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How knowledgeable are people in Nepal about rabies?

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ABSTRACT

Eliminating dog-mediated human rabies cases by 2030 is a collective global pledge. Rabies is a vaccine-preventable, zoonotic, and fatal viral disease tormenting human beings and animals for at least four thousand years. An average annual fatality of 59,000 people has been reported from rabies in more than 150 countries, including Nepal. Understanding people's knowledge towards rabies is paramount to preventing this disease. A cross-sectional study was conducted in three districts, namely, Siraha, Parsa, and Parasi in Nepal, from October to December 2021 to assess the level of public awareness of rabies. Information was obtained using a structured questionnaire among 308 household heads. Study findings show that some of the respondents were unfamiliar with the term 'rabies'. They knew major carriers or sources of rabies, but the majority of them (87.3%) did not know its causative agent. They had some idea of how rabies is transmitted from animals to humans, but they lacked a clear understanding of the fate of the animals and humans once affected cases are symptomatic. Only 35.1% of respondents knew that rabies pathogens attack and multiply in the brain tissues. Rabies vaccination in pets is critical for rabies eradication, yet only 26.3% of respondents were aware of the vaccination schedule. Nearly 90% of respondents thought post-exposure prophylaxis (PEP) to be effective immediately after a suspected animal bite. The findings show that there was a significant relationship between independent variables viz. pet ownership ($X^2 = 20.273$, $p < 0.001$), level of education ($X^2 = 39.215$, $p < 0.001$), household income ($X^2 = 13.574$, $p < 0.001$), family size ($X^2 = 15.053$, $p < 0.001$), main occupation ($X^2 = 11.618$, $p = 0.020$), age ($X^2 = 6.982$, $p = 0.008$) with dependent variable i. e., knowledge category (good and poor knowledge). Education to invoke awareness among rural people about rabies, its transmission and prevention, including making anti-rabies vaccines freely available, should be the priority for municipalities, public health and veterinary health authorities in the study districts and throughout the country.

1. Introduction

Rabies is a vaccine-preventable, zoonotic, viral disease caused by RNA virus belonging to genus Lyssavirus and family Rhabdoviridae [1]. It is an ongoing threat to human beings and animals, as it is almost 100% fatal once clinical signs are seen [2]. Rabies has been a part of human history for millennia, embedded in its enzootic environment (animal host) and posing serious health risks to people all over the world [3]. Generally, rabies-infected animals spread the infection by their saliva to other animals and humans [4].

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Globally, every year about 59,000 people die due to rabies and most of them are children below 15 years [5]. Despite the fact that many measures are being taken to eliminate rabies, the virus continues to spread across the world, posing a significant health and economic burden in developing countries, especially in Africa and Asia [6–8]. Poor public awareness and sylvatic cycle maintained by wild animals is considered as the major hurdle for prevention and control of rabies [9]. The main source of rabies transmission to human beings is by dogs and it contributes to most of global human death [5] as the case in Nepal [10]. Control efforts aimed at dogs can successfully lower the risk of rabies in public [11]. However, rabies cases in humans are recorded from wildlife such as foxes, jackals, mongooses, raccoons, skunks, and bats where domestic rabies cases have been successfully controlled [12,13].

Nepalese people have close association with animals, unaware to most that they serve as a reservoir for many zoonotic diseases like rabies [14,15]. In the past five years around 20,00–40,000 cases of animal bites were reported in Nepal [16–20]. The number of rabies deaths that have been documented has been varying every year. Department of Health Services, Nepal [21] reports that there were 18 rabies-related human deaths in 2018/19, 32 in 2017/18, 8 in 2016/17, 6 in 2015/16, 13 in 2014/15, and 10 in 2013/14. People in hilly and himalayan regions do not have access to appropriate transportation, education, and medicine due to topographical limitations, resulting in a lack of access to rabies awareness campaigns and other rabies control-related initiatives [22]. Due to these constraints accompanied with lack monitoring and laboratory infrastructure, it is possible that actual rabies cases in Nepal are under-reported. Moreover, if the wound is minor, a dog bite is typically overlooked, and the same applies to puppy bites [23]. In 2018, the Veterinary Epidemiology Centre in Nepal reported an increase in rabies outbreak, a total of 159 outbreaks and 427 animal deaths. The government of Nepal, in collaboration with the support of numerous international non-governmental (INGO) and non-governmental organizations (NGO), has been working to reduce rabies cases through mass dog vaccinations, animal birth control services in heavily populated areas, and public awareness campaigns. Despite the fact that 2020 marked the end of the first phase approach to eliminate rabies [24], rabies-related human deaths have been confirmed in Nepal in 2021 [25,26] as were in the last five years [27].

