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Epidemiological characteristics and trends of animal bites in Neyshabur, Iran: A cross-sectional study

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ABSTRACT

Objective: To investigate the trend of animal bites between 2015–2021 in Neyshabur, Iran.

Methods: In this cross-sectional descriptive study, data were retrieved from the vice-chancellery of the Neyshabur University of Medical Sciences. The data included person variables, place and time variables, and animal variables.

Results: There were 13 190 cases of animal bites and the trend was increasing during 2015–2020. Most injuries were caused by dogs (86%), most animal bites (76.6%) occurred in males, and 28.1% of all cases were farmers. The most common bitten parts were the lower limbs (64.8%), often reported as a scratch (83.4%). Most of the biting animals (67.9%) were not strays, and 83.3% of them had bitten their owners. No rabies death was reported during the study period.

Conclusions: The incidence of animal bites increases and is higher than the national statistics in Neyshabur, Iran. Serious attention and intervention should be given to control and prevent this health threat.

KEYWORDS: Animal bites, Rabies, Epidemiology, Iran, Incidence

1. Introduction

Animal bites are one of the main causes of death worldwide[1]. Animal saliva can transmit several infectious diseases such as rabies to humans[2,3]. According to the Center for Disease Control, approximately 4.5 million people are bitten by animals worldwide

each year[3,4].

Rabies can be transferred by scratching, rubbing, breathing, and contaminated equipment[5–8]. With the onset of rabies symptoms, the disease is incurable and the death of the infected person is certain[3,9]. This disease is important because of its high fatality rate and the high costs related to prevention and treatment[10].

Rabies exists in all continents except Antarctica[3]. It annually causes 59 000 deaths worldwide[11,12], of which 31 000 occur in Asia[4]. The majority of the estimated human rabies deaths each year occur in developing countries in Asia and Africa[12]. Rabies is a dilemma in Iran, Turkey, Saudi Arabia, Yemen, and other Middle

Significance

Neyshabur has a higher rate of animal bites than the national average. The results showed that the number of animal bites continues to increase (from 1 946 to 2 705). In 2021, two cases of positive animal rabies were reported; this can be a sign of increasing rabies in the region. The results of this study indicate that most animal bites were from stray dogs and happened in the city. This trend can be stopped by controlling the stray dog population and educating the people.

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East countries[13].

The World Health Organization has shown that more than 2.5 billion people are at risk of rabies[14-16]. Then, it announced its ambitious goal of zero deaths from rabies in dogs by 2030[7].

Rabies virus is endemic in Iran, and all the provinces of the country are infected with it[5]. The incidence of animal bites was about 306 cases per 100 000 people and the trend of animal bites was increasing[17]. Rabies is a fatal disease that still kills 2-6 people a year in Iran[18]. Animal bites increasing was reported in different cities and provinces[5,8,19]. According to the report of the Ministry of Health Disease Control Center regarding animal bites, Ardabil and Golestan are in first place with an increase of 450 per 100 000[19]. In many cities, such as Sanandaj, Khorramshahr and Yazd, the increasing trend of animal bites has also been reported[20-22].

The average number of animal bites was 506 in Neyshabur, which was much higher than the national average[17]. Recently, four cases of suspected rabies were observed in Neyshabur and the initial test results of 2 of them were positive[6].

The statistics of developed and developing countries are not comparable with the situation in Iran because of the different cultures of the societies and the epidemiological situation of rabies. For example, Russia (2012-2016) reported an incidence of 2-4 thousand cases of human rabies[23], and China (2016-2020) reported about 2074 cases[24].

It seems that dogs are the main carriers of this disease[9]. The economic burden of rabies caused by dogs is estimated at 8.6 billion dollars per year worldwide[3]. Every year, billions of rials are spent to prevent rabies in Iran[13,25,26].

Studies have shown that rabies control programs have played a significant role in rabies control, but their design and implementation are one of the main challenges facing governments in developing countries, including Iran[19]. The success of any control program is to provide extensive and in-depth information about the epidemiological situation.

