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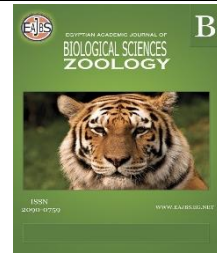


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A Retrospective Analysis of Mammal Bites in Kuwait: Seasonality, Demographics, and Occupations

Mohammed T. Al-Sayegh¹, Muna A. Alsalameen¹, Qais A.H. Majeed¹, Abdulaziz M. Alateeqi², Rihaan B. Hani³ and Zuhair S. Amr³

1-Department of Science, College of Basic Education, Public Authority for Applied Education and Training, Adailiya, 73251, Kuwait City. Kuwait.

2-Kuwait Institute for Scientific Research, P.O.Box 24885, 13109 Safat, Kuwait.

3-Department of Biology, Jordan University of Science and Technology, Irbid, Jordan.

E-mail*: mt.alsayegh@paaet.edu.kw

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Objective: Investigate mammal bites in Kuwait and their public health implications. **Design:** A retrospective analysis of mammal bite records from 2012 to 2020 was conducted, using data obtained from the Ministry of Health, Department of Public Health. Statistical analyses were performed with the SPSS Professional Statistics package (Version 17).

Setting: The study took place in Kuwait, a small, arid country situated in the northwestern corner of the Arabian Peninsula, with a diverse population of 4.363 million. **Subjects:** The study involved 24,426 mammal bite victims. **Interventions:** Bite victims received post-exposure prophylaxis with the human diploid cell culture rabies vaccine (HDCV); quarantined animals were tested for rabies. **Main Outcome Measures:** The number of mammal bites, species involved, victim demographics, and vaccination rates were assessed. **Results:** Animal bites ranged from 1,977 cases in 2012 to 3,866 cases in 2019. Dogs and cats were responsible for 53.22% and 42.29% of the cases, respectively. Most cases occurred between December and January. The male-to-female ratio was 2.74:1, with an average age of 24.7 ± 17.5 years. Bites were most common among individuals aged 25-45 years, accounting for 53% of total cases. Overall, 83.6% of bite victims received vaccinations, and all tested animals were negative for rabies. **Conclusion:** Mammal bites in Kuwait represent a significant public health issue. Enhanced surveillance measures and prevention strategies are crucial due to the presence of rabies in neighboring countries and the potential for cross-border transmission.

INTRODUCTION

The State of Kuwait is a small country located in the northwestern corner of the Arabian Peninsula, with a total area of about 19000 km², and currently a population of 4,363 million, including about 3.1 million non-Kuwaiti citizens. It is an arid country, consisting mainly of desert. A total of 522 cases of mammal bites were reported in Kuwait during the 4-year period 1981-1984. Two foxes and one sheep proved positive for rabies, but there were no reported human cases (Rollin *et al.*, 1985). Mammal bites have been investigated in several countries in the Middle East, including Iraq (Bairmani & Baiee,

2017; Thabit & Faraj, 2012), Iran (Eslamifar *et al.*, 2008; Ghannad *et al.*, 2012), Lebanon (Bizri *et al.*, 2000; Kassir *et al.*, 2019), Oman (Ia *et al.*, 2015), Saudi Arabia (Khan *et al.*, 2020; Memish *et al.*, 2015) and Turkey (Yalcin *et al.*, 2012). Other studies reviewed the epidemiology of rabies in the Middle East with data on animal bites (Seimenis, 2008; Taylor *et al.*, 2021). In the Arabian Peninsula, only the United Arab Emirates, Qatar and Kuwait are considered rabies-free (Memish *et al.*, 2015).

The aim of the present study was to investigate the epidemiology of mammal bites in Kuwait during 2012-2020, with an emphasis on the seasonality, age, gender, nationality and occupation of victims.

MATERIALS AND METHODS

This retrospective study is based on records of mammal bites that occurred in the State of Kuwait. Records on mammal bite cases admitted to hospitals in Kuwait from 2012-2020 were obtained from the Ministry of Health, Department of Public Health, after approval of the Chairman of the Permanent Committee for Coordination of Medical and Health Research on 22.9.2021. The collected data included the victim's age, gender, date of bite, nationality, and occupation and the mammal species responsible for the bite. Treatment of victims was by vaccination with three doses of Human diploid cell culture rabies vaccine (HDCV) of human subjects. All quarantined animals including dogs were tested for rabies. Dead animals were examined for the presence of Negri bodies in the brain tissue. SPSS Professional Statistics package (Version 17) was used for all statistical analyses.

RESULTS

A total of 24426 cases of mammal bites were recorded during 2012-2020, with an average of 2714 cases annually. Annual numbers ranged from as low as 1977 in 2012 to as high as 3866 in 2019 (Fig. 1). Most of the bites were reported during the winter period, between December and January, while the lowest numbers of recorded cases were in June (Fig. 2).

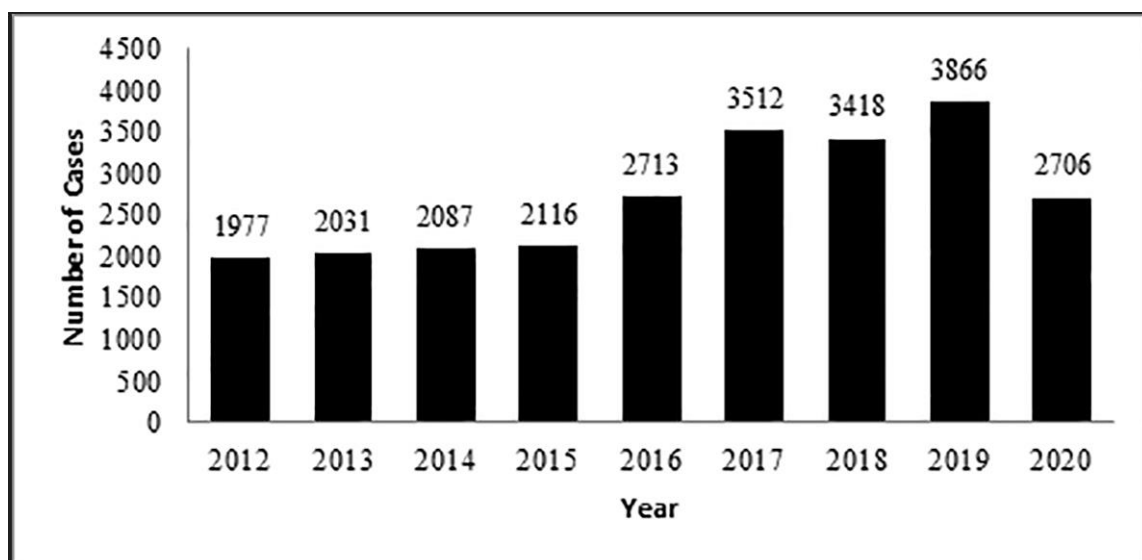


Fig. 1: Number of mammal bite between 2012-2020 in Kuwait.

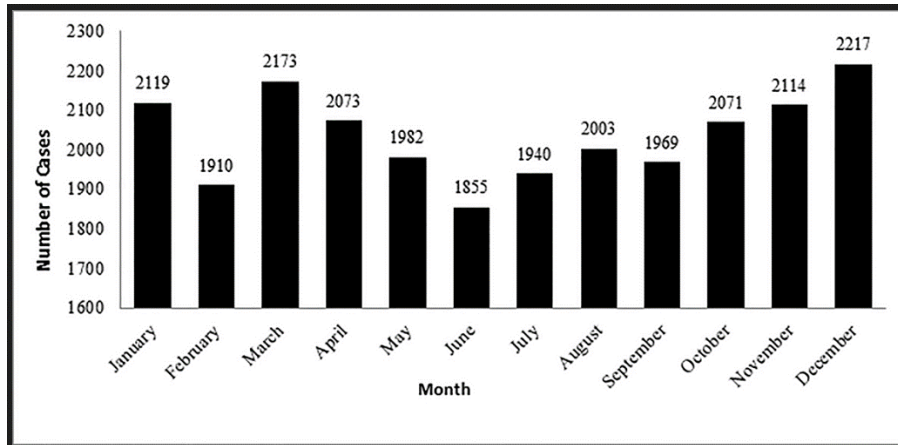


Fig. 2: Seasonality of mammal bite between 2012-2020 in Kuwait.

Male to female ratio was 2.74:1 and was statistically significant ($P < 0.001$, 0.61–0.63, 95%CI). By nationality, Kuwaitis constituted the highest percentage among males and females ($P < 0.001$, 2.59–2.62, 95%CI). (Table 1), while male Indians/Pakistani and Asians accounted for 26.32 and 29.80% respectively. The lowest incidences were among Africans and Americans (Table 1).

Table 1: Mammal bites between 2012-2020 in Kuwait among different nationalities.

Nationalities	Male		Female		Total	
	No.	%	No.	%	No.	%
Kuwaiti	4426	24.72	2712	41.52	7138	29.2
Arab Nationals	3119	17.42	1012	15.50	4131	16.9
Indian/Pakistani	4711	26.32	705	10.80	5416	22.2
Asians	5329	29.80	1828	27.98	7157	29.3
Europeans	179	1.00	192	2.93	371	1.5
African	87	0.50	52	0.80	139	0.6
American	43	0.24	31	0.47	74	0.3
Total	17894	100	6532	100	24426	100

The average age for both sexes was 24.7 ± 17.5 years, with an average age of 22.7 ± 16.5 and 27.1 ± 18.4 years for males and females respectively. Most bites occurred between the ages of 25-45 years ($P < 0.001$, 0.29–0.32, 95%CI), constituting 53% of the total cases (Fig. 3). Among males, most bites also occurred in 1-20-year-olds ($P < 0.001$, 0.64–0.67, 95%CI). Among those aged 20 years and above ($P < 0.001$, 0.75–0.77, 95%CI). By occupation, data were available for 16,221 cases of mammal bites. The majority were students, workers and house servants (Table 2).

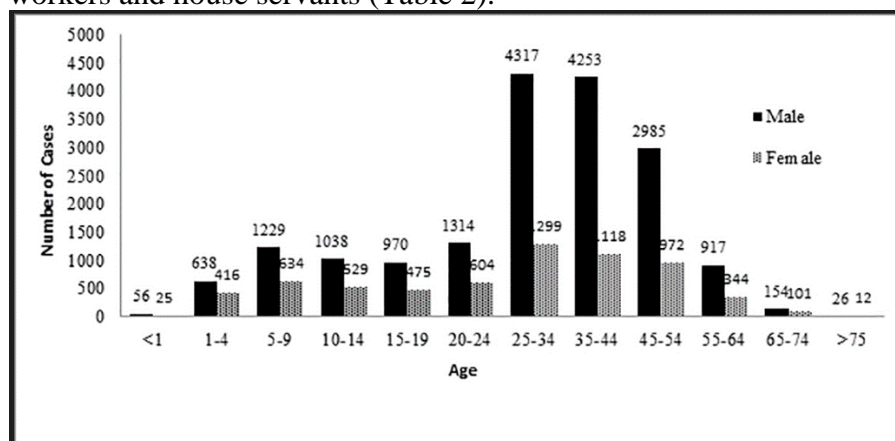


Fig. 3: Age and gender of mammal bite victims between 2012-2020 in Kuwait.

Table 2: Occupation of mammal bite victims between 2012-2020 in Kuwait.

Occupations	Male		Female	
	No.	%	No.	%
Students	2051	17.54	1372	30.3
Teachers	67	0.57	93	2.1
Police and Army personnel	146	1.25	3	0.07
Food handlers	23	0.19	11	0.22
House wives	27	0.23	524	11.6
Shepherds	550	4.70	32	0.71
House servants	1215	10.39	901	19.9
Other occupations	7482	64.00	1522	33.6
Unknown	133	1.13	69	1.5
Total	11694	100	4527	100

Data were available on the 22 species of mammal involved in 24426 of the bites (Table 3). Dogs and cats were most often incriminated, accounting for 53.22 and 42.29% respectively, followed by horses, camels, and rats. Pet animals owned by Kuwaiti citizens, such as lions, tigers and monkeys were also reported (Table 3).

Table 3: Animals involved in bite accidents between 2012-2020 in Kuwait.

Mammal	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	
										No.	%
Bat	0	0	0	0	1	0	0	0	0	1	0.004
Camel	7	5	7	0	0	0	0	6	7	64	0.26
Cat	715	772	840	830	1125	1471	1492	1721	1161	10127	42.30
Cow	0	0	0	0	0	1	0	0	0	1	0.004
Dog	1214	1171	1053	1005	1270	1666	1802	2075	1486	12742	53.22
Donkey	2	2	3	4	1	4	1	3	6	26	0.108
Fox	0	0	0	2	4	8	2	1	1	18	0.075
Gerbil	0	0	0	0	1	0	0	0	0	1	0.004
Hamster	0	0	0	0	4	5	6	0	0	15	0.06
Hedgehog	0	0	0	0	0	1	0	0	0	1	0.004
Horse	10	10	14	0	0	0	0	26	16	76	0.304
Gazelle	0	0	0	0	0	0	1	0	0	1	0.004
Lion	3	20	0	7	3	0	0	1	2	36	0.15
Monkey	23	23	22	16	15	28	29	29	19	204	0.85
Rabbit	0	1	0	1	2	3	1	0	0	8	0.033
Raccoon	0	0	0	0	0	0	1	0	0	1	0.004
Rat	0	21	0	227	0	296	51	0	2	597	2.49
Sheep	0	0	0	2	1	0	0	0	0	3	0.012
Squirrel	0	0	0	0	0	1	0	0	0	1	0.004
Tiger	0	0	0	0	0	0	0	2	1	3	0.012
Wolf	1	1	1	0	0	3	1	0	1	8	0.033
Zebra	0	0	0	0	0	0	3	1	0	4	0.016
Unknown	2	5	147	22	286	25	28	1	4	520	
	1977	2031	2087	2116	2713	3512	3418	3866	2706	24426	100

Table 4 shows the number of bite victims who received post-exposure rabies prophylaxis each year (total of 20427 vaccines (type of vaccine varied according to years) courses during 2012-2020. Victims were categorized into three categories: 1. those who touched suspected animals without skin injury, 2. Victims with minor skin injury without bleeding, or exposed to animal licking in broken skin, 3. exposed to an animal bite.

Treatment of victims falls into two regiments; not vaccinated before as shown in Table 5, and vaccinated previously whereas if the immunity was above 0.5 IU/ml, three doses of Human diploid cell culture rabies vaccine (HDCV) in days (0-3-7), and no need for Human rabies immune globulin (HRIG).

This represents 83.6% of bite victims were vaccinated. All quarantined animals, including dogs, proved negative for rabies. If the animal died during the quarantine period, the body was taken to the pathology laboratory in the Veterinary Authority for diagnosis by trying to find Negri bodies in brain tissue.

Table 4: Mammal bite victims who received post-exposure rabies vaccination and number of quarantined mammals during 2012-2020.

Year	No. of victims receiving post-exposure rabies vaccination	No. of quarantined mammals
2012	1759	NA
2013	1762	NA
2014	2087	NA
2015	2116	NA
2016	1836	106
2017	2872	150
2018	2247	131
2019	3538	216
2020	2210	93
Total	20427	696

Table 5: Treatment regiments for bites victims.

Vaccine type for victims not vaccinated before	First category	Second category	3rd category
Human diploid cell culture rabies vaccine (HDCV) Intra muscular 4 doses in days (0-3-7-15)	Not given	given	given
Human rabies immune globulin (HRIG) Intra muscular dose of 20 international Unite (IU)	Not given	Not given	given

DISCUSSION

Mammal bites are a health hazard encountered in both industrial and low and middle-income countries. In Kuwait, mammal bites are considered a major health problem with a rising number of cases annually. Dogs and cats caused most bites, accounting for 53.22 and 42.29% of reported bites respectively. Dogs were also the main cause in other countries; 65.9% in Tehran, Iran (Eslamifar *et al.*, 2008) and 89.2% in Ilam Province, Iran (Eslamifar *et al.*, 2008); 93.7% in Western Rajasthan, India (Singh *et al.*, 2016); 85%–90% in the United States of America (Cook *et al.*, 2020), 91.2% in Lebanon (Kassir *et al.*, 2019) and 99.8% in Iraq (T, 2020).

Bites were reported by several species including dogs (n=5482), monkeys (n=72), foxes (n=142), wolves (n=58), cats (n= 3276), camels (n= 351), mice (n= 868) and rats (529) in Saudi Arabia during 2007-2009 without any confirmed human rabies cases (Memish *et al.*, 2015). Cases of rabies in mammals were recorded in dogs, foxes, wolves, cats, monkeys, camels, sheep, goats and rock hyrax in Saudi Arabia during 2010–2017 (Kasem *et al.*, 2019). A total of 1715 cases of animal bites were reported in Bursa province Turkey. Bites were inflicted by dogs (68.04%), cats (28.45%), mice (2.56%), and other species including hamsters, donkeys, horses, foxes, and rabbits (Yalcin *et al.*, 2012). Dogs, cats, squirrels, monkeys, hamsters, and other species were also reported to cause bites in Tehran, Iran (Eslamifar *et al.*, 2008).

In neighboring Iraq, Al Muthanna Province, located on the Kuwaiti borders, is considered one of the hotspots for rabies with 0.42-0.62 cases per 100,000 population (Ismail *et al.*, 2020). Dogs can cross the Iraqi-Kuwaiti borders and may incur rabies-related health problems in Kuwait. In Oman, foxes and camels proved positive for rabies, along with dogs and sheep/goats (Ia *et al.*, 2015).

Mammal bites were more common among Asian and Pakistani/Indian workers reaching 51.5% of the reported cases. The labour force in Kuwait is entirely based on foreign workers from Asian countries, and they are involved in all types of work (construction, agriculture, house servants, etc.) bringing them into contact with mammals. However, mammal bites are also common among Kuwaiti citizens (29.2%).

Most bites occurred among people aged between 25-45 years (12,944 cases, 53%), the working group. Males were much more vulnerable to bites than females. This is also true in Turkey where most bite victims were older than 18 years (Yalcin *et al.*, 2012), while in Oman, the victims were between 10-19 years old, with 70.1% and 29.9% being males and females (Ia *et al.*, 2015), and in Ilam Province, in Iran, the age group between 10-19-year-old accounted for 26% of bites, and 68.3% and 31.7% were males and females respectively. In Babylon Province, Iraq, children under 10 years and students accounted for most dog bites cases (34.7%) and (37.7%) respectively (Bairmani & Baiee, 2017).

Mammal bites in Kuwait constitute a health issue that should receive high priority since neighboring countries such as Saudi Arabia and Iraq reported cases of rabies among animals as well as human. Historically, rabies was found in animals in Kuwait (Rollin *et al.*, 1985). Further surveillance measures should be implemented to screen dogs and wild animals in Kuwait.

Conclusion

This study highlights the significant public health concern posed by mammal bites in Kuwait. The findings reveal that dogs and cats are the primary perpetrators, with a higher incidence of bites among males and individuals aged 25-45 years. Considering the presence of rabies in neighboring countries and the potential for cross-border transmission, it is crucial to implement enhanced surveillance measures and prevention strategies to mitigate the risk of rabies outbreaks.

Public awareness campaigns aimed at educating the population about responsible pet ownership, animal behavior, and bite prevention should be prioritized. Additionally, it is essential to enforce strict animal control measures, promote the vaccination of pets, and establish efficient reporting systems for animal bites. Coordination with neighboring countries to share information on rabies cases and control measures will further contribute to a regional effort in combating the disease.

Future research should focus on understanding the factors contributing to the high incidence of mammal bites in Kuwait and identifying targeted interventions to address these factors. By adopting a comprehensive and proactive approach, Kuwait can effectively tackle the challenges posed by mammal bites and protect its population from the potential threat of rabies.

Acknowledgment

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Ethics Approval and Consent to Participate:

The informed consent was waived because of the retrospective nature of this study.

Authors' Contribution:

- Mohammed T Al-Sayegh: Conceived and designed the study, collected data, and provided critical revisions to the manuscript.
- Muna Ayesh Alsalameen: Assisted in designing the study, conducted data analysis, and contributed to the interpretation of the results.
- Qais AH Majeed: Participated in data collection, contributed to the discussion of the findings, and revised the manuscript for intellectual content.

- Abdulaziz M Alateeqi: Assisted in data analysis and interpretation, reviewed the literature, researched vaccines and treatment protocols for patients admitted to hospitals, and contributed to the drafting of the manuscript.
- Rihan Bani Hani: Contributed to the study design, coordinated data collection, and assisted in drafting and revising the manuscript.
- Zuhair S Amr: Provided expertise in the field of mammal bites and rabies, contributed to the interpretation of results, and critically reviewed the manuscript for intellectual content.

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