Epidemiological Analysis of Cases of Animal Bite Injuries at Rabies Prevention Centers Affiliated with Iranshahr University of Medical Sciences

HEKMATOLLAH KHOUBFEKR[1], VAHID RAHMANIAN[2], MOHAMMAD JOKAR[3], ABBAS BALOUCHI[4], ASHKAN POURVAHED[5]

[1] MSc of Epidemiology, Center of Health Vice-Chancellor of Iranshahr University of Medical Sciences and Health Services, Iranshahr, Iran; [2] Assistant Professor in Epidemiology, Department of Public Health, Torbat Jam Faculty of Medical Sciences, Torbat Jam, Iran; [3] DVM, Faculty of Veterinary Medicine, University of Calgary, Calgary, AB, Canada; [4] PhD of Nursing, Department of Nursing Iranshahr University of Medical Sciences and Health Services, Iran; [5] MD, Chabahar University of Medical Sciences, Chabahar, Iran

Keywords

Summary

Objective. *Rabies remains a significant public health threat, particularly in developing countries. This study aimed to analyze the epidemiological characteristics of animal bite injuries in Iranshahr, Iran, from 2019 to 2021.*

Methods. *A descriptive analysis was conducted on 6,085 animal bite incidents reported to Iranshahr University of Medical Sciences' rabies prevention centers between April 2019 and March 2021. Data collected included demographic information (age, gender, occupation, nationality), type of animal involved (dog, cat, etc.), timing of the incident, injury severity, and treatment received. Statistical analysis was performed using SPSS version 19, ArcGIS version 10.8.2, and Excel 2019.*

Results. *The average age of victims was 25.22 years, with males constituting 66.9% of cases. A significant majority (67.1%) of bites occurred in rural areas, and 38% of victims were under 19 years old. Dogs were responsible for 89.8% of bites, followed by cats at 5.2%. The highest incidence was noted in spring (30.8%). The cumulative incidence rate was 151 per 100,000 population, peaking at 253 per 100,000 in Rask City and dropping to 131 per 100,000 during the first year of the COVID-19 pandemic. Among the sampled animals suspected of rabies, eight were confirmed positive.*

Conclusions. *The findings indicate that school-aged children and adolescents are particularly vulnerable to dog bites, highlighting the need for targeted educational programs. The presence of confirmed rabies cases in animals underscores the necessity for comprehensive control measures, including stray dog management and vaccination initiatives for domestic pets.*

Introduction

The incidence of animal bites presents a considerable public health challenge, not only due to immediate health consequences, but also due to potential economic burdens on nations. These bites, often resulting from interactions with pets, domestic, or wild animals, carry the risk of transmitting the rabies virus, particularly in regions where rabies is endemic [1, 2]. Dogs are the predominant contributors to human-animal bite injuries, constituting over 90%, followed by cats, humans, and rodents [3, 4]. In low-income countries, dogs are major culprits, leading to increased rabies prevalence and higher fatality rates, exacerbated by limited access to anti-rabies post-exposure treatment [1, 5]. The global human mortality attributed to canine rabies is staggering, reaching an estimated 60,000 annually, with Asia and Africa bearing a significant burden, particularly in rural areas [6].

Despite the evident severity, rabies control measures face underinvestment in affected countries, largely attributed to the lack of reliable data and limited awareness regarding the disease's burden and associated risk factors [7]. The escalating number of animal bites necessitates increased governmental procurement of vaccines and medicines, imposing a financial burden on health budgets, as exemplified in Iran, where a significant portion is allocated for rabies prevention [4, 8]. The annual cost of rabies vaccination in Iran highlights the financial strain, totaling 12 million dollars for rabies prevention treatment [9]. Notably, the majority of reported animal bites, exceeding 10 million cases annually, are concentrated in Asia and Africa, with dogs being the primary source [10].

The indigenous presence of jackals in Iran's wildlife has been a longstanding source of infection for domestic animals [5, 11]. Additionally, the country employs an early prevention and treatment system, irrespective of the rabies virus carrier status in animals, to prevent the disease. Despite efforts to strengthen healthcare and control rabies, it remains a significant endemic disease and a major public health challenge nationwide, with rising incidence reported in all provinces [12]. The COVID-19 pandemic has globally heightened rabies cases and mortality with disruptions during quarantine potentially leading to underreporting of zoonotic cases

and delays in addressing suspected rabid dogs [13, 14] Reduced vehicular traffic during quarantine has extended the survival time of stray dogs, evading potential collisions with vehicles. Overall, numerous disruptions in rabies control during the COVID-19 pandemic have notably affected low-income countries [13, 14].