The increasing incidence of animal bites and rabid animals showed that it is necessary to conduct an epidemiological study, to provide useful information for planning and implementing public health intervention programs to prevent and reduce animal bites. Therefore, this study was conducted to describe and analyze the epidemiological characteristics of animal bites in Neyshabur.

2. Subjective and methods

The current research is a cross-sectional descriptive study between 2015 and 2020. The population of this research includes all animal bite individuals who refer to animal bite prevention and treatment centers. Data were retrieved from health deputy, Neyshabur University of Medical Sciences.

The investigated variables included demographic variables (age, sex, and job), injury area, type of wound, and residential area (urban and rural); time variables (year, season, and time); the animal variables including the type of biting animal, condition of the animal (domestic, wild), and examination of receiving services (vaccine).

This research was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.FHMPM.REC.1401.107).

After coding the data, descriptive statistics were presented in the form of tables and graphs to describe the situation, and STATA (version 14) software was used for statistical analysis. χ^2 was used to analyze. The difference was significant when $P < 0.05$.

3. Results

There was no report of rabies cases during 2015-2020. According to the available statistics, 13 190 cases of animal bites were reported during the research period and 9757 cases happened due to a sudden attack (Table 1). As shown in Figure 1, the trend of animal bites increased in Neyshabur.

Overall, 76.6% of animal bites were men and 23.4% were female (Figure 2). Based on the statistical analysis there were no significant differences in the sex of the subjects ($P=0.439$).

Results showed that 96.7% of animal bites were caused by domestic animals and only 3.3% by wild animals, and this difference was significant ($P < 0.05$). The highest percentage of animal bites occurred in dogs (86.0%). It showed that 67.9% of all animals were not strays, 83.3% of injured persons were owners, and in 16.7% of cases, someone other than the animal's owner was bitten.

About occupations, farmers and ranchers were the most frequently bitten, followed by students and housekeepers. Statistical analysis showed significant differences ($P < 0.05$).

A significant difference was observed among the seasons in which animal bites occur ($P=0.039$). The frequency of animal bites was higher in spring and summer, and the highest occurrence of bites was in the evening (Table 1).

In most cases (64.8%) the location of the injury was the lower limbs (leg, thigh, buttock, genital area, and anus) and less in the upper limbs (head, face, neck, hand, chest, abdomen, back, etc.). The difference was significant ($P < 0.05$).

Most injured persons lived in urban (71.5%), followed by rural (23.2%) and the outskirts of the urban areas (5.3%). The difference was significant ($P < 0.05$).

Events leading to animal bites included sudden attacks, teasing an animal, caring for, playing with, feeding an animal, and self-defense, respectively.

Injuries caused by bite were mostly scratches or perforation, and there were fewer reports of laceration and crushes. The number of

Table 1. Frequency distribution of animal bites cases (n=13 190).

Variables	n	%	χ^2	P
Sex				
Male	10 106	76.6	4.81	0.439
Female	3 084	23.4		
Sites of occurrence				
Urban	9 433	71.5	123.33	<0.001
Rural	3 057	23.2		
Outskirt	700	5.3		
Seasons				
Spring	3 673	27.8	25.86	0.039
Summer	3 535	26.8		
Autumn	3 076	23.3		
Winter	2 906	22.1		
Time of occurrence				
Gloaming	269	2.1	197.20	<0.001
Morning	2 908	22.2		
Noon	3 306	25.3		
Evening	5 465	41.7		
Night	1 144	8.7		
Number of injuries				
1	8 009	61.5	148.29	<0.001
2	3 559	27.0		
3	1 109	8.4		
>3	409	3.1		
Injured limbs				
Upper	4 315	33.1	1 030.86	<0.001
Lower	8 455	64.8		
Both	284	2.2		
Occupations				
Farmer/ranchers	3 700	28.1	655.96	<0.001
Student	2 787	21.1		
Children	1 011	7.7		
Housewife	2 282	17.3		
Employee	416	3.2		
Soldier	1 986	15.1		
Self-employee	61	0.5		
Unemployed	22	0.2		
Other	925	7.0		
Animal types				
Dog	11 341	86.0	77.98	<0.001
Cat	1 451	11.0		
Donkey	136	1.0		
Others	262	2.0		
Owner				
Stray	1 295	32.1	210.00	<0.001
No-stray	2 735	67.9		
Bite person				
Owner	9 996	83.3	1 887.82	<0.001
Non-owner	1 998	16.7		
Description of the event				
Sudden attack	9 757	74.0	527.71	<0.001
Playing	771	5.8		
Taking care	806	6.1		
Harassment	951	7.2		
Feeding	614	4.7		
Defending	180	1.4		
Others	111	0.8		
Type of injury				
Perforation	1 648	12.5	200.96	<0.001
Scratch	11 000	83.4		
Laceration	519	3.9		
Crush	23	0.2		