Anecdotal evidence suggests that a lack of public awareness about the disease is one of major bottlenecks for rabies prevention and control in Nepal, particularly canine rabies. Some studies [28–30] have been conducted in Nepal for assessment of knowledge towards rabies in Nepal. Knowing people's perceptions of sources of rabies, routes of transmission, symptoms, fate once clinical symptoms are observed, treatment, and prospective intervention measures is critical in developing rabies-control strategies and deciding the future activities. So, this study was conducted among residents of three municipalities with maximum dog bite cases to assess their knowledge of rabies. The result of this study is expected to contribute to government policy making and initiate and scale up programs to achieve

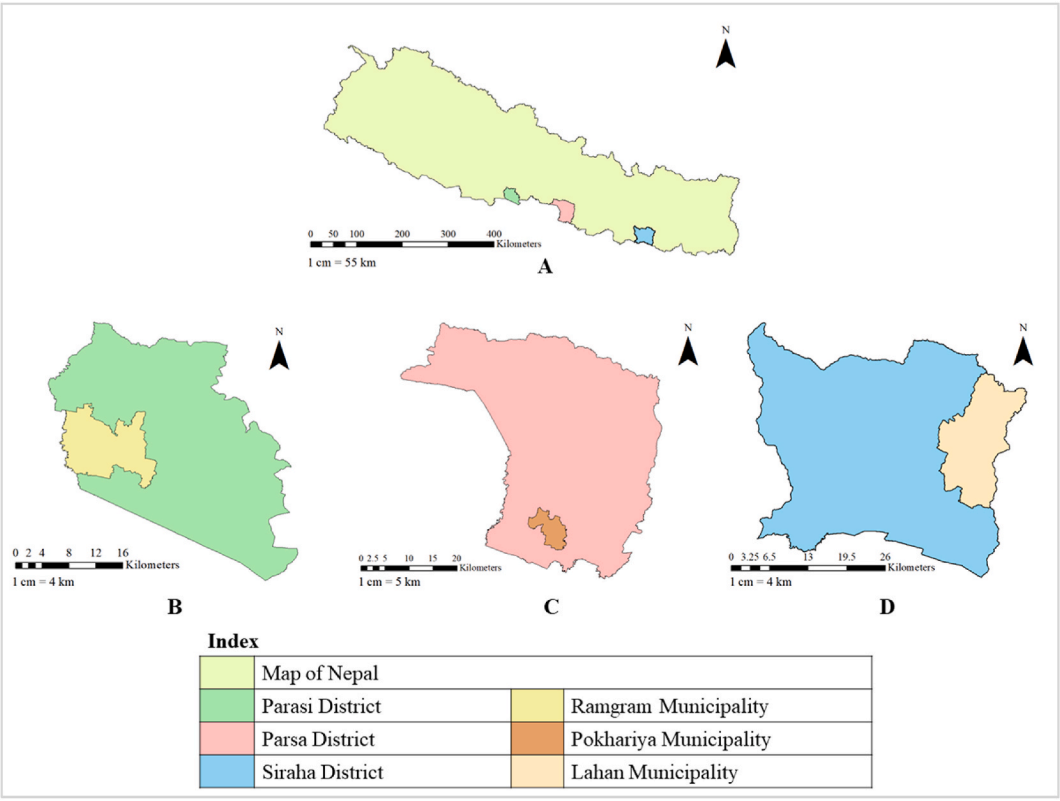

Fig. 1. A: The map of Nepal showing the study districts, B: Map of Parasi District showing Ramgram Municipality, C: Map of Parsa District showing Pokhariya Municipality, D: Map of Siraha District showing Lahan Municipality. Map was prepared using Arc GIS 10.8.
Shape file source: https://nationalgeoportal.gov.np/

zero rabies by 2030.

2. Methodology

2.1. Study area

The study was conducted in Siraha, Parsa and Nawalparasi (Bardaghat Susta West), called hereafter as Parasi, the three districts having municipalities with highest dog bite cases (Fig. 1). In 2018/19, Siraha, Parsa and Parasi had a total of 1727, 1025 and 1312 dog bite cases, respectively [31]. These districts lie in the Terai region of Nepal. The densely populated Terai region poses a high risk for rabies as it provides better feeding opportunities for stray dogs, thus helping them to survive and reproduce [20].

Siraha, a district in Madhesh Province has an area of 1188 square kilometers and a population of 637,328. The major ethnic groups residing in this district are Yadav, Musalman, Musuhar and Kushwaha with Maithili language as the widely used language [32]. There are 17 municipalities in Siraha. Among those 17 municipalities, Lahan Municipality reported 1409 dog bite cases in human. Ward number 1, 4, 5, 9 and 10 with the highest dog bite cases were chosen for the study.

Parsa has an area of 1353 square kilometers. As of 2011, Parsa had a population of 601,017. The major ethnic groups living in this district are Muslim, Kurmi, Tharu and Yadav. Bhojpuri is the main language spoken by a majority of people followed by Nepali, Maithili and Tharu. The district comprises of 1 metropolitan city, 3 urban municipalities and 10 rural municipalities. Pokhriya municipality reported 968 dog bite in human and wards 1, 3, 4, 5 and 9 with the higher dog bite cases were chosen as the study sites.

Parasi, lying in Lumbini Province in western Nepal has a total area of 1606 square kilometers. In 2011, its total population was 331,904; and Brahmin, Chhetri, Rajbansi, and Limbu being the major ethnic groups residing in the district [32]. There are 7 municipalities (3 urban, 4 rural) in it. Ramgram municipality reported 851 dog bite in human and its ward no 2, 3 and 5 with the higher dog bite cases were chosen for the study.

