease burden (Dahourou et al., 2021). Veterinarians, animal handlers, and laboratory staff are considered high-risk occupations; therefore, pre-exposure prophylaxis, including vaccination, is strongly recommended (Mamoudou et al., 2020). In cases of exposure, thorough wound washing for at least 15 minutes with running water and antiseptics or soap, combined with prompt administration of rabies vaccine, remains the most effective post-exposure intervention (Verdoes et al., 2021).

Nonetheless, rabies continues to pose a major public health challenge in many low-resource settings. In Ethiopia, for example, 261 cases were recorded at the Gondar Health Center between 2011 and 2013, with the majority reported among rural residents and children under 15 (Yibrah & Damtie, 2015). In Pakistan, an estimated 2,000–5,000 rabies deaths occur each year (Mughal et al., 2018), while the WHO recorded nearly 97,000 dog-bite cases in 2010 alone (WHO, 2018). In Afghanistan, official records indicate 33,089 reported dog bites between 2022 and 2023, with 18 confirmed human deaths (Sangary et al., 2023).

However, the prevalence and risk factors of rabies in Kandahar Province are poorly understood. This study aims to fill this gap by assessing reported cases, community awareness, vaccination coverage, and dog-related practices.

- To identify the occurrence of rabies cases and examine the associated risk factors in Kandahar Province.
- To assess the level of knowledge and awareness about rabies among the general population and livestock owners.
- To evaluate the epidemiological status of rabies in Kandahar Province.
- To analyze the distribution of rabies cases according to different age groups.

METHODS AND MATERIALS

A retrospective cross-sectional study was conducted to investigate the prevalence, geographic distribution, and community awareness of rabies in Kandahar Province. The study utilized two sources of data:

- **Quantitative data** from health facility records (2020–2024).
- **Primary data** collected through structured household questionnaires.

Study area

Data were collected from nine public health facilities located in Kandahar City and the districts of Dand, Daman, Arghandab, Shah Wali Kot, Khakrez, Zherai, Spin Boldak, and Arghastan. These facilities, under the supervision of the Kandahar Provincial Public Health Directorate, provide rabies-related services, including post-exposure prophylaxis (PEP), to residents of both urban and rural areas. Kandahar Province has an estimated population of approximately 1.38 million people, of whom about 612,000 reside in Kandahar City (Afghanistan Statistical Yearbook, 2025). Free-roaming and owned dogs are commonly observed in both urban and rural settings, and livestock rearing—particularly sheep, goats, and cattle—is widespread, suggesting these factors may influence rabies transmission dynamics (Naeemi et al., 2025).

Study Period

This study was carried out in Kandahar Province, Afghanistan, from April 2020 to December 2024.

Study Population

The study population included Individuals of all ages and both sexes who reported dog bites and sought treatment at public health facilities.
Household residents from selected districts were interviewed to assess knowledge, attitudes, and practices related to rabies, as well as potential risk factors for exposure.

Sampling Procedure

A multistage random sampling method was used for the household survey: Districts were randomly selected. Households within each district were randomly selected.
One eligible respondent per household was interviewed. Health centers from Kandahar City and nine surrounding districts—Arghandab, Daman, Dand, Panjwayi, Maiwand, Zherai, Khakrez, Spin Boldak, and Arghaistan—were included in the survey. For the clinical record review, all documented dog-bite cases reported from 2020 to 2024 were analyzed.

Sample Size

The sample size for the questionnaire survey was determined using Cochran's formula (Cochran, 1977):

$n = \frac{z^2.\ p.\ (1-p)}{E^2}$ Where:

n = required sample size
Z = Z-score (1.96 for 95% confidence)
p = estimated prevalence (0.5 used due to lack of exact data)
E = margin of error (0.05).

A total of 400 participants were included in the study, with 40 respondents selected from each of the nine surrounding districts and the city center.

Data Collection

Data were collected using a structured questionnaire designed to capture demographic and epidemiological variables relevant to the study objectives. Data were collected using a structured questionnaire developed specifically for this study with input from academic supervisors and refined through multiple review rounds. While informed by previous studies, including Karshima et al. (2013), the tool was not directly adopted. The questionnaire comprised two sections: Clinic Information, extracted from health facilities in Kandahar City and nine surrounding districts, included clinic name and location, reporting staff, patient demographics, dog bite exposures, treatment received, vaccination status, and clinical symptoms in humans and animals; and Rabies Knowledge, Attitudes, and Practices (KAP), collected from household residents, assessed awareness, disease recognition, preventive measures, vaccination practices, and treatment-seeking behavior. The KAP section included 18 items (knowledge: 6; attitudes: 2; practices: 10), including vaccine availability and cost. Suspected rabies cases were diagnosed clinically, as laboratory confirmation was not available in the province. Content validity, pilot testing, and internal consistency (Cronbach's alpha = 0.82, indicating good reliability) ensured the tool's quality before administration following informed consent.