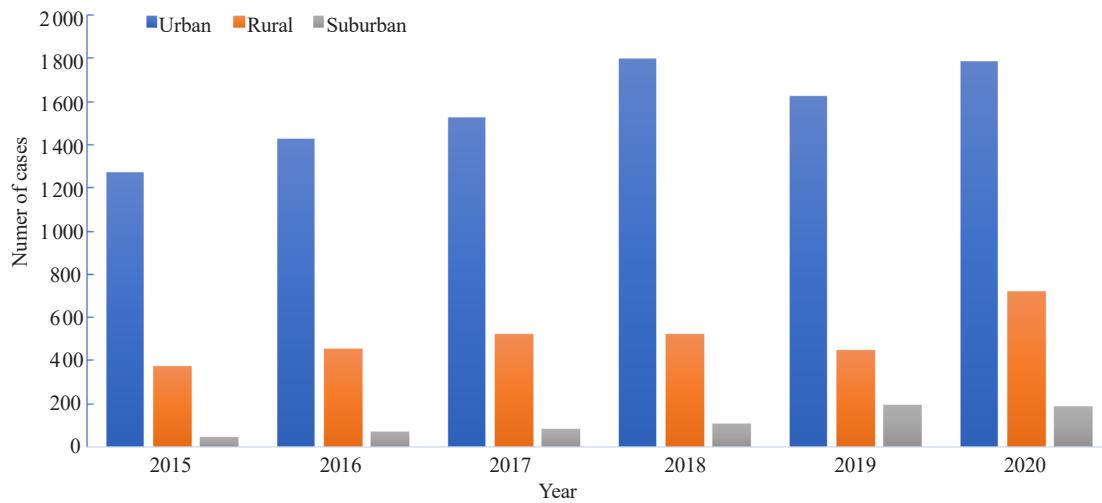


Figure 1. Distribution of animal bites in different areas in Neyshabur 2015-2020.

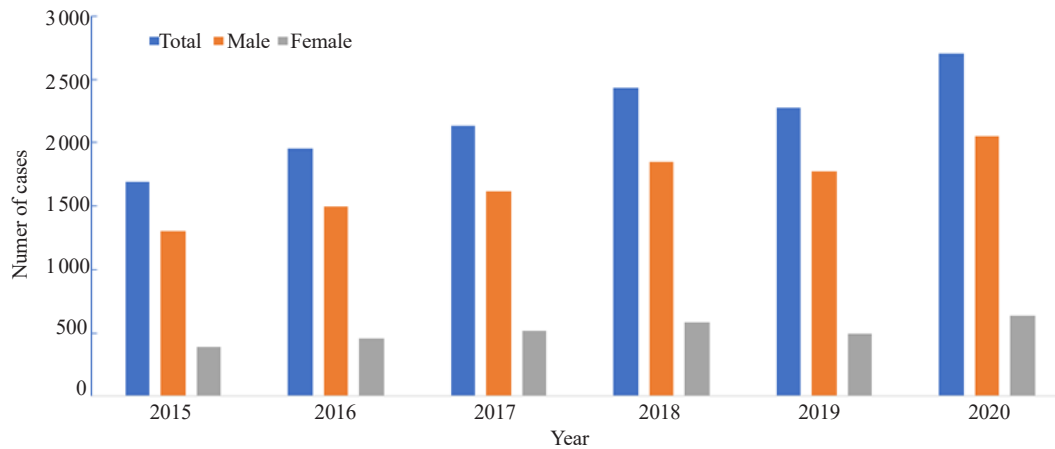


Figure 2. Incidence of animal bites based on sex in Neyshabur 2015-2020.

injuries from animal bites is also reported differently (Table 1).