2.2. Study population, design and sampling technique

The units for this cross-sectional study were household heads (HHs). A survey was conducted from October–December 2021 among 308 (Siraha: 102, Parsa: 102, Parasi: 104) HHs. The snowball sampling method was employed in the selected three municipalities to identify households and collect data. Where HHs were not available, the next eldest one in the family provided the information. HH from the first identified and interviewed household provided information about the next available household until the target number of household respondents was interviewed in the study area as done by Tiwari et al. [33] and Tenzin et al. [34]. Since snowballing methods may lead to sampling bias, sampling error and diversity bias in the research [35], readers are requested to take these limitations into account while generalizing the study findings.

2.3. Data collection

A researcher-developed, expert-validated and pre-tested questionnaire was used to collect data. Specifically, the questionnaire consists of question relating to i) the causative agent of rabies, ii) main carriers or sources of rabies in human, iii) host range of rabies, iv) clinical signs and symptoms of rabies in animals and human, v) mode of transmission of rabies, vi) fate of rabid animals and humans once clinical symptoms seen, vii) group of people at higher risk, viii) part of body that rabies pathogen attack and multiply, ix) prevention and control measures of rabies, and x) respondents' demographic details. The instrument was pre-tested among 15 individuals and modified to integrate their input. The survey instrument was in the English language. Two researchers conversant with Nepali, Hindi and English met HHs in person and asked questions in Nepali (national language) and Hindi language to ease the understanding. Subjects were informed of the objectives of the study, were assured of confidentiality of the data they provided, anonymity of their individual identity and voluntariness of their participation in the study prior to data collection. All the data were collected from only those who consented to share their opinion in a face-to-face interview.

2.4. Data analysis

The data was examined for incompleteness, missing values, and errors. The data from the surveys were cleaned and imported to IBM Statistical Package for Social Sciences 20.0 (SPSS) for analysis. Descriptive statistics, and Chi square test were calculated. A p-value of less than 0.05 was judged statistically significant. Descriptive statistics were computed to see frequency distribution. For every correct response, a score of 1 was awarded whereas a wrong answer got 0. Note that, for questions with multiple correct answers the score 1 was evenly distributed between the number of correct answers. For example, if there is a question with 4 correct options, then each correct answer will get 0.25 points. Similarly, respondents giving two correct options will get 0.5, for 3 correct options will get 0.75 and all the 4 correct options will get 1. Those respondents who obtained more than or equal to 50% of total score (maximum score: 14) were categorized as having 'Good Knowledge', and those with total score less than 50% as having 'Poor Knowledge'. This scoring method was used by Al-Mustapha et al. [36]. Phi value was used to measure the strength of an association between two categorical variables in a 2×2 contingency table and Cramer's V being an alternative to phi in tables bigger than 2×2 tabulation. Interpretation of Phi and Cramer's V was done as suggested by Akoglu [37].

2.5. Ethics statement

The guidelines of the 2013 World Medical Association (WMA) Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects was followed and the study was approved by the Research & Capacity Building Committee of Association of Nepalese Agricultural Professionals of Americas (NAPA-RMG-2020-02). Furthermore, the research team seriously followed the research protocols to safeguard the privacy and confidentiality. These protocols include strictly seeking of oral consent from the respondents that was read to them prior to administration of the survey, ways to maintain privacy and confidentiality of the responses provided, and protecting their identity at any time of the research process. The research team was mindful of the social, cultural, religious, and economic background of respondents at the time of designing research tools.

3. Results

3.1. Demographic profile of respondents

Male comprised 75.3% (232/308) of respondents. They were on an average 45 years old. All the respondents were married and had an average family size of 6. Nearly ninety percent (276/308) of the HHs were males. Slightly over half (51.6%, 159/308) were Madeshi followed by Adhibasi/Janajati (17.5%, 54/308) and Brahmin (16.6%, 51/308). The majority (87%, 268/308) were Hindus while Islamic (6.5%, 20/308) and Buddhist (6.2%, 19/308) comprised the same proportion. Respondents had an average 7 years of education. Over one-third (36.4%, 112/308) were self-employed and 31.8% (98/308) do farming/agriculture. Details of socio demographic characterstics of respondents is in Table 1.

3.2. Pets and domestic animals ownership

As presented in Fig. 2, 22.7% (70/308) respondents owned pets (dog or cat) and 51.9% (160/308) reared domestic animals. About one-fifth (19.2%, 59/308) of them kept dogs and only 3.6% (11/308) of them owned cats. Majority of the respondents said that they reared goats followed by buffalo, and cows.

3.3. Knowledge of respondents towards rabies

3.3.1. Causative agent of rabies

Although, all the respondents have heard about 'rabies', some of the respondents seemed to be unfamiliar with the term 'rabies' and mistook it for an illness induced by poison transmitted through the bite of a 'mad dog'. Descriptive statistics show that the majority of respondents (87.3%, 269/308) did not know virus as the causative agent of rabies (Fig. 3). Only 12.7% (39/308) knew that rabies is

Table 1
Socio demographic characteristics of respondents in the study area.