Data Analysis

Data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics—including frequencies and percentages were calculated to summarize participants' demographic characteristics, dog bite exposures, and knowledge, attitudes, and practices

(KAP) responses. The results are presented in tables and graphs, to facilitate clear visualization and interpretation, with all figures and tables included in dedicated sections of the manuscript.

FINDINGS

A total of 524 dog bite cases were reported in Kandahar Province from 2020 to 2024. The annual distribution showed 111 cases in 2020 (21.2%), 102 cases in 2021 (19.5%), 119 cases in 2022 (22.7%), 116 cases in 2023 (22.1%), and 76 cases in 2024 (14.5%) (Table 1). The trend indicates a generally high burden of dog bite exposures over the five years, with a peak in 2022 and a decline in 2024. Geographic distribution: The majority of cases (436, 83.2%) were reported from rural areas, whereas 88 cases (16.8%) occurred in urban areas (Figure 1). Sex distribution: Male individuals accounted for 373 cases (71.2%), while females comprised 151 cases (28.8%) (Figure 2). Age distribution: Of the total cases, 130 (24.8%) were in children under 5 years, and 394 (75.2%) occurred in individuals aged 5 years and older. It should be noted that the "≥5 years" category includes both children and adults, as no further age stratification was available (Figure 3). Mortality and transmission: During the study period, 3 deaths were attributed to rabies (Figure 1).

The number of individuals bitten by rabid dogs in Kandahar Province over five years is presented

Table 1. *Distribution of Reported Rabies Dog Bite Cases by Year, Area, Gender, Age, and Mortality in Kandahar Province, 2020–2024*

Year	Total Cases	Urban	Rural	Male	Female	Age >5 years	Age <5 years	Deaths (M/F)
2020	111	16	95	85	26	93	18	2 / 0
2021	102	18	84	70	32	59	43	0 / 0
2022	119	19	100	98	21	99	19	1 / 0
2023	116	19	97	76	40	94	22	0 / 0
2024	76	16	60	45	31	45	31	0 / 0
Total	524	88	436	374	150	390	133	3 / 0

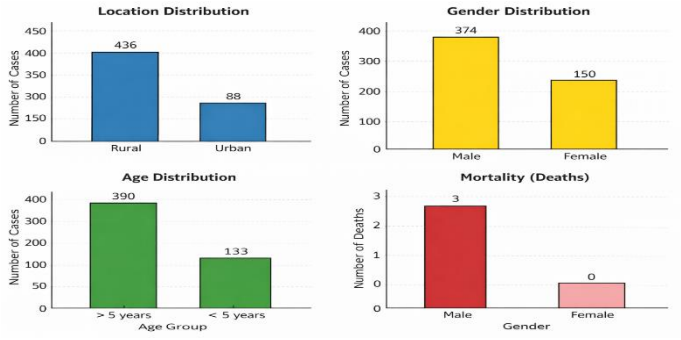

Figure 1. *Epidemiological Distribution of Cases: Geography, Sex, Age, and Mortalit*

Among the 400 respondents, 80% reported being aware of rabies, whereas 20% had no prior knowledge of the disease. Regarding infection outcomes, none reported death, 70% indicated that infected individuals could recover, and 30% were uncertain. Dog bites were identified as the primary route of rabies transmission (88.8%), followed by contact with wounds (5%), bites from wild animals (5%), and contact with saliva (1.3%). Knowledge of rabies prevention was very limited: only 2.5% reported adequate understanding, 5% had partial knowledge, and 92.5% had no knowledge. Awareness of the rabies vaccine was extremely low: 0.5% reported full knowledge, 1.3% partial knowledge, and 98.3% had no knowledge. Regarding vaccination availability, 30% reported the vaccine was free, 55% reported it was paid, and 15% were unsure. Recognition of clinical symptoms in infected individuals was minimal: neurological signs were reported by 5%, photophobia and hydrophobia by 2.5%, and refusal of food and water by 5%, while 87.5% did not recognize any symptoms. In animals, behavioral changes were observed in 37.5%, neurological symptoms in 35%, drooling and hydrophobia in 12.5%, and 15% reported no apparent signs. These findings indicate substantial gaps in knowledge regarding rabies transmission, preventive measures, vaccination, and recognition of clinical signs in both humans and animals, highlighting the urgent need for targeted community education and awareness programs (Table 2).