The lack of epidemiological information hinders disease prevention and control efforts. Understanding factors contributing to health challenges, transmission modes, prevention strategies, and the prevalence of gasping syndrome, along with associated mortality due to climatic and population differences, is crucial [7]. Particularly vulnerable are specific regions, notably border provinces like Sistan and Baluchestan, characterized by potential local virus exchange between animals in neighboring countries and Iran [4]. This highlights the need for increased attention to this infectious disease, especially in southeast Iran. Political will and inter-sectoral coordination are vital for enhancing surveillance systems to control the disease effectively. Implementing interventions to prevent animal selectivity and reduce the burden on the healthcare system can significantly aid relevant authorities [1, 7].

Animal bites, especially those leading to rabies, pose a significant public health threat in many regions, including Iranshahr. Understanding the epidemiological patterns of animal bites is crucial for developing effective prevention and control strategies to mitigate the risk of rabies transmission. By providing insights into the demographic characteristics of individuals bitten by animals, the types of animals responsible for bites, and the temporal and spatial patterns of incidents, this study contributes to the broader body of knowledge on animal bite epidemiology. Such information can be used to guide future research and inform public health practice in similar settings. Therefore, this study was conducted to determine the epidemiological patterns of animal bite in Iranshahr, southeast of Iran during the years of 2019 to 2021.

Methods and materials

Study design

In this descriptive study, a total of 6085 instances of animal bites were systematically documented National Rabies Surveillance System over a three-year timeframe (2019-2021). The comprehensive data collection occurred within the rabies prevention centers affiliated with Iranshahr University of Medical Sciences, spanning across 12 registered counties. Compilation of the dataset was carried out by extracting data from the records maintained by animal bite treatment Center. The study participants comprised all individuals who sought medical attention for animal bites during the stipulated period, undergoing a spectrum of preventive, therapeutic, and follow-up interventions within the specialized rabies prevention and treatment units. Moreover, an individual case of animal bite was operationally defined as an individual seeking care at the rabies unit due to both an actual animal bite and the presence of fear concerning rabies infection.

Data Collection

Data collected from selected animal bite cases are organized into three sections: temporal and spatial trends of incidents, and the occurrence details, differentiated by the covered counties and the location of incidents (urban or rural areas). The type of events leading to animal bites, such as provoking animals, sudden attacks, contact with a suspected rabid animal, defense against an attacking animal, and engaging in play or feeding animals, along with the number of injuries and the owner's information, constitute the second section. This part includes demographic data and healthcare measures undertaken for animal bite cases, such as age, gender, occupation, nationality, and patterns of health services received for the bitten individuals (washing with soap and water, wound disinfection, dressing, suturing, serum therapy, and vaccination). The examination of the serum injection time (for timeliness and delay status), assessment of previous rabies vaccination history, the number of wounds (single, double, triple, or more than three wounds or injuries), and the pattern of injuries (day, month, and year) are also included. The third section pertains to information on actions taken for the attacking animals, encompassing the type of animal (dog, cat, wildlife, or domesticated animals), the type of dog and cat (owner or stray), the status of the bitten animal after the incident (killed, alive under care), and the sampling status from the attacking animal (conducted or not conducted). The outcome of the test for the attacking animal is also documented.

Statistical analysis

Using SPSS 19 software, data analysis was performed, employing descriptive statistics such as mean and standard deviation. Subsequently, frequency tables and percentages were generated to illustrate relative frequencies. The association between age and gender was examined using an independent t-test. Moreover, the Cochran-Armitage trend test was utilized to evaluate the incidence over three years based on the year. Furthermore, ArcGIS 10.3 and Microsoft Office 2019 will be utilized for mapping the distribution and generating visual representations. The significance level was set at $p < 0.05$.

Results

Of the 6085 injured patients in the study, the mean age of the victims was 25.22 ± 20.14. The age range of the injured individuals varied from 1 to 100 years and 2562 cases (42.10%) under 15 years (Fig. 1). There was no significant difference between the mean age of men (22.8 years) and women (30.11 years) (p = 0.76). In this study, the annual incidence of animal bites per 100,000 population was examined for the years 2019, 2020, and