Socio-Demographics		Siraha, n = 102	Parsa, n = 102	Parasi, n = 104	Total, n = 308
Gender	Male	72 (70.6%)	89 (87.3%)	71 (68.3%)	232 (75.3%)
	Female	30 (29.4%)	13 (12.7%)	33 (31.7%)	76 (24.7%)
Age	Lowest to 40 (≤40)	46 (45.1%)	45 (44.1%)	41 (39.4%)	132 (42.9%)
	41 to highest (≥41)	56 (54.9%)	57 (55.9%)	63 (60.6%)	176 (57.1%)
Family size	Mean ± SD	6.74 ± 2.3	6.22 ± 2.4	6.18 ± 2.7	6.4 ± 2.5
Household head gender	Male	96 (94.1%)	100 (98.0%)	80 (76.9%)	276 (89.6%)
	Female	6 (5.9%)	2 (2.0%)	24 (23.1%)	32 (10.4%)
Ethnicity	Madeshi	58 (56.9%)	64 (62.7%)	37 (35.6%)	159 (51.6%)
	Aadibasi/Janajati	20 (19.6%)	17 (16.7%)	17 (16.3%)	54 (17.5%)
	Brahmin	9 (8.8%)	10 (9.8%)	32 (30.8%)	51 (16.6%)
	Chhetri	6 (5.9%)	8 (7.8%)	10 (9.6%)	24 (7.8%)
	Musalman	9 (8.8%)	3 (2.9%)	8 (7.7%)	20 (6.5%)
Religion	Hinduism	89 (87.3%)	91 (89.2%)	88 (84.6%)	268 (87.0%)
	Islam	9 (8.8%)	3 (2.9%)	8 (7.7%)	20 (6.5%)
	Buddhism	4 (3.9%)	8 (7.8%)	7 (6.7%)	19 (6.2%)
	Christianity	0	0	1 (1.0%)	1 (0.3%)
Years of education	No formal education (0 years of education)	25 (24.5%)	15 (14.7%)	22 (21.2%)	62 (20.1%)
	School level (1–10)	45 (44.1%)	72 (70.6%)	49 (47.1%)	166 (53.9%)
	College/University (11 to highest)	32 (31.4%)	15 (14.7%)	33 (31.7%)	80 (26.0%)
Main family occupation	Self-employed/Own business	46 (45.1%)	31 (30.4%)	35 (33.7%)	112 (36.4%)
	Agriculture	36 (35.3%)	35 (34.3%)	27 (26.0%)	98 (31.8%)
	Private jobs	8 (7.8%)	17 (16.7%)	12 (11.5%)	37 (12.0%)
	Government job/Public Services	5 (4.9%)	6 (5.9%)	20 (19.2%)	31 (10.1%)
	Others	7 (6.9%)	13 (12.7%)	10 (9.6%)	30 (9.7%)
Monthly household income of family	Lower (Rs. 10,000 to Rs. 25,000)	61 (59.8%)	74 (72.5%)	41 (39.4%)	176 (57.1%)
	Middle/Upper (Rs. 25,001 to Rs. 60,000)	41 (40.2%)	28 (27.5%)	63 (60.6%)	132 (42.9%)

Note: Rs. refers to Nepalese currency in rupees.

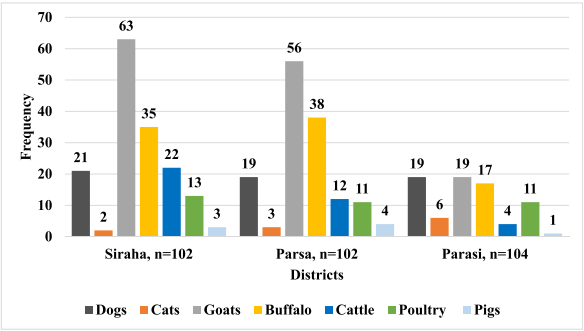

Fig. 2. Respondents owning pets and/or domestic animals.

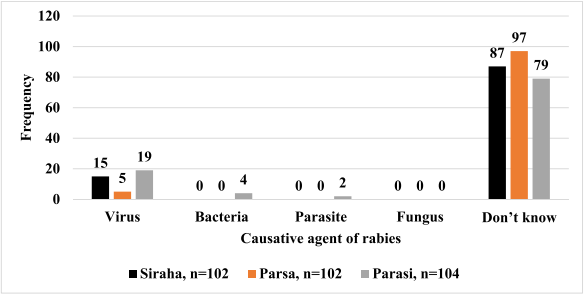

Fig. 3. Knowledge on causative agent of rabies.

caused by a virus. Among three districts, 18.3% (19/104) respondents in Parasi, 14.7% (15/102) respondents in Siraha and 4.9% (5/102) respondents in Parsa knew the causative agent of rabies.

3.3.2. *Main carrier or source of rabies in human*

The majority (94.8%, 292/308) of respondents knew that major carriers or sources of rabies are dogs. Proportionately more respondents from Parasi (97.1%, 101/104) answered this correctly than those from Parsa (94.1%, 96/102) and Siraha (93.1%, 95/102) (Fig. 4). None of the respondents thought cat, bat and domestic animal as the main sources of rabies, whereas 5.2% (16/308) of respondents claimed wild animals to be the major carrier or source of rabies in humans.

3.3.3. *Clinical signs and symptoms of rabies in dog and humans*

Results show most respondents being aware of clinical signs of rabies in dogs and humans (Table 2). Ninety-nine percentage (305/308) of respondents indicated aggressiveness/biting, 94.2% (290/308) of respondents indicated knowledge of salivation, 48.1% (148/308) indicated dropping of the jaws as symptoms of rabies in dogs. On the contrary, only a few respondents 4.5% (14/308), 15.9% (49/308), and 25% (77/308) knew difficulty in swallowing, exaggerated response to light and sound, and pica, respectively as the symptoms of rabies in dogs. Similarly, most respondents knew major signs and symptoms or rabies in humans. For example, 82.1% (253/308), 77.6% (239/308), and 72.4% (223/308) knew sudden change of behavior, hydrophobia, and excessive salivation, respectively as major symptoms of rabies in humans. Contrarily, only a few respondents knew difficulty in swallowing, and paralysis of muscles as symptoms of rabies in humans. One in ten did not know any symptoms of rabies in humans.