Table 2. *Knowledge of Rabies Among the Community (N = 400)*

Variables	Response	Frequency	Percentage (%)	Cumulative %
Awareness of rabies	Yes	320	80.0	80.0
	No	80	20.0	100.0
Outcome of infected individuals	Death	0	0.0	0.0
	Recovered/Healthy	280	70.0	70.0
	Don't know	120	30.0	100.0
Mode of infection	Dog bite	355	88.8	88.8
	Contact with wound	20	5.0	93.8
	Contact with saliva	5	1.3	95.0
	Bite from wild animals	20	5.0	100.0
Understanding of rabies prevention	Yes	10	2.5	2.5
	A little	20	5.0	7.5
	No knowledge	370	92.5	100.0
Knowledge about the rabies vaccine	Yes	2	0.5	0.5
	A little	5	1.3	1.8
	No knowledge	393	98.3	100.0
Vaccination availability	Free	120	30.0	30.0
	Paid	220	55.0	85.0
	Don't know	60	15.0	100.0
Symptoms in infected persons	Neurological signs	20	5.0	5.0
	Fear of light and water	10	2.5	7.5
	Refusal of water and food	20	5.0	12.5

Variables	Response	Frequency	Percentage (%)	Cumulative %
	None of the above	350	87.5	100.0
Clinical signs in animals	Behavioral changes	150	37.5	37.5
	Neurological symptoms	140	35.0	72.5
	Drooling and hydrophobia	50	12.5	85.0
	No apparent signs	60	15.0	100.0

Community attitudes and practices regarding rabies prevention revealed substantial gaps. Only 2.5% of respondents reported that they could afford the rabies vaccine if it were not free, whereas 97.5% could not. Exposure to dog or cat bites was reported by 30% of participants, 45% had not experienced such incidents, and 25% were uncertain. Access to healthcare facilities was generally favorable: 70% reported a clinic nearby, 15% indicated limited access, and 15% were unsure of clinic availability. However, only 1.3% of respondents were aware that their local clinic provided rabies vaccines, 78.8% had limited knowledge, and 20% were uncertain. Regarding pet ownership, 42.5% of respondents kept dogs or cats, but only 2.5% had vaccinated their pets, while 97.5% had not. Following a bite from a potentially rabid animal, 37.5% of participants would take the person to a clinic, 12.5% would call a doctor, 40% would dress the wound at home, and 10% were unsure of the appropriate response. These results indicate that although general access to clinics exists, significant economic, educational, and behavioral barriers to effective rabies prevention persist, underscoring the need for public health interventions targeting both human and animal populations (Table 3).

Table 3. *Attitudes and Practices Regarding Rabies (N = 400)*

Variables	Response	Frequency	Percentage (%)	Cumulative %
If the rabies vaccine cost money, could you afford it?	Yes	10	2.5	2.5
	No	390	97.5	100.0
Have you or a family member ever been bitten by a dog or cat?	Yes	120	30.0	30.0
	No	180	45.0	75.0
	Don't know	100	25.0	100.0
Is there a clinic near your area?	Yes	280	70.0	70.0
	Limited access	60	15.0	85.0
	Don't know	60	15.0	100.0
Does the local clinic provide rabies vaccines?	Yes	5	1.3	1.3
	Limited knowledge	315	78.8	80.1
	Don't know	80	20.0	100.0
Pet ownership	Yes	170	42.5	42.5
	No	230	57.5	100.0

Variables	Response	Frequency	Percentage (%)	Cumulative %
Pet vaccination	Yes	10	2.5	2.5
	No	390	97.5	100.0
Response after a bite by a rabid animal	Took the person to a clinic	150	37.5	37.5
	Called a doctor	50	12.5	50.0
	Dressed the wound at home	160	40.0	90.0
	Did not know what to do	40	10.0	100.0

The majority of respondents (81.3%) reported that social media was their primary source of information about rabies. Radio was cited by 9.8%, television by 2.5%, and professional personnel by 1.3%. An additional 5.3% of participants obtained information from other or unspecified sources. These findings highlight the predominance of digital platforms in disseminating rabies information, suggesting that health education campaigns could effectively leverage social media to reach a wide audience (Table 4).