After animal bites, bitten individuals would be treated through anti-rabies vaccination. A total of 44 876 Rabie’s vaccines were used during the research period. The statistics of vaccinations performed during the research period are shown in Table 2.

Table 2. Number of rabies vaccine injections for animal bites in Neyshabur 2015-2020.

No. of injection	Frequency	Percent	Valid percent	Cumulative percent
2	146	1.1	1.1	1.1
3	7604	57.6	58.3	59.4
4	4733	35.9	36.3	95.6
≥ 5	568	5.4	4.8	100.0

4. Discussion

This study was conducted to investigate the epidemiology of animal bite cases referred to the Ministry of Health Disease Control Center of Neyshabur 2015-2020. National statistics showed that the trend of animal bites in Neyshabur was increasing. The incidence of animal bites increased from 1 692 cases per hundred thousand to 2704 cases in this period.

Abedi *et al.* in their meta-analysis study (1993-2013) reported that the trend of animal bites increased in Iran[18]. Some studies have reported an increasing incidence of animal bites in other cities [4,16,22].

The reasons for these increases were not exactly clear, but the

possible explanations might be population growth, wider coverage of health centers, improved public awareness about animal bites and referring to these centers, and increased keeping of pets in urban areas.

Although 62.2% of animal bites lived in villages, animal bites were often found in urban areas and their outskirts. In Kasiri's study, 71.8% of animal bites cases were living in urban areas[21]. This increase in the number of animal bites can be due to the expansion of urbanization, the proximity of wildlife to human residential, the presence of stray dogs, and Keeping dogs at home. Regarding geographical distribution, in some studies, the highest percentage of animal bites was found in rural areas[16,18,22].

Overall, many cases of animal bites occur in children and teenagers[6,22], and men are bitten 1.15 times more than women[8]. The study revealed that 3 084 females (23.4%) and 10 106 males (76.6%) were bitten by animals. Saqhafipour *et al.* reported that 89.6% of the bitten people were men[19]. Results of many studies noted that the highest number of animal bites occurred in men, which is in line with this study[4,16,18].

The higher occurrence in men can be explained by their presence outside the house and more contact with animals because of their jobs, and social and economic status. The number of rabies sufferers in females is lower than in males due to their type of employment and social activities in society. In the last decades, keeping dogs at home has caused more women to encounter dogs and then increased dog bites.

Domestic animals, including dogs and cats, are the cause of 94% of animal bites in different parts of the world, and stray and wild animals such as wolves, jackals, foxes, and other animals are the cause of only 6% of cases[8]. In the world, 99% of people's deaths caused by rabies were caused by rabid dog bites[17]. In 99% of cases, domestic dogs are responsible for transmitting the virus to humans[3].

Rabies is mostly related to dogs in Europe, Asia, and Africa[4]. Consistent with the results of previous studies[16,18,22], most animal bites were caused by dogs in Neyshabur (86%). In addition to increasing the number of stray dogs, most dog bites occurred by owned dogs, and this statistic has increased in 2021 compared to 2020[27]. In a study conducted in Kenya in 2011-2016, it was also found that in 93% of cases, the bite was caused by dogs[28]. Because in Kenya and many rabies-endemic countries, dog owners allow their dogs to roam freely[28]. It seems that a large majority of dog bites are due to more dog population in comparison with other animals, more human exposure to dogs because of the proximity of the habitat of dogs to the human populations and additionally increasing keeping of dogs in homes because of new cultural changes. A dog bite is more crucial because infectious wounds may occur due to the dog's teeth. Fortunately, in this study, most of the injuries were reported as a scratch.

The study showed that the largest number of animal bites was among farmers or ranchers, which seems reasonable based on their occupation and dealing with animals. This was in line with Ghaffar's study[4] and was different from Abedi's and Abbasi's research, which reported a higher incidence in students[18,26].

The high number of bites in students (21.1%) and housewives (17.3%) is a worthy debate. These are probably due to students playing with or teasing animals and increasing the keeping of dogs in homes, respectively. The prohibition of animal walking in public areas in Iran leads to keeping dogs in apartments, and thus they are less likely to be in contact with people. This resulted in more aggression if they faced strangers, therefore, the chance of dog bite increased. If dogs are not vaccinated, this can increase the risk of rabies. Therefore, careful policymaking, planning, and management of vaccinations of dogs (with or without owners) are essential.

As rabies virus has a tissue tropism, the site of animal bites is very important and the infection is dependent on the location of the bite[13]. Wild animals mostly bite the legs, whereas hands are most bitten by pet animals[13]. According to the extracted data, the limb most frequently involved was the lower limbs (64.8%). Some studies reported similar results[4,19]. Most animal bites occur in spring, which can be due to the beginning of holidays, and trips, more presence outside the home, and more traffic to rural areas[4]. In some studies, the incidence of animal bites increased in summer[16,22,26].

According to the WHO's estimation (2023), annually, more than 29 million people worldwide receive rabies postexposure prophylaxis[3]. Globally, the economic burden of rabies caused by dogs is estimated at 8.6 billion dollars per year[3]. Annually, billions of rials are spent to prevent rabies in Iran[13,25,26]. Only in 2015, 170 000 cases of animal bites were reported in Iran, which led to the allocation of a budget of two thousand billion rials for the purchase of vaccines and anti-rabies serum[10].

During the research period, 44 876 doses of rabies vaccine were injected in Neyshabur. The direct cost of treatment after exposure is more than ten million rials[10]. Obviously, with Iran's embargo situation, the cost of purchasing serum and vaccines is increasing every year. Considering that the services are free in Iran, animal bites impose a great financial burden on the health system[4,22,25].

This study showed that the incidence of animal bites in Neyshabur was higher than the national statistics and has an increasing trend. Therefore, due to the importance of this issue, serious attention and intervention should be done, such as legal measures, and vaccination of dogs (domestic, Owner, and stray dog). High frequently bitten-in students and housekeepers revealed that control and prevention of this health threat must be done by raising the level of people's awareness, especially for children and teenagers.

To reduce the number of animal bites and the incidence of rabies, the following suggestions are recommended:

- 1) Targeted information and educational development of the

targeted groups: raising the level of people's awareness through public and media training, including the rules of keeping pets, appropriate behavioral skills in dealing with these animals, and ways to prevent animal bites, especially for children and teenagers, such as refraining from animal abuse.

2) Increasing interactions and promoting interdepartmental cooperation between officials of various political and executive organizations and other related organizations.

3) Increasing cooperation with animal protection non-governmental organizations to control stray dogs.

4) Developing and implementing legal measures such as requiring the vaccination of owners' dogs, the use of collars in public environments, and not releasing animals into the environment.

5) Cooperation with animal protection organizations to control the population of dogs, including live capture, sterilization, vaccination, and release.

6) Epidemiological investigation of rabies foci, concentration of rabies vaccination

7) Vaccination of dogs: The dog is considered as an intermediate link between wildlife, domestic animals, and society, therefore, immunizing this animal causes the disconnection and transmission of the rabies agent from wildlife to the domestic and human environment.

However, this study was based on health center recorders and included patients who provided care in these centers, and therefore may miss some injured people who did not refer to these centers.

Conflict of interest statement

The authors report no conflict of interest.

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Data availability statement

The data supporting the findings of this study are available from the corresponding authors upon request.

Authors' contributions

MSh: concepts, design, definition of intellectual content, literature search, data acquisition, manuscript preparation, manuscript editing, manuscript review; NP: concepts, definition of intellectual content,

manuscript editing, manuscript review; NE: data analysis, statistical analysis, manuscript editing; NZ: data acquisition, data analysis.

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