Fig. 1. The frequency of animal bite cases according to the age.
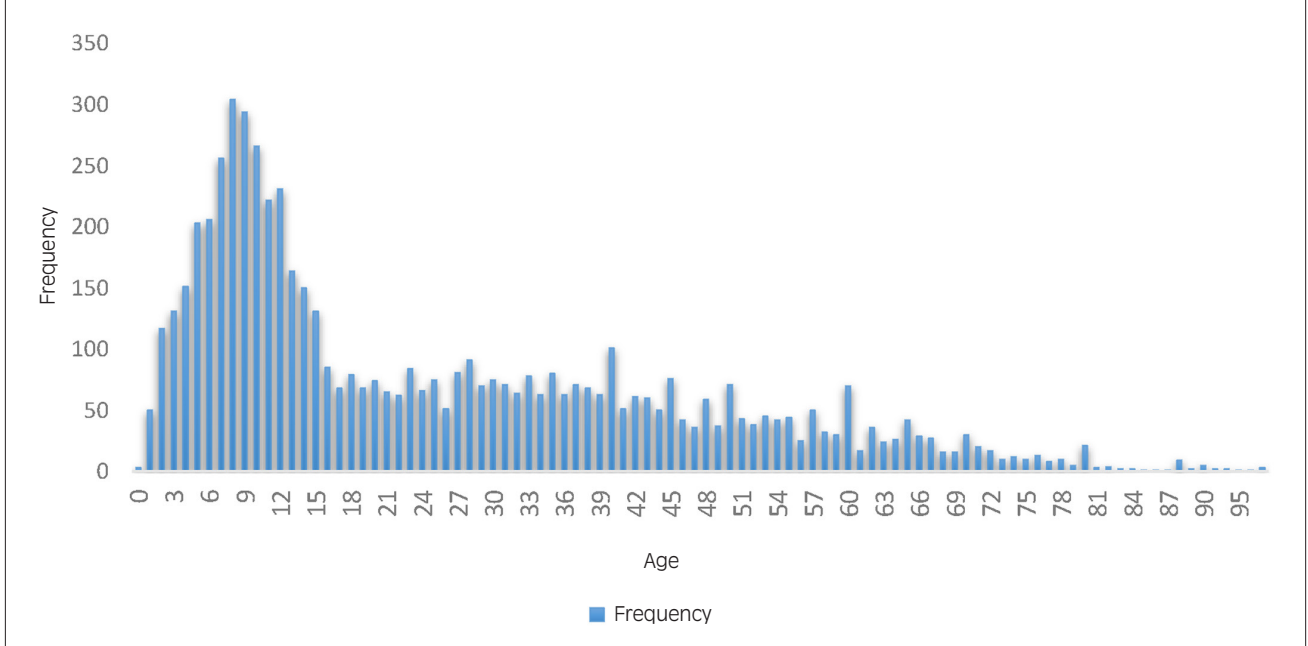
2021. The respective incidences were 199, 131, and 143 for each year, respectively. The Cochran-Armitage trend test was employed to assess the trend in animal bites incidence before and after the COVID-19 pandemic. The results indicated a statistically significant trend (p < 0.001) in both periods.

Iranshahr city had the highest frequency with 1144 (18.8%) cases. However, in the three-year cumulative incidence, the cities of Rask (253/100000) and Bampur (240/100000) showed the highest cumulative incidence (Fig. 2). 4478 (73.7%) cases of bites were reported as a sudden attack by an attacking animal, with only one case reported as a result of contact with an animal suspected of rabies. The highest frequency of injuries related to one injury was reported at 3001 (49.3%). Additionally, the frequency of bites in rural areas was reported to be 4083 (67.1%), higher than in urban areas at 2002 (32.9%). Finally, 641 (10.5%) of the bites were from the owner of an attacking animal, with the remaining cases being 5444 (89.5%) individual cases other than the owner of the animal (Tab. I).

Most of the observed wounds, 6029 (99.1%) were washed with soap and water, while in 56 cases (less than 1%) this process was neglected. In the disinfection of the bite site, 752 (12.4%) cases were not disinfected. It is worth mentioning that 83 (1.4%) cases required stitches, and this procedure was performed in 13 cases. Regarding the delay of vaccination, 5790 (95.2%) cases were referred with a delay of less than 48 hours (timely referral). Out of the total cases of animal bites, only 15 cases did not require vaccination. In addition, 2080 (34.2%) of the reported bites received treatment with serum. Out of these, 10 individuals were administered serum 4 to 7 days post-bite, while 1858 (89.2% of serum-treated cases) received serum within 12 hours of the bite. Furthermore, 4071 (66.9%) cases were male, and 2014

(33.1%) were female. Among the affected occupations, students accounted for the highest frequency of 2315 (38%) cases. There were 118 (1.9%) non-Iranian cases and the remaining 5967 (98.1%) were Iranian cases. Only 70 (1.2%) cases had a history of prior rabies vaccination (Tab. II).