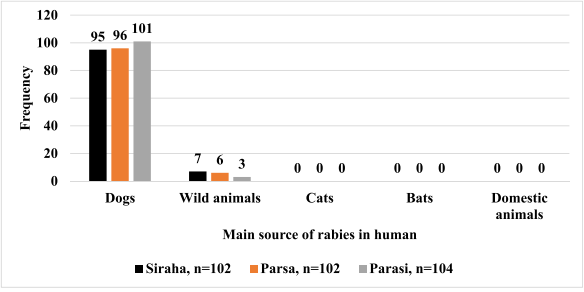

Fig. 4. Knowledge on the main carrier or source of rabies in humans.

Table 2
Knowledge of clinical signs of rabies.

Clinical Signs	Siraha, n = 102	Parsa, n = 102	Parasi, n = 104	Total, n = 308
Clinical signs of rabid dog				
Aggressiveness/biting	100 (98.0%)	101 (99.0%)	104 (100.0%)	305 (99.0%)
Salivation	100 (98.0%)	93 (91.2%)	97 (93.3%)	290 (94.2%)
Dropping of the jaw	41 (40.2%)	49 (48.0%)	58 (55.8%)	148 (48.1%)
Characteristic change in the sound	44 (43.1%)	35 (34.3%)	33 (31.4%)	112 (36.4%)
Pica (e.g., Sticks, nails, feces, etc.)	25 (24.5%)	25 (24.5%)	27 (26.0%)	77 (25.0%)
Exaggerated response to light and sound	24 (23.5%)	17 (16.7%)	8 (7.7%)	49 (15.9%)
Difficulty in swallowing	6 (5.9%)	5 (4.9%)	3 (2.9%)	14 (4.5%)
Don't know	2 (2.0%)	1 (1.0%)	0	3 (1.0%)
Clinical signs and symptoms of rabies in human				
Change in behavior/confusion	94 (92.2%)	95 (93.1%)	64 (61.5%)	253 (82.1%)
Hydrophobia	85 (83.3%)	87 (85.3%)	67 (64.4%)	239 (77.6%)
Aggressiveness/biting	94 (92.2)	78 (76.5%)	66 (63.5%)	238 (77.3%)
Excessive salivation	97 (95.1%)	71 (69.6%)	55 (52.9%)	223 (72.4%)
Characteristic change in the sound	64 (62.7%)	69 (67.6%)	49 (47.1%)	182 (59.1%)
Aerophobia	16 (15.7%)	3 (2.9%)	3 (2.9%)	22 (7.1%)
Difficulty in swallowing	3 (2.9%)	1 (1.0%)	10 (9.6%)	14 (4.5%)
Fever	2 (2.0%)	0	3 (2.9%)	5 (1.6%)
Paralysis of muscle	1 (1.0%)	0	3 (2.9%)	4 (1.3%)
Don't Know	3 (2.9%)	5 (4.9%)	23 (22.1%)	31 (10.1%)

3.3.4. Host range of rabies

Table 3 shows the host range of rabies as perceived by respondents. Dogs and humans were cited by almost all respondents as hosts of rabies. Data show that relatively more respondents in Parasi (88.5%, 92/308) were aware of all warm-blooded animals are susceptible to rabies than from Parsa (86.3%, 88/102) and 69.6% (71/102) respondents in Siraha.

3.3.5. Methods of transmission of rabies

As shown in Table 4, almost all (99.7%, 307/308) respondents knew biting as the major method of rabies transmission. Half of respondents knew that contact with saliva in lacerated or damaged skin (49.7%, 153/308) and scratching (33.1%, 102/308) could also transmit rabies. Twenty-seven percent of respondents thought that eating raw meat (26.6%, 82/308) could also transmit the rabies. It is surprising that 34.3% (24/70) of pet owners and 55% (131/238) of non-pet owners were not aware that contact with saliva in damaged skin could transmit rabies.

3.3.6. Fate of animals and humans once clinical signs and symptoms are manifested

Less than half of respondents knew that rabies is fatal in humans and animals once acquired (Table 5). Forty-three percent (132/308) of the respondents thought that rabies cases in human with clear manifestation of symptoms are treatable.

3.3.7. Perception on people at higher risk of rabies

We found that 70.5% (217/308) of respondents knew that the children are at a higher risk of rabies (Fig. 5). Out of 3 districts, respondents from Parsa (75.5%, 77/102) appeared to be more knowledgeable than respondents from Siraha (68.6%, 70/102) and Parasi (67.3%, 70/104) (Fig. 5).

3.3.8. Body parts where rabies pathogen multiply

When asked in which part of the body do rabies pathogens attack and multiply, 35.1% (108/308) answered it to be the brain (Fig. 6). Nearly a half (45.5%, 140/308) indicated they did not know this. There was a variation in responses by districts. Only 23.5% (24/102) of the respondents from Parsa knew rabies attacks and grows in the brain against 33.3% (34/102) from Siraha and 48.1%

Table 3
Knowledge on host range of rabies.

