ORIGINAL ARTICLE

Annals of Agricultural and Environmental Medicine 2023, Vol 30, No 2, 229–234
www.aaem.pl

Epidemiological characteristics, seasonality, trends of dog bite injuries, and relationship with meteorological data

Sinan Yılmaz[1,A-F], Orhan Delice[2,A-B,D,F], Sibel İba Yılmaz[3,B,D,F]

[1] *Faculty of Medicine, Department of Public Health, Ataturk University, Erzurum, Turkey*
[2] *Medical Faculty, Department of Emergency Medicine and Traumatology, Health Sciences University, Erzurum, Turkey*
[3] *Medical Faculty Infectious Diseases Clinic, Health Sciences University, Erzerum, Turkey*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation,
D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Yılmaz S, Delice O, Yılmaz SI. Epidemiological characteristics, seasonality, trends of dog bite injuries, and relationship with meteorological data. Ann Agric Environ Med. 2023; 30(2): 229–234. doi: 10.26444/aaem/162308

Abstract

Introduction and Objective. Animal bites are among the most critical in public health problems. Dogs are the leading cause of bite injuries. The study aimed to investigate the epidemiology and clinical features of dog bite cases admitted to an emergency department, as well as their temporal trends, seasonality, and tr relationship with meteorological data.

Materials and method. Study data comprised eight years (2012–2019) emergency room records of a tertiary center. Demographic characteristics of the cases, bite anatomical area, treatment applied, hospitalization, and death rates were determined. The incidence rates and distribution of meteorological data by years were examined using ANOVA and Kruskal Wallis tests. Seasonality and temporal trends were investigated for incidence rates using the additive decomposition technique. The temporal relationship of incidence rates with meteorological data was evaluated using the Autoregressive Distributed Delayed Boundary Test. Causality verification was perfoirmed using the Granger test.

Results. Dog bite cases consisted of 1,335 records of partients with a mean age of 26.6±0.2 years. Bite cases were most common in the 20–44 age group (44.7%), males (76.4%), and lower extremities (48.2%). The frequency of hospitalization was 4.1%. Annual incidence rates ranged from 52.7–49.9/100,000, with a non-significant increasing trend. The incidence of bites had two peaks, in June and August. A co-integration relationship was observed between incidence rates and air temperature and humidity levels ($p<0.001$).

Conclusions. Effective implementation of prevention programmes is needed for high-risk demographic groups. In addition, a national monitoring and reporting system could evaluate the effectiveness of any prevention programme and reduce the incedence of dog bites.

Key words

dog bite injury, dog bite incidence, trend, epidemiology, emergency department, meteorological data

INTRODUCTİON

Animal bites are an important cause of morbidity and mortality worldwide [1]. The main animal species with the potential to bite humans are snakes, dogs, cats, and monkeys [1]. The animal most frequently involved in bite-related injuries is the dog, responsible for 76% – 94% of injuries [2, 3].

The estimated annual incidence of dog bites among those presenting to the United States emergency services is 1.1 per 1,000 [4], with reported incidence rates from European countries being similar [5]. The precise incidence of dog bite injuries in Turkey, however, is not known. According to the Ministry of Health of the Republic of Turkey, approximately 250,000 cases of suspected rabies contact are reported annually, most of which are from dog bites [6].

The incidence and epidemiological characteristics of dog bite injuries may vary depending on geographical location, income level, industrialization, and cultural factors [5, 7]. Most bite cases are children, and the incidence of dog bites is high in mid-late childhood [1]. Men are more also often exposed to dog bites than women [1]. People can experience significant health consequences and financial losses from dog bite injuries [8]. Although bite cases have been evaluated from many aspects, studies examining temporal trends and their relations with meteorological data (MD) are in the minority. Besides the epidemiological characteristics of the cases, the relationship with natural variables, such as MD, can provide additional information on bite control [9]. On the other hand, MD has also been used in modelling studies to estimate the incidences of various health events, especially infectious diseases [9]. Although various studies on dog bite cases have been carried out in the study area to date, to the best of the authors' knowledge, the temporal trend, seasonality and relationship of the cases with MD, have not been addressed.

This study aimed to investigate the epidemiological and clinical features of dog bite cases admitted to an emergency department, as well as their temporal trends, seasonality, and relationship with MD.

MATERIALS AND METHOD

The study was planned as cross-sectional. Within the scope of the research, dog bite cases were not physically examined in any way, no questions were asked, no drugs were administered; only recorded data were examined. Therefore,

✉ Address for correspondence: Sinan Yılmaz, Faculty of Medicine, Department of Public Health, Ataturk University 25240, Erzurum, Turkey
E-mail: snn_yilmaz@yahoo.com

Received: 28.02.2023; accepted: 16.03.2023; first published: 28.03.2023

Figure 1. Map of Turkey with Erzurum province marked in red [27]

the study was deemed exempt from Ethics Committee review. The data were compiled from the emergency room records of a tertiary centre in Erzurum, a city in eastern Turkey with a population of approximately 757,000 (2021) [10]. Compared to the western part of the country, the city is relatively underdeveloped, has cold climatic conditions prevail, and where agriculture and animal husbandry are mainly conducted. In terms of area, it is Turkey's fourth largest province (25,000 km^2) and is at an altitude of about 1,900 m above sea level. Figure 1 [11], demonstrates the location of Erzurum on the map of Turkey.

The cases comprise 96 months (1 January 2012 – 31 December 2019) of emergency service applications exposed to dog bites in Erzurum city centre. Data were compiled from hospital information management system records by scanning with the ICD code (W54.0) (application date, address, age, gender, anatomical site of bite, treatment, hospitalization, death). The book in which the rabies prophylaxis records were kept was also examined. All accessed records are anonymized. Cases referred from outside the province, encountering dogs (no bite), injuries caused by non-dog animals, and cases with lost records, were excluded from the study. Between 2012–2019, the total number of emergency polyclinic applications amouinted to 2.561,075, and the number of dog bite cases – 1,335. Population data of the province were obtained from the Turkish Statistical Institute [monthly average temperature (°C), precipitation (mm/day), relative humidity (%) and wind speed (m/sec)].

Statistical Package for the Social Science (version 22), EViews (version 10), and Tableau Public (version 2022.4) programs were used for data analysis and visualizations. Analyzes were carried out in the stages of descriptive statistics, annual incidence information (trend and forecast), evaluation of variables by year, and application of time series techniques (stationary tests and lag length selection, cointegration tests, and modeling of bite cases). Descriptive statistics are presented using mean, standard error, number, percentage, and ratio. Incidence rates were calculated by dividing the number of cases by the mid-year population of the city center (100,000 people). ANOVA, Kruskal Wallis, and Mann Whitney U tests with Bonferroni correction were used for post-hoc analyses to evaluate incidence rates and MD by years. A partial correlation technique was used to evaluate the relationship between monthly incidence rates and MD.

Using the additive decomposition method, monthly incidence rates were adjusted according to seasonality and trend components, and estimates calculated. In order to avoid misinterpretations due to random movements of the variables, co-integration analysis was preferred instead of classical regression. Augmented Dickey-Fuller (ADF) was used as the unit root test and the lag length was determined according to the Schwarz information criterion. In the co-integration analysis, the Autoregressive Distributed Delayed Boundary Test (ARDL) approach was used, since the variables were stationary at that level. Ramsey Reset, CUSUM and CUSUM of squares, Jarquera-Bera, Breusch-Godfrey performance tests were used to investigate possible model problems. Finally, the relationships between incidence rates and MD were confirmed by the Granger causality test. Results were significant when p<0.05 was obtained in all analyses.

RESULTS

Demographic and clinical characteristics of bite cases are presented in Table 1, and their distribution by age group and anatomical region in Table 2. 1,335 dog bite cases were included in the study. The mean age of patients was 26.6±0.2 years. Bite frequency was higher in the 20–44 age group (44.7%), and in men (74.6%) than in women. In all age groups, the lower extremities were the anatomical region most frequently exposed to bite. Most of the cases (82.6%) comprised injuries requiring simple medical intervention. The general hospitalization frequency of bite cases was 4.1%. No deaths ccurred.

In Table 3, the mid-year populations of the study area, annual number and incidence rates of bite cases, and annual averages of MD are given. The overall annual incidence of bites was 40.5/100,000. The incidence of dog bites was calculated as a minimum in 2015 (27.2/100,000, 95% CI: 21.5 – 32.9) and a maximum in 2012 (52.7/10 – 2015 and 2015 – 2019 (p=0.001), there was no significant difference between the distribution of MD by years (p>0.05). Figure 2 indicates the seasonality, estimates and trend of dog bite incidence by

Table 1. Distribution of dog bite cases according to demographic and clinical characteristics

Variables	Mean / Cont	SE / %
Age (year)	26.6	0.5
Age groups		
0-9	264	19.8
10-19	279	20.9
20-44	597	44.7
45 and above	195	14.6
Gender		
Female	339	23,6
Male	996	76.4
Bitten anatomical area*		
Head/Neck/Face	83	6.1
Body	99	7.3
Upper extremity	523	38.4
Lower extremity	656	48.2
Treatment applied		
Suture/Complex operations	232	17.4
Dressing	1103	82.6
Hospitalization		
Yes	55	4.1
No	1280	95.9
Death		
Yes	–	–
No	1335	100.0

* total exceeds the number of participants, in some cases due to bites located in more than one anatomical region

Table 2. Distribution of dog bite cases by age group and anatomical regions

	0–9 years	10–19 years	20–44 years	45 years and above
Anatomical area	n (%)[a]	n (%)[a]	n (%)[a]	n (%)[a]
Lower extremity	86 (44.3)	176 (46.3)	290 (50.5)	104 (48.8)
Upper extremity	81 (41.8)	144 (37.9)	221 (38.9)	77 (36.2)
Body	10 (5.1)	38 (10.0)	37 (6.4)	14 (6.5)
Head/Neck/Face	17 (8.8)	22 (5.8)	26 (4.5)	18 (8.5)
Total[b] [n (%)]	194 (14.2)	380 (27.9)	574 (42.2)	213 (15.7)

[a] Column percentage; [b] total exceeds the number of participants, as some cases have bites in more than one anatomical region

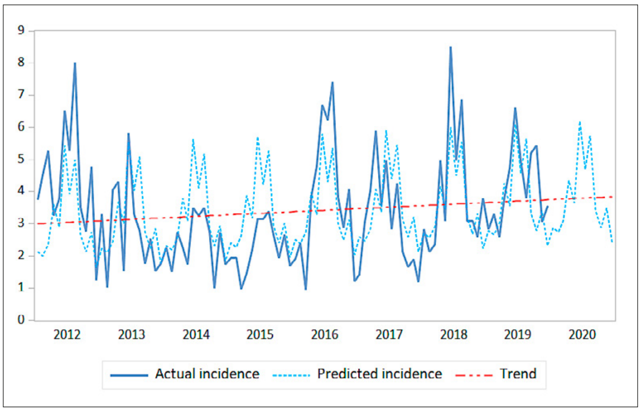

Figure 2. Seasonality, trend and forecasts of bite cases by year

year. The incidence of dog bites indicated a non-significant increasing trend over the eight-year period (p>0.05).

Figure 3 presents the monthly trends of dog bite incidence rates and MD. The incidence rates, which increased in March when the temperatures rose regionally, had two separate peaks – in June and August. The lowest incidence rates were recorded in December. There was a positive correlation between monthly mean incidence rates and only air temperature (r= 0.470; p<0.001). Precipitation, relative humidity, and wind speed were not significantly correlated with monthly incidence rates (p>0.05).

Time series analyzes were used to evaluate possible relationships between incidence rates and MD. ADF test results of the variables used in time series analyzes are presented in Table 4. stationary testing using the ADF test with a maximum lag length of 11 showed that all the variables were stationary on the level (p<0.05 for all). Time series graphs of weather components are given in Figure 4.

Table 5 presents the time series analysis results. Long- and short-term relationships between incidence rates and MD were evaluated with the ARDL approach. Because of the analysis, the ARDL (2, 0, 0, 1, 0) estimation model was

Table 4. ADF test results of incidence rates and weather components

Variables	t- Statistics	Critical Value (%1)	p Value
Incidence	-3.69	-3.50	**0.006**
Temperature	-9.33	-3.50	**<0.001**
Precipitation	-7.95	-3.50	**<0.001**
Relative humudity	-7.86	-3.50	**<0.001**
Wind speed	-8.06	-3.50	**<0.001**

Table 3. Mid-year population, bite case numbers, bite incidence and annual distribution of weather components

Years	Mid-year population	Number of cases	Crude Incidence (per 100.000) (Sum±SE)	Temperature(°C) (Mean±SE)	Precipitation (mm/day) (Mean±SE)	Relative humdity (%) (Mean±SE)	Wind speed (m/sec) (Mean±SE)
2012	398.368	210	52.7 (39.1-66.3)[a]	5.6±3.4	2.6±0.3	68.4±4.0	2.8±0.2
2013	394.684	133	33.7 (22.9-44.5)	5.3±3.3	2.6±0.3	66.3±4.2	2.9±0.2
2014	399.683	116	29.0 (22.9-35.2)	6.9±3.0	2.6±0.3	66.5±4.5	2.9±0.2
2015	412.326	112	27.2 (21.5-32.9)[a,b]	6.1±3.2	3.5±0.5	66.8±4.5	2.7±0.2
2016	417.385	193	46.2 (30.0-62.5)	5.5±3.1	4.3±0.7	66.5±3.5	3.4±0.2
2017	422.389	156	36.9 (25.5-48.4)	5.6±3.5	4.8±1.5	63.3±4.7	3.0±0.3
2018	422.164	204	48.3 (33.3-63.3)	7.6±2.6	3.3±0.5	69.2±3.7	3.1±0.2
2019	422.832	211	49.9 (40.6-59.2)[b]	6.2±3.1	3.3±0.5	65.9±4.2	2.8±0.2

[a,b] significant difference between groups with the same character (*p*=0.001)

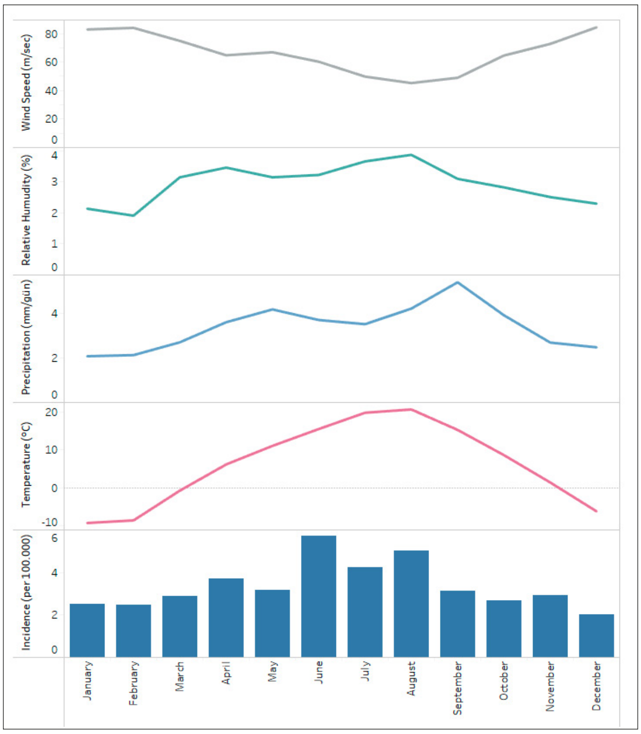

Figure 3. Incidence rates of cases and distribution of meteorological data by months

determined (R^2=0.472, F=11,009; p<0.001). According to the model, there was a positive long-term co-integration relationship between the number of cases and air temperature, and a negative relationship with humidity levels. The error correction coefficient of the model showed that the effect of a deviation in the relationship between the variables could reach equilibrium within 2.1 months [CointEq(-1): -0.472, p<0.001]. This showed the low variance in estimates caused by previous incidence rates, temperature and humidity shocks.

Table 6 presents the results of MD's Granger causality test. The causality for the temperature and humidity variables associated with the incidence rates as a result of the ARDL test was confirmed by the Granger test (χ^2=12.046; p=0.002 and χ^2=6.208; p=0.044, respectively).

Table 5. Time series analysis results for annual incidence rates and meteorological data

Variables	Coefficient	SE	t-Statistics	p Value
Incidence (-1)	0.165	0.097	1.694	0.094
Incidence (-2)	0.363	0.094	3.845	<0.001
Temperature	0.049	0.018	2.666	**0.009**
Precipitation	-0.004	0.032	-0.134	0.893
Relative humudity	0.004	0.013	0.321	0.749
Relative humudity (-1)	-0.030	0.009	-3.443	**<0.001**
Wind speed	0.163	0.168	0.970	0.334
Constant	-2.221	1.097	-2.024	0.046

R^2 0.472; Adjusted R^2 0.429; F - 11.009, Schwarz Criterion - 2.391; Durbin-Watson - 2.036; p<0.001; CointEq (-1): -0.472.

Table 6. Granger causality test results of meteorological data

Variables	χ^2	df	p Value
Temperature	12.046	2	0.002
Precipitation	0.410	2	0.814
Relative humudity	6.208	2	0.044
Wind speed	0.529	2	0.767

DISCUSSİON

Tes study identifies the main epidemiological and clinical features of dog bite cases admitted to the emergency department of a tertiary hospital between 2012 – 2019, investigates their seasonality, and explains their temporal trends and relationship with MD. The results of the study could help to develop local control and prevention policies for dog bite cases, as well as provide data comparable to other parts of the world.

Age is an important demographic determinant of dog bite injuries [4]. Almost half of the victims (44.7%) in this study were in the young-middle age group, and the findings are consistent with some studies [4, 12–14]. However, most studies have reported that dog bites are more common in the paediatric age group [2, 5, 12–15]. This may be related to

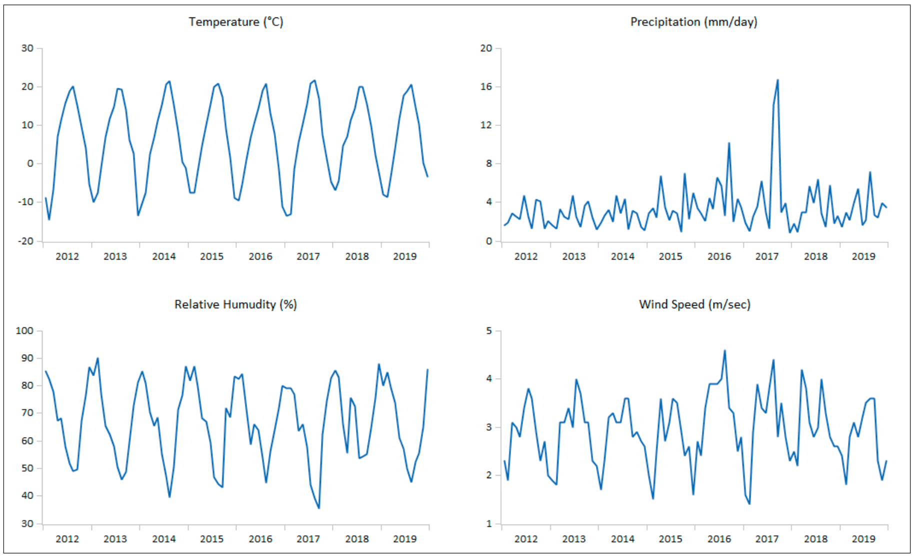

Figure 4. Time series graphs of meteorological data by year.

the demographic structure and dog ownership rates in the research groups.

Men are more often affected by dog bites [2, 15–18]. The current study found that bites are almost three times more common in men than in women,which is consistent with the literature. Being involved in agricultural activities and spending a lot of time outdoors may increase the likelihood of males being bitten. However, there are also studies reporting that incidences of dog bites are higher in women [5, 19, 20]. This contradiction may be because of socio-cultural reasons and, therefore, behavioural differences.

This study is compatible with the literature, and the lower extremities were determined as the anatomical region most frequently exposed to dog bites [2, 16, 12, 21, 22]. However, in some studies, hand and upper extremity bites were observed more frequently [14, 15, 17, 18, 23]. The high rate of dog ownership in some regions and the intensity of activities such as interaction with animals and games can explain this situation. It is known that children are frequently exposed to dog bites in the head, neck and face areas [2, 18]. Their short stature and vulnerability may explain the burden of head bites in children. Contrary to expectations, incidences of head injuries were low (14.6%) in the 0–19 age group in this study. This suggests that children in the region may have been bitten by an aggressive animal while playing or running, causing provocation.

Depending on the characteristics of the biting animal and the victim, dog bites can cause substantial physical injury and hospitalization [3, 18]. However, hospitalizations and deaths are not comparable, as they are usually reported for developing rabies cases [18, 24]. The current study showed that almost one-fifth of bite victims underwent sutures or other complex treatment procedures, and 4.1% were hospitalized. The incidence of hospitalization was the same as in regional studie, and no deaths occurred [22].

Reported incidence rates of dog bites vary widely (1.5 to 650/100,000) [5, 16, 4, 12–14, 17–19]. Various factors, such as geographical location, number of uncontrolled animals, industrialization and socio-cultural structure, can affect incidence rates. The likely unregistered nature of most minor and self-treated cases causes estimates to be limited to hospital admissions [25]. In the presented study, the crude incidence was calculated between 52.7–49.9/100,000. In addition, significant fluctuations in incidence rates were observed between years. Calculated incidence rates are higher than studies conducted with regional data [15, 22]. In this study, a non-significant upward trend in bite incidence was found. This may be a sign of a real increase, but may also be caused by population movements, the effectiveness of studies on stray dogs, improvements in reporting and changes in bite survivors' demand for healthcare.

Understanding the seasonal distribution of health problems and their relationship with MD can guide control studies [9]. However, it is reported that MD rarely acts alone, and its combinations, together with other factors, provide optimum conditions [26–28]. In the current study, consistent with the literature [17, 18, 20, 19, 21–23], the distribution of bite cases throughout the year increased almost in parallel with the air temperature, and made two separate peaks in June and August. This may be because of the increase in people's outdoor activities and dog activity in warmer weather.

In the current study it was found that air temperature and humidity levels simultaneously predicted the incidence of bites. Studies conducted in the Ezurum region [22] and in the Philippines [9] have also associated high temperature, low precipitation and humidity with mammalian bites. The fact that animals are more mobile and travel longer distances in hot and dry weather may increase the likelihood of encounters and people being bitten.

This study provides up-to-date information on the epidemiological features and public health burden of dog bite injuries. Bite records created through the hospital automation system in the emergency department are reliable.

Limitations of the study. It is acknowledged that this study has some limitations. First, the study data included only cases of dog bites that occurred in the city centre and presented to the emergency room. There may be victims who do not seek medical help or receive treatment in primary and secondary care centres. It is therefore possible that the study provides lower incidence estimates for dog bite injuries. In addition, a reporting bias may have arisen because of severe cases that were more likely to seek medical attention. Second, there are significant fluctuations in incidence rates from year to year. In the years when dog bite injuries were observed, the issues of how the cases were handled in the emergency department and how they were reflected in the records came to the fore. Studies conducted by local governments, lack information on bite cases, such as whether they occurred in the countryside or in the city centre, and whether the animal had an owner or was a stray dog.

CONCLUSIONS

This study determined that dog bite injuries were especially more common in the child-adolescent and young-middle-aged adult groups, as well as during the hot and low humidity seasons. To reduce the incidence of bites, it is important to intervene before appropriate climatic conditions in age groups where bite cases are common. Educating children and teenagers about how to treat dogs and signs of aggression can reduce bite injuries. An effective trauma surveillance system, in which emergency room conditions are also observed, is important to define risk groups and planning interventions. Finally, introducing national control programmes for stray dogs can provide long-term control of dog bite incidents.

REFERENCES

1. Animal bites; 2023 [cited 2023 Mar 6]. Available from: URL: https://www.who.int/news-room/fact-sheets/detail/animal-bites
2. Villagra V, Cáceres D, Alvarado S, Salinas E, Caldera ML, Lucero E, et al. Caracterización epidemiológica de mordeduras en personas, según registro de atención de urgencia: Provincia de Los Andes, Chile. Rev Chilena Infectol. 2017;34(3):212–20. https://doi.org/10.4067/s0716-10182017000300002
3. 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
4. Tuckel PS, Milczarski W. The changing epidemiology of dog bite injuries in the United States, 2005–2018. Inj Epidemiol. 2020;7(1):57. https://doi.org/10.1186/s40621-020-00281-y
5. Westgarth C, Brooke M, Christley RM. How many people have been bitten by dogs? A cross-sectional survey of prevalence, incidence and factors associated with dog bites in a UK community. J Epidemiol

Community Health. 2018;72(4):331–6. https://doi.org/10.1136/jech-2017-209330
6. Republic of Turkey Ministry of Health. Rabies Prophylaxis Guide 2019 [in Turkish]. Accessed: 7 July 2022. Available at: https://hsgm.saglik.gov.tr/depo/birimler/zoonotik-vektorel-hastaliklar-db/zoonotik-hastaliklar/2-Kuduz/6-Rehbler/Kuduz_Profilaksi_Rehberi.pdf.
7. Rothe K, Tsokos M, Handrick W. Animal and Human Bite Wounds. Dtsch Arztebl Int. 2015;112(25):433–42; quiz 443. https://doi.org/10.3238/arztebl.2015.0433.
8. Maksymowicz K, Janeczek A, Szotek S, Łukomski R, Dawidowicz J. Dog bites in humans in a large urban agglomeration in the southwest of Poland, an analysis of forensic medical records. Journal of Veterinary Behavior. 2016;12:20–6. https://doi.org/10.1016/j.jveb.2015.12.007
9. Lachica ZPT, Peralta JM, Diamante EO, Murao LAE, Mata MAE, Alviola Iv PA. A cointegration analysis of rabies cases and weather components in Davao City, Philippines from 2006 to 2017. PLoS One. 2020;15(8):e0236278. https://doi.org/10.1371/journal.pone.0236278
10. TÜİK Kurumsal; 2023 [cited 2023 Mar 6]. Available from: URL: https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2020-37210
11. Search media – Wikimedia Commons; 2023 [cited 2023 Feb 5]. Available from: URL: https://commons.wikimedia.org/w/index.php?search=Locator+map+Turkey+Erzurum+city&title=Special:MediaSearch&go=Go&type=image
12. Bashir K, Haq I, Khan SMS, Qurieshi MA. One-year descriptive analysis of patients treated at an anti-rabies clinic-A retrospective study from Kashmir. PLoS Negl Trop Dis. 2020;14(8):e0007477. https://doi.org/10.1371/journal.pntd.0007477
13. Janatolmakan M, Delpak M, Abdi A, Mohamadi S, Andayeshgar B, Khatony A. Epidemiological study on animal bite cases referred to Haji Daii health Center in Kermanshah province, Iran during 2013–2017. BMC Public Health. 2020;20(1):412. https://doi.org/10.1186/s12889-020-08556-1
14. Ghaffari-Fam S, Hosseini SR, Daemi A, Heydari H, Malekzade R, Ayubi E, et al. Epidemiological patterns of animal bites in the Babol County, North of Iran. J Acute Dis. 2016;5(2):126–30.
15. Can FK, Tekin E, Sezen S, Clutter P. Assessment of Rabies Prophylaxis Cases in an Emergency Service. J Emerg Nurs. 2020;46(6):907–13. https://doi.org/10.1016/j.jen.2020.03.014
16. 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(5):e0252058. https://doi.org/10.1371/journal.pone.0252058
17. Loder RT. The demographics of dog bites in the United States. Heliyon. 2019; 5(3):e01360. https://doi.org/10.1016/j.heliyon.2019.e01360
18. Cohen-Manheim I, Siman-Tov M, Radomislensky I, Peleg K. Epidemiology of hospitalizations due to dog bite injuries in Israel, 2009–2016. Injury. 2018;49(12):2167–73. https://doi.org/10.1016/j.injury.2018.09.058
19. Park JW, Kim DK, Jung JY, Lee SU, Chang I, Kwak YH, et al. Dog-bite injuries in Korea and risk factors for significant dog-bite injuries: A 6-year cross-sectional study. PLoS One. 2019;14(2):e0210541. https://doi.org/10.1371/journal.pone.0210541
20. Khan A, Al-Kathiri WH, Balkhi B, Samrkandi O, Al-Khalifa MS, Asiri Y. The burden of bites and stings management: Experience of an academic hospital in the Kingdom of Saudi Arabia. Saudi Pharm J. 2020;28(8):1049–54. https://doi.org/10.1016/j.jsps.2020.07.004
21. Abedi M, Doosti-Irani A, Jahanbakhsh F, Sahebkar A. Epidemiology of animal bite in Iran during a 20-year period (1993–2013): a meta-analysis. Trop Med Health. 2019;47:55. https://doi.org/10.1186/s41182-019-0182-5
22. Emet M, Beyhun NE, Kosan Z, Aslan S, Uzkeser M, Cakir ZG. Animal-related injuries: epidemiological and meteorological features. Ann Agric Environ Med. 2009;16(1):87–92.
23. Amiri S, Maleki Z, Nikbakht H-A, Hassanipour S