Dogs were responsible for the majority of bites, accounting for 5,462 (89.8%), while wildlife animals caused 189 (3.1%) bites during the three-year period. It is important to highlight that 4,397 (72.3%) of the bite incidents involved the owner's dogs, and 110 (1.8%) of the attacking animals were either bitten by people or killed by onlookers. A total of 14 animals were examined, with 8 confirmed as having animal rabies by the Pasteur Institute of Iran. Furthermore, based on the data collected, 7 (1%) of the infected animals exhibited symptoms and passed away. Additionally, 3,657 (60.1%) cases of invasive animals were either not tracked or had an unknown outcome (Tab. III).

Discussion

The results of this study have shown, animal bite incidents constituted 30.7% of cases before the COVID-19 pandemic, indicating a significant public health issue. During the pandemic, there was a slight increase in the number of animal bites, which warrants further investigation of the factors contributing to this trend. According to a similar study conducted in India, there was an increase in cases of animal bites during the COVID-19 pandemic in the second to tenth week [13]. The increase observed during the pandemic is consistent with findings in other regions, suggesting that animal behavior may have changed during the pandemic [15, 16]. Geographically, Iranshahr city emerged as a hotspot,

Fig. 2. The cumulative incidence of animal bite per 100,000 population in Iranshahr.
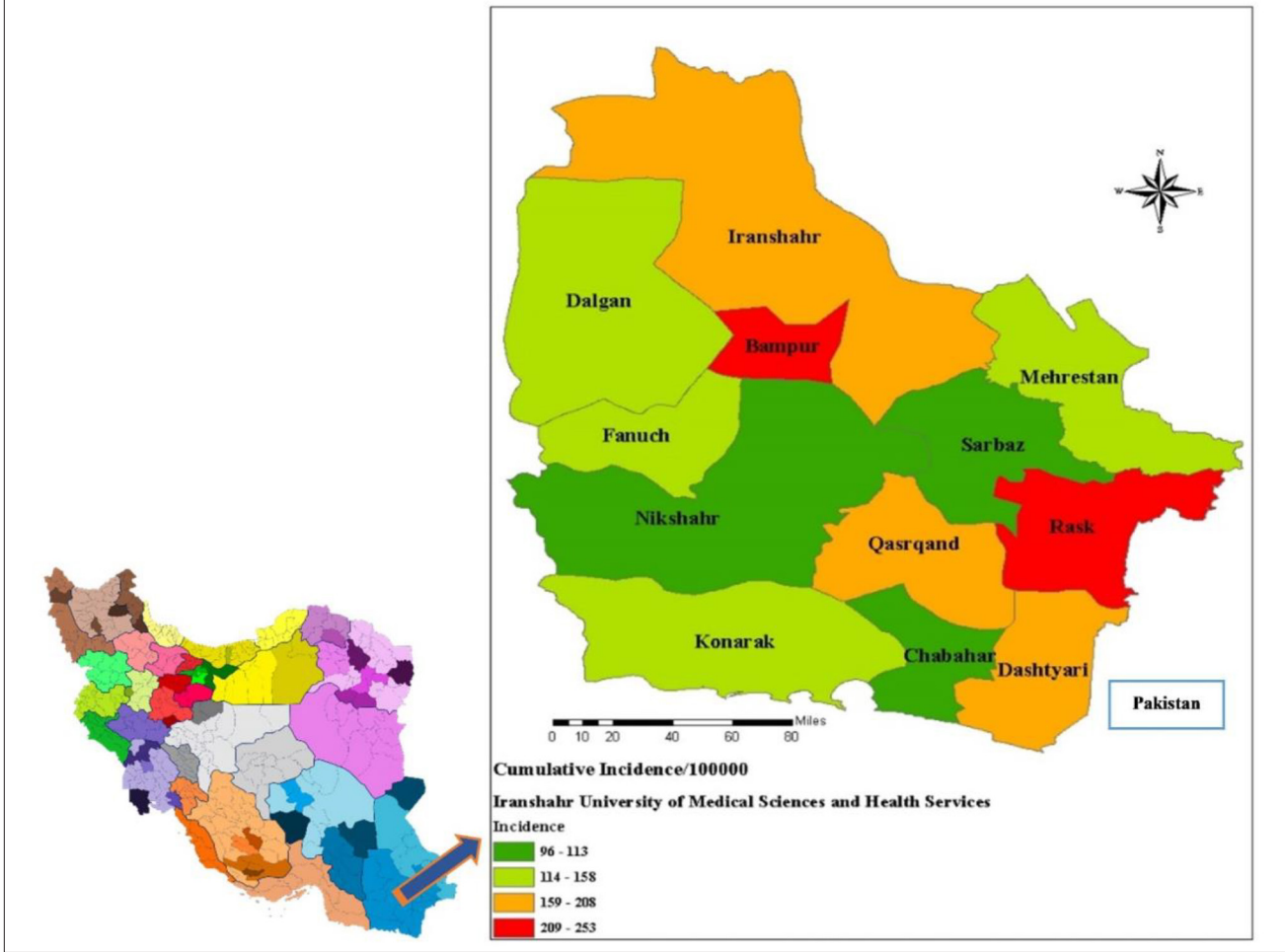
Tab. I. The status of the temporal and spatial trend of animal bite cases.