Hosts	Siraha, n = 102	Parsa, n = 102	Parasi, n = 104	Total, n = 308
Dog	102 (100.0%)	101 (99.0%)	104 (100.0%)	307 (99.7%)
Human	102 (100.0%)	102 (100.0%)	101 (97.1%)	305 (99.0%)
Jackal	97 (95.1%)	101 (99.0%)	97 (93.3%)	295 (95.8%)
Cat	82 (80.4%)	90 (88.2%)	95 (91.3%)	267 (86.7%)
Goat	74 (72.5%)	90 (88.2%)	94 (90.4%)	258 (83.8%)
Buffalo	74 (72.5%)	90 (88.2%)	94 (90.4%)	258 (83.8%)
Cattle	74 (72.5%)	89 (87.3%)	94 (90.4%)	257 (83.4%)
Sheep	72 (70.6%)	89 (87.3%)	94 (90.4%)	255 (82.8%)
Pigs	73 (71.6%)	89 (87.3%)	93 (89.4%)	255 (82.8%)
Rabbit	72 (70.6%)	89 (87.3%)	93 (89.4%)	254 (82.5%)

Table 4
Knowledge on methods of transmission of rabies.

Methods of transmission of rabies	Siraha, n = 102	Parsa, n = 102	Parasi, n = 104	Total, n = 308
Biting	102 (100.0%)	101 (99.0%)	104 (100.0%)	307 (99.7%)
Contact with saliva of rabid animals in damaged skin	50 (49.0%)	47 (46.1%)	56 (53.8%)	153 (49.7%)
Scratching	41 (40.2%)	25 (24.5%)	36 (34.6%)	102 (33.1%)
Eating raw meat and milk of rabid domestic animal	27 (26.5%)	31 (30.4%)	24 (23.1%)	82 (26.6%)

Table 5
Knowledge on fate of rabies infected humans and animals.

Fate of rabies infected humans and animals	Siraha, n = 102	Parsa, n = 102	Parasi, n = 104	Total, n = 308
Fate of rabies infected humans once the clinical signs are developed?				
Can be treated	41 (40.2%)	36 (35.3%)	55 (52.9%)	132 (42.9%)
Die	47 (46.1%)	48 (47.1%)	35 (33.7%)	130 (42.2%)
Don't know	14 (13.7%)	18 (17.6%	14 (13.5%)	40 (14.9%)
Fate of a rabid animals once the clinical signs are developed?				
Die	47 (46.1%)	48 (47.1%)	46 (44.2%)	141 (45.8%)
Can be treated	41 (40.2%)	36 (35.3%)	43 (41.3%)	120 (39.0%)
Don't know	14 (13.7%)	18 (17.6%)	15 (14.4%)	47 (15.3%)

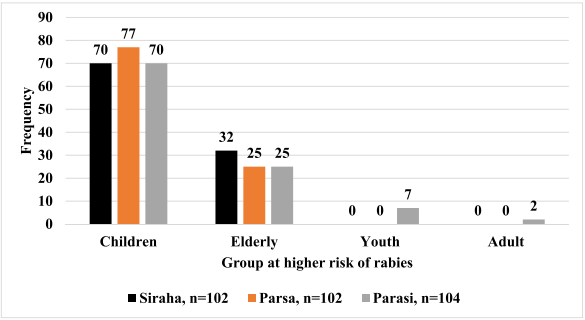

Fig. 5. Knowledge on people at higher risk of rabies.

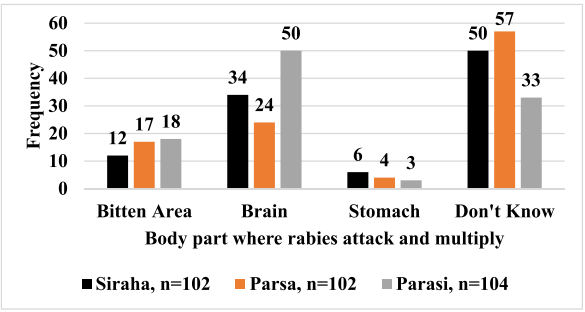

Fig. 6. Knowledge on part of the body where rabies pathogens attack and multiply.

(50/104) from Parasi.

3.3.9. Prevention and control of rabies

All the respondents indicated they knew that rabies could be prevented by vaccination and anti-rabies vaccines can be obtained from government hospitals (Table 6). Only 26.3% (81/308) respondents knew the schedule for rabies vaccination in pets. Nearly 90% (277/308) of respondents knew that anti rabies vaccine is effective immediately after suspected animal bite.

3.4. Association of knowledge of respondents and their sociodemographic traits

Out of 308 respondents, 73.4% (226/308) had good knowledge whereas 26.6% (82/308) had poor knowledge about rabies. The

Table 6
Knowledge on prevention and control measures.

Prevention and control measures	Siraha, n = 102	Parsa, n = 102	Parasi, n = 104	Total, n = 308
Can rabies be prevented by vaccination?				
Yes	102 (100.0%)	102 (100.0%)	104 (100.0%)	308 (100.0%)
Do you know that anti- rabies vaccines can be obtained from authorized government veterinary hospital?				
Yes	102 (100.0%)	102 (100.0%)	104 (100.0%)	308 (100.0%)
Do you know the schedule for vaccination against rabies in pets?				
Yes	25 (24.5%)	20 (19.6%)	36 (34.6%)	81 (26.3%)
No	77 (75.5%)	82 (80.4%)	68 (65.4%)	227 (73.7%)
At which stage is anti-rabies vaccine effective after a suspected animal bite?				
Immediately	91 (89.2%)	94 (92.2%)	96 (88.5%)	277 (89.9%)
After 1–2 days	9 (8.8%)	7 (6.9%)	3 (2.9%)	19 (6.2%)
Any time	1 (1.0%)	0	2 (1.9%)	3 (1.0%)
Don't know	1 (1.0%)	1 (1.0%)	7 (6.7%)	9 (2.9%)

maximum score that a respondent scored was 13.53 out of 14 whereas the lowest score was 2.84. Table 7 shows association of the knowledge category of respondents about rabies with their socio-demographic characters. It was found that there was significant relationship between pet ownership and knowledge category ($X^2 = 20.273$, $p < 0.001$), level of education and knowledge category ($X^2 = 39.215$, $p < 0.001$), HH income and knowledge category ($X^2 = 13.574$, $p < 0.001$), family size and knowledge category ($X^2 = 15.053$, $p < 0.001$), main occupation and knowledge category ($X^2 = 11.618$, $p = 0.020$), age group and knowledge category ($X^2 = 6.982$, $p = 0.008$). Phi and Cramer's V value signifies that pet ownership, and level of education had a very strong relationship. Whereas, main occupation, family size, and HH income had a strong relationship. Age group had moderate relationship.

4. Discussions

Rabies remains a major public health problem in both the developed and developing countries including Nepal. This research studies the knowledge of people in rural Nepal on various aspects of rabies and whether and how their knowledge on rabies varies by their socio-demographics. The findings show some gaps and variation in knowledge on rabies among the respondents.

Respondents were found to be aware of the causative agent of rabies. They knew rabies as a disease caused by biting from a 'mad dog' but very few knew it was by a virus. Our findings that only a few respondents (12.7%, 39/308) know rabies is caused by a virus, resonates with findings in Ethiopia [38] and in Mozambique [39] where only 13.3% and 10.1% of the respondents knew the virus as the causative agent of rabies.

Number of people owning pets is growing globally and it is more so in growing economies such India, China and even in small countries like Nepal. Making those people aware of pet diseases is paramount to prevent and control these diseases and also ensure public health. The findings of our study align with the study of Chaudhary et al. [29] in Kathmandu in 2017 who also reported significant association between pet ownership and the owners' knowledge on causative agents of rabies.

A high proportion of respondents (94.8%, 292/308) in our study are found to be aware of the fact that dogs are the main source of rabies in humans. These findings support the findings of Hagos et al. in Ethiopia [40] and Bouaddi et al. in Morocco [41] where 98.6% and 93.4% respondents indicated dogs as the source of most human rabies cases. None in our study cited cats and bats as the source for human rabies. This might be due to the fact that in Nepal only a few respondents and even only a few people keep cats as pet animals and also cats are generally scorned and put aside, whereas dogs are adored, admired, and venerated. Even seeing a black cat is considered bad luck as they are said to represent evil omens and witches in disguise [42]. A few respondents cited wild animals as the source for rabies, which might be due to frequent jackal bites to themselves and livestock.

There was an agreement between our study and those conducted elsewhere [38,43,44] that excessive salivation and change in behavior in rabid dogs were cited by most respondents as clinical signs and symptoms observed in rabid cases. In our study, many respondents were unaware of other important signs and symptoms such as difficulty in swallowing, exaggerated response to light and sound, pica, characteristic change in sound and dropping of jaw exhibited by rabid dogs which is in line with other researches [28,45]. This can be because a furious form of rabies is the common type of rabies that is seen in a community. Similar is the result of knowledge towards signs and symptoms in humans. It could be due to the lack of educational or awareness programs towards rabies.

Relatively more respondents in our study (81.5%, 251/308) were aware that all mammals (warm blooded animals) are susceptible to rabies than in studies in Ethiopia and Morocco [38,40,41,43]. In our study, all respondents indicated knowing biting as the mode of transmission of virus from carrier animals and a similar finding was seen in Ethiopia [43]. Only a small percentage of respondents were aware of the fact that contact with saliva of rabid animals in damaged skin (49.7%, 153/308), scratches (33.1%, 102/308) and eating products derived from rabid animals (26.6%, 82/308) could spread the disease. On the contrary, about 6% of respondents mentioned scratches as mode of transmission in Brazil [45]. Similar to our study, only a few respondents knew other possible methods of transmission of rabies in India [33] and Ethiopia [38]. For example, CDC [46] notes the possibility of acquiring rabies from drinking raw milk from a rabid animal. Knowing sites of bites and severity of wounds are critical as these factors are likely to influence onset of rabies signs and symptoms [47].

The findings of our study reveal that not many respondents know the fate of animals and humans once they manifest signs and symptoms of rabies. It was surprising to know that nearly 43% respondents thought human cases of rabies can be treated and 39%

Table 7
Association of knowledge category of respondents with their sociodemographic traits.

Socio-demographics		Knowledge category		X^2	df	*p* value
		Good	Poor			
Districts	Siraha	70	32	2.261	2	0.323
	Parsa	75	27			
	Parasi	81	23			
Gender	Male	176	56	2.973	1	0.085
	Female	50	26			
Age group	Lowest to 40 (≤40)	107	25	6.982	1	0.008*
	41 to highest (≥41)	119	57			
Pet ownership	Yes	66	4	20.273	1	<0.001***
	No	160	78			
Ethnicity	Brahmin	43	8	5.434	4	0.246
	Chhetri	18	6			
	Adhibashi/Janajati	40	14			
	Madhesi	113	46			
	Mushalman	12	8			
Household head	Male	202	74	0.048	1	0.826
	Female	24	8			
Family size	Small (1–5)	107	19	15.053	2	<0.001***
	Medium (6–10)	106	54			
	Large (≥11)	13	9			
Religion	Hinduism	198	70	–	–	–
	Buddhism	15	4			
	Islam	12	8			
	Christianity	1	0			
Main occupation	Agriculture	61	37	11.618	4	0.020*
	Government/Public Service	27	4			
	Self/Own employed	85	27			
	Private Jobs	31	6			
	Others	22	8			
Level of education	No formal education (0 years of education)	31	31	39.215	2	<0.001***
	School level (1–10)	118	48			
	College/University (11 to highest)	77	3			
Household income	Lower (10000–25000)	115	61	13.574	1	<0.001***
	Middle/Upper (25001–60000)	111	21			

Note: X^2 = Pearson Chi-square value, *p < 0.05, **p < 0.01, ***p < 0.001, df = degrees of freedom.

(120/308) respondents thought animal rabies cases are treatable or curable. Our findings resonate with findings in Ethiopia [43] where researchers also found that 17.7% were unaware of the fatal nature of rabies and in Rwanda [44] where people thought that human and animal rabies cases can be treated successfully.

Seven in ten respondents knew that children are at higher risk of rabies which support the findings of Nejash et al. [38] where 74.1% respondents cited children to be at higher risk for rabies. Children are the most common victims of rabies [48,49]. One of the reasons for this is that children love to play with pets, therefore come in contact with pets more often. They are also afraid to report bites from their pets to their parents. Oppositely, adults are relatively more aware of rabies and are proactive to seek medical attention. The findings of our study that over one-fourth (26.7%, 82/308) of respondents believing that older people are at more risk of rabies contradicts the above notion.

Only 35.1% (108/308) respondents indicated that rabies viruses attack and multiply in brain tissues of carrier animals whereas 15.3% (47/308) respondents cited bitten areas as the main sites for attack and multiplication of virus. These findings are in line with research conducted in Ethiopia [43] which noted 43.5% respondents being aware of brain tissues as the main body area where virus attacks and multiplies.

Only 26.3% (81/308) of respondents knew the vaccination schedule against rabies. This low percentage of people knowing vaccination schedule is concerning as getting their pet animals vaccination on a recommended schedule is critical to attain and sustain an immunity level. This might be due to efforts being centered on promoting dog vaccination and health seeking behavior rather than educating people on how the vaccine works and how vaccination schedule is related to the efficacy of the vaccine.

Many socio-demographic traits of respondents were found to be significantly associated with their knowledge of rabies. Pet ownership, education level, age group, family size, main occupation and household income were found to have association with their knowledge of rabies. It shows that the idea of examining the relationship between the respondents' demographic traits and their knowledge was important. The future rabies elimination awareness programs should be focused keeping these statistics into consideration. The findings of our study support the findings of [28,29,40,50–52] that people having pets had more knowledge about rabies than the ones without pets. Education helps gain information and knowledge. Generally, the higher the education of people, higher is their level of inquiry, they are better able to understand their societies, animals and human relationships, and their contexts including health and they hold higher critical thinking and decision-making ability.

One of the ways to increase awareness about rabies among community members is to provide training to them [38] and this has

been demonstrated in Malawi where a session on rabies increased awareness of rabies among school children [53]. Moreover, informing and educating children is crucial because targeted education of this group can lead to long-term community changes [54].

5. Conclusion

This study sought to examine the level of knowledge of rural people in Nepal towards rabies. The study findings show that the majority of the respondents in the research areas have good knowledge of rabies. However, most participants do not have a comprehensive understanding of fatality of rabies once clinical signs are seen. It is of great concern as they may neglect dog bite cases. It is therefore essential that there are educational and awareness programs in place, specifically focusing on people with lower income, lower education and those who do not own pets. Campaigns to raise public awareness can use educative and catchy slogans: "You must immediately seek anti-rabies vaccination if any rabid or rabid suspected animal bites", "Rabies virus affects all warm-blooded animals", "Rabies is fatal once symptoms are seen in humans and animals" and "Rabies vaccination is key to prevent against rabies". The governments at all three levels – federal, provincial and local – along with private sector, nonprofit agencies, community-based agencies and local people should join hands to educate about control and prevention of rabies. The One Health approach could be effective to control and prevent rabies in a sustainable manner moving forward.

Consent to participate

Individual consent was received prior to collecting data from them.

Author contribution statement

Alok Dhakal: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Ramjee P Ghimire: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Sujit Regmi: Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Krishna Kaphle: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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