Table 4. *Supplementary Table. Sources of Rabies Information (N = 400)*

Source	Frequency	Percentage (%)	Cumulative %
Social media	325	81.3	81.3
Radio	39	9.8	91.1
Television	10	2.5	93.6
Professional personnel	5	1.3	94.9
Other / Not specified	21	5.3	100.0

DISCUSSION

The present study investigated rabies in Kandahar province, focusing on its occurrence and associated risk factors. The results indicate that rabies is a significant public health concern, particularly in rural areas, where 83.2% of cases were reported, compared with 16.7% in urban areas. Children aged 5 or older accounted for 75.1% of cases, while those under 5 accounted for 24.2%. Males were disproportionately affected (71.1%) compared to females (28.8%). All reported cases were caused by dog bites, highlighting domestic dogs as the main reservoir and vector. Only 2.5% of participants had received rabies vaccination for themselves or their animals, and most relied on informal sources for information.

The high incidence in rural areas likely reflects limited access to healthcare, insufficient vaccination coverage, and low public awareness of rabies prevention. Urban areas, in contrast, benefit from better access to healthcare, public education, and vaccine availability, leading to fewer cases. The predominance of cases among children over five may result from frequent interaction with animals and a lack of awareness about safe behavior around dogs. Male predominance could be due to greater involvement in dog-related activities, including

farming, hunting, and occupational exposure. The exclusive role of dogs in transmission emphasizes the need for targeted dog vaccination and responsible ownership programs.

Our findings are consistent with previous studies in Chad, where 64% of cases occurred in rural areas (Madajadian et al., 2020), and in Nigeria, where 77.8% of cases occurred in children aged 5 or older (Karshima et al., 2013). Male predominance mirrors patterns observed in Nigeria (57.6% males) and other regions. Dog-mediated transmission as the exclusive source of rabies aligns with studies in Nigeria (Awoyomi et al., 2019), supporting global estimates that over 95% of human rabies cases are dog-related. These comparisons reinforce the universal nature of key risk factors, including rural residence, age, gender, and dog exposure.

This study addresses the main objective by identifying key risk factors contributing to rabies occurrence in Kandahar. Regarding the first sub-objective, the assessment of public knowledge revealed low awareness among both the general population and livestock owners, highlighting the need for targeted educational programs. The second sub-objective, epidemiological evaluation, confirmed the higher burden in rural areas and among older children, providing insight into high-risk populations. The third sub-objective, age-specific analysis, demonstrated that children aged 5 and above are most vulnerable, suggesting that interventions should focus on safe interaction with dogs, vaccination campaigns, and community awareness. Overall, these findings provide actionable guidance for rabies prevention, surveillance, and control aligned with the One Health approach.

Despite its contributions, the study has several limitations. First, its cross-sectional design prevents causal inference. Second, self-reported data may introduce recall bias. Third, vaccination status and exposure history were not independently verified. Fourth, results are specific to Kandahar province, limiting generalizability. Finally, reliance on informal sources of information may have led to reporting bias regarding knowledge and preventive behaviors.

Future studies should include longitudinal designs to establish causal relationships between exposure factors and rabies. Expanding research to other provinces would provide a national perspective. Evaluating the effectiveness of targeted educational campaigns and vaccination programs is recommended. Research into innovative strategies to improve vaccination coverage among at-risk populations and domestic dogs would further enhance rabies control efforts in Afghanistan.

CONCLUSION

Dogs are the main vectors of rabies in Kandahar Province, with higher prevalence in rural areas, among males, and among children over 5 years, largely due to low dog vaccination coverage, limited healthcare access, and inadequate public awareness. Stray dogs and delayed post-exposure care further contribute to transmission. To address this, targeted public health interventions are urgently needed, including mass vaccination of domestic and stray dogs, community education on rabies prevention and post-exposure care, enforcement

of stray dog control measures, and improved access to well-equipped healthcare services in rural areas. Strong governmental support and dedicated funding are essential to control and ultimately eliminate rabies in the region effectively.

AUTHORS CONTRIBUTIONS

- Mohammad Dawood Bawer: Conceptualization, study design, methodology, and drafting of the manuscript.
- Mahboobullah Ahmadi: Literature review, data collection, and interpretation of results.
- Aminullah Noor: Data analysis and preparation of figures and tables.
- Ahmadullah Zahir: Supervision, project administration, and critical revision of the manuscript.

All authors reviewed and approved the final manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article and its supplementary information files (Tables S1–S3). Additional datasets are available from the corresponding author upon reasonable request.

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