Variable	Category	Frequency	%	Variable	Category	Frequency	%
The year of the bite	2019	2526	41.5	The cause of the bite	Harassing the animal	676	11.1
	2020	1688	27.7		Sudden attack	4478	73.6
	2021	1871	30.7		Contact with an animal suspected of rabies	1	0.0
City	Iranshahr	1144	18.8		Defense against with the animal	267	4.4
	Bampur	484	8.0		Care of the game and feeding the animal	663	10.9
	Chabahar	808	13.3	Number of injuries	1 injury	3001	49.3
	Dashtyari	370	6.1		2 injuries	1845	30.3
	Dalgan	355	5.8		3 injuries and more	1239	20.4
	Rask	504	8.3	Bite of the owner of the animal	Yes	641	10.5
	Mehrestan	326	5.4		No	5444	89.5
	Sarbaz	679	11.2	Bite area	City	2002	32.9
	Fanoj	256	4.2		Village	4083	67.1
	Qasrqand	374	6.1				
	Konarak	344	5.7				
	Nikshahr	441	7.2				

contributing 18.8% of cases, emphasizing the need for targeted urban interventions. In a study conducted by Sarani in Iranshahr, 54.4% and 54.6% of cases were reported in the cities and villages, respectively [17]. Rask and Bampur cities were identified as areas with the highest cumulative incidence, which require tailored

Tab. II. Demographic information and measures taken for animal bite cases.

Variable		Frequency	Percent	Variable		Frequency	Percent
Washed with soap and water	Yes	6029	99.1	Gender	Man	4071	66.9
	No	56	0.90		Female	2014	33.1
Disinfection of the bite site	Yes	5333	87.6	Job	Health and medical worker	21	0.30
	No	752	12.4		Veterinary personnel	4	0.10
Dressing the bite site	Yes	83	1.4		Employee of other departments	114	1.9
	No	6002	98.6		Rancher/Farmer	249	4.1
Stitch the bite	Yes	13	0.20		Housewife	1177	19.3
	No	6072	99.8		Student	2315	38.0
Zero round vaccination delay	40 days and more	3	0.0005		University student	25	0.40
	11 to 20 days	11	0.20		Child	655	10.8
	4 to 10 days	82	1.3		Other jobs	1525	25.1
	48 to 72 hours	184	3.0	Nationality	Iranian	5967	98.1
	Less than 48 hours	5790	95.2		Non-Iranian	118	1.9
	No need for vaccination	15	0.20	History of rabies vaccination	Yes	70	1.2
Serum injection time	4 to 7 days after the bite	10	0.20		No	6015	98.8
	12 to 72 hours after the bite	212	3.5	Perform serum therapy	Yes	3265	53.7
	Less than 12 hours after the bite	1858	30.5		No	2820	46.3
	No need for serum therapy	4005	65.8				

Tab. III. Determining the occurrence of bites and the condition of the attacking animal.

Variable		Frequency	Percent	Variable		Frequency	Percent
Type of attacking animal	Dog	5462	89.8	Sampling the invasive animal	Yes	14	0.20
	Cat	315	5.2		No	6071	99.8
	Wildlife animals	189	3.1	Test result	Positive	8	0.10
	Domestic pets	119	2.0		Negative	6077	99.9
Type of dog and cat	The owner	4397	72.3	Follow-up status of the attacking animal	Symptoms and death	7	0.10
	The tramp	1688	27.7		With no sign	2421	39.8
The state of the attacking animal	Killed	110	1.8		Untracked/uncertain	3657	60.1
	Alive/abandoned	5975	98.2				

prevention measures. Particularly, rural areas were burdened with 67.1% of cases, emphasizing the unique dynamic of animal-human interactions, which aligns with other studies across the country that emphasize the universal value of context-specific interventions and consistent challenges [4, 5].

According to this study, most wounds were cleaned with soap and water, which highlights the importance and effectiveness of this cleaning procedure in reducing rabies transmission risk. The finding that less than 1% of cases did not undergo cleaning is concerning. A study conducted by Savu et al. [3] suggested that wound management protocols and guidelines might not be followed, potentially compromising wound care efficacy and safety. Moreover, in 12.4% of cases, the bite site was not disinfected. Numerous studies have shown that proper disinfection of the bite site is crucial for reducing the risk of rabies infection and transmission [18, 19]. As a result, improved disinfection protocols are

necessary, particularly in Iranshahr, a rabies-prone area. Additionally, suturing was reported in 1.4% of the cases, which may be necessary for certain types of wounds or in cases where there is significant tissue damage. Nevertheless, suturing alone cannot prevent rabies transmission, and disinfection and immunization procedures must also be followed to ensure that the virus is not transmitted [20]. Out of the total sample, 40 days or more, 11 to 20 days, and 4 to 10 days of vaccination delays were observed for 3 people, 11 people, and 82 people, respectively. Delays in treatment can have a significant impact on the prognosis and outcome of rabies infection [19, 21]. Therefore, when bitten by a potential rabies carrier, individuals should receive timely and appropriate vaccinations.

In 53.7% of bite cases, serum treatment was administered, indicating that a high number of victims sought medical attention and received the necessary treatment. The gender distribution among the bitten

individuals revealed that 66.9% were male, highlighting men's higher susceptibility to dog bites. The gender distribution of animal bites was found to be consistent across various investigations. For instance, studies conducted in Iran [2, 4, 8], and southern India [22] all reported a higher proportion of men affected, likely due to occupational exposure and increased contact with biting animals. Moreover, the pattern of students being the most affected occupational group (38%) suggests that this demographic group may be at higher risk of dog bite injuries. The results of this study align with previous research, demonstrating that students engage in more interactive behavior with animals, leading to a higher likelihood of animal bites [2, 4]. Approximately 1% of animal bites were attributed to non-Iranians, since non-Iranians may be less familiar with local wildlife and the precautions necessary to avoid animal bites.

In the study, dogs accounted for 89.8% of bite incidents; in contrast, wildlife animals were responsible for just 3.1% of reported cases. Furthermore, the majority of bites were caused by owned dogs, accounting for 72.3%. A study conducted by Fragoso et al. (2022) found that 87.2% of dog bites occurred in comparison to other forms of animal aggression [23]. Another similar study found that owned dogs played an important role in the epidemiology of dog bites, further supporting their dominance [24]. Out of 14 animals sampled, eight were confirmed by the Pasteur Institute of Iran to be positive for animal rabies; additionally, seven cases of the attacked animals showed symptoms and ultimately died. The deaths of seven animals further highlight the importance of this issue and the need for further investigation and control. In 73.6% of the cases, sudden animal attacks were responsible for the bites, while 43% were recorded as injuries, and 10.5% involved an attacking animal attacking its owners. By examining other studies that have also focused on animal attacks, similarities and differences can be observed. Previous studies demonstrated a high incidence of bites on owners of attacking animals, which suggests there may be underlying factors influencing the nature of these interactions, which suggests further investigation is warranted [16, 25].

The strength and limitation of study

The purpose of this study was to analyze the epidemiological patterns of animal bites in Iranshahr, an area in which there has been limited research in the past. The dataset of over 6,000 cases across three years provides a solid basis for studying factors affecting bite incidents. Additionally, the use of ArcGIS for spatial mapping adds value by identifying geographical hotspots for animal bites, representing a novel approach in this field. This study relies on data collected by rabies prevention centers, which may not capture all cases of bites, particularly those that do not seek medical attention. The findings may also be context-specific to Iranshahr and might not be applicable to other regions with different conditions. Lastly, there is a potential bias towards more severe cases, as milder instances may be underrepresented.

Conclusions

In conclusion, educational programs must prioritize school-aged children and adolescents to reduce the incidence of animal, particularly dogs, bites. Additionally, organizations involved in rabies control should focus on implementing comprehensive control programs, including the relocation of stray dogs and widespread vaccination of owned dogs, to effectively address the issue of confirmed rabies cases in animals. The frequency and severity of animal bites may vary across different geographic areas and populations. Factors such as population demographics, pet ownership, and behavior, can significantly impact bite incidents.

Public health policymakers should consider these contextual factors when attempting to prevent dog bite incidents and ensure public safety. In order to do so, responsible pet ownership and adequate education regarding responsible dog ownership should be taken into account. Therefore, the results of this study can inform public health policies and interventions aimed at reducing the incidence of animal bites and improving the management of individuals bitten by animals. This includes targeted educational programs, vaccination campaigns, and measures to control stray animal populations. Veterinary and public health services should work together to develop regular vaccination and sterilization programs for stray animals in order to decrease the number of animal bite cases. Furthermore, community engagement and awareness campaigns should emphasize responsible pet care, the dangers of stray animals, as well as bite prevention strategies, particularly in high-risk areas.

Ethics approval and consent to participate

In accordance with ethical guidelines, all data extraction procedures adhered strictly to ethical standards. Data were collected without the inclusion of any personally identifiable information. Furthermore, during the analysis phase, the data were aggregated to ensure anonymity and confidentiality of the participants. This study protocol has been approved by the ethical committee of Iranshahr University of Medical Sciences under code number: IR.IRSHUMS.REC.1402.009.

Data availability

The results drawn from this study are sufficiently supported by the data in the article and its appendices, as acknowledged by the authors.

Conflicts of Interest statement

None.

Funding/Support

None.

Authors' contributions

HK: conceptualization; data curation; methodology; investigation; writing-review & editing. VR: conceptualization; methodology; formal analysis, project administration; supervision; writing-original draft; writing-review & editing. MJ: data curation; methodology; formal analysis, investigation; writing-review & editing. AB: data curation; methodology; formal analysis, investigation; writing-original draft. AP: data curation; investigation; writing-original draft.

References

[1] Nyasulu PS, Weyer J, Tschopp R, Mihret A, Aseffa A, Nuvor SV, Tamuzi JL, Nyakarahuka L, Helegbe GK, Ntinginya NE, Gebreyesus MT, Doumbia S, Busse R, Drosten C. Rabies mortality and morbidity associated with animal bites in Africa: a case for integrated rabies disease surveillance, prevention and control: a scoping review. BMJ Open 2021;11:e048551. https://doi.org/10.1136/bmjopen-2020-048551.

[2] Bay V, Jafari M, Shirzadi MR, Bagheri A, Masoudi Asl I. Trend and epidemiological patterns of animal bites in Golestan province (Northern Iran) between 2017 and 2020. PLoS One 2021;16:e0252058. https://doi.org/10.1371/journal.pone.0252058.

[3] Savu AN, Schoenbrunner AR, Politi R, Janis JE. Practical Review of the Management of Animal Bites. Plast Reconstr Surg Glob Open 2021;9:e3778. https://doi.org/10.1097/GOX.0000000000003778.

[4] Rahmanian V, Shakeri H, Jahromi AS, Shakeri M, Khoubfekr H, Hatami I. Epidemiological characteristic of animal bite and direct economic burden of rabies vaccination in the southern of Iran. Am J Anim Vet Sci 2020;15:245-51. https://doi.org/10.3844/ajavsp.2020.245.251.

[5] Khoubfekr H, Jokar M, Rahmanian V, Blouch H, Shirzadi MR, Bashar R. Fatal cases in pediatric patients after post-exposure prophylaxis for rabies: a report of two cases. Asian Pac J Trop Med 2024;17:39-42. https://doi.org/10.4103/1995-7645.390169.

[6] Bilal A. Rabies is a Zoonotic Disease: a Literature Review. Occup Med Heal Aff 2021;9.

[7] Acharya KP, Acharya N, Phuyal S, Upadhyaya M, Lasee S. One-health approach: a best possible way to control rabies. One Health 2020;10:100161. https://doi.org/10.1016/j.onehlt.2020.100161.

[8] Delam H, Eidi A, Keshtkaran Z, Soufi O, Rezaei B, Bazrafshan M-R. Incidence rate of animal bites in southern Iran during 2015-2019 using Cochrane-Armitage trend test. J Acute Dis 2023;12:29. https://doi.org/10.4103/2221-6189.369076.

[9] Amiri S, Maleki Z, Nikbakht HA, Hassanipour S, Salehiniya H, Ghayour AR, Kazemi H, Ghaem H. Epidemiological Patterns of Animal Bites in the Najafabad, Center of Iran (2012-2017). Ann Glob Health 2020;86:38. https://doi.org/10.5334/aogh.2776.

[10] Abdel-Kader S, Abbas IM, Abu-Zidan FM. Management of Animal Bites: A Global Perspective. In: Textbook of Emergency General Surgery: Traumatic and Non-traumatic Surgical Emergencies. Springer 2023;401-10. https://doi.org/10.1007/978-3-031-22599-4_26.

[11] Shariat MS, Esmaeilzadeh N, Zerangian N, Peyman N. Epidemiological characteristics and trends of animal bites in Neyshabur, Iran: A cross-sectional study. J Acute Dis 2023;12:219-25. https://doi.org/10.4103/2221-6189.390387.

[12] Abbasi M, Barfar E, Hazratian T, Abbasi R. Estimating the cost of prevention and control of rabies: a case study in the northwest of Iran. EBHPME 2018;2 :166-73.

[13] Saleem SM, Quansar R, Haq I, Salim Khan SM. Imposing COVID-19 lockdown and reported dog bite cases: An experience from a tertiary antirabies center of North India. J Vet Behav 2021;42:48-52. https://doi.org/10.1016/j.jveb.2021.01.007.

[14] Nadal D, Beeching S, Cleaveland S, Cronin K, Hampson K, Steenson R, Abela-Ridder B. Rabies and the pandemic: lessons for One Health. Trans R Soc Trop Med Hyg 2022;116:197-200. https://doi.org/10.1093/trstmh/trab123.

[15] Norwood SD. The Impact of the COVID-19 Pandemic on Animal Bite Incidences in Cobb & Douglas Counties. GPHA Annual Meeting and Conference 2023.

[16] Parente G, Gargano T, Di Mitri M, Cravano S, Thomas E, Vastano M, Maffi M, Libri M, Lima M. Consequences of COVID-19 Lockdown on Children and Their Pets: Dangerous Increase of Dog Bites among the Paediatric Population. Children (Basel) 2021;8:620. https://doi.org/10.3390/children8080620.

[17] Sarani H, Robani H, Pishkarmofrad Z, Shahsavani AR. Survey epidemiological animal bites in iranshre during 2002-2003. 2nd congress on epidemiology Zahedan Univ Med Sci 2004;9.

[18] Liu Q, Wang X, Liu B, Gong Y, Mkandawire N, Li W, Fu W, Li L, Gan Y, Shi J, Shi B, Liu J, Cao S, Lu Z. Improper wound treatment and delay of rabies post-exposure prophylaxis of animal bite victims in China: Prevalence and determinants. PLoS Negl Trop Dis 2017;11:e0005663. https://doi.org/10.1371/journal.pntd.0005663.

[19] Whitehouse ER, Mandra A, Bonwitt J, Beasley EA, Taliano J, Rao AK. Human rabies despite post-exposure prophylaxis: a systematic review of fatal breakthrough infections after zoonotic exposures. Lancet Infect Dis 2023;23:e167-74. https://doi.org/10.1016/S1473-3099(22)00641-7.

[20] Rupprecht CE, Kuzmin I V. Why we can prevent, control and possibly treat − But will not eradicate − Rabies. Future Virol 2015;10:517-35. https://doi.org/10.2217/fvl.15.26.

[21] Wani RT, Chowdri IN, Dar H. Factors influencing delay in initiating post-exposure prophylaxis for rabies prevention among animal bite victims: a cross sectional study. J Family Med Prim Care 2020;9:4751-55. https://doi.org/10.4103/jfmpc.jfmpc_890_20.

[22] Taylor LH, Wallace RM, Balaram D, Lindenmayer JM, Eckery DC, Mutonono-Watkiss B, Parravani E, Nel LH. The Role of Dog Population Management in Rabies Elimination-A Review of Current Approaches and Future Opportunities. Front Vet Sci 2017;4:109. https://doi.org/10.3389/fvets.2017.00109.

[23] Fragoso S, Anjos C, Almeida A, Manteca X, de Sousa L. Dog bites in Portugal: Analysis of incidents, and consequences for both people and dogs. J Vet Behav 2022;54:19-27. https://doi.org/10.1016/j.jveb.2022.06.005.

[24] Overall KL, Love M. Dog bites to humans - Demography, epidemiology, injury, and risk. J Am Vet Med Assoc 2001;218:1923-34. https://doi.org/10.2460/javma.2001.218.1923.

[25] Essig GF, Sheehan C, Rikhi S, Elmaraghy CA, Christophel JJ. Dog bite injuries to the face: Is there risk with breed ownership? A systematic review with meta-analysis. Int J Pediatr Otorhinolaryngol 2019;117:182-8. https://doi.org/10.1016/j.ijporl.2018.11.028.

Correspondence: Mohammad Jokar, Faculty of Veterinary Medicine, University of Calgary, Calgary, AB T2N 1N4, Canada. E-mail: mohammad.jokar@ucalgary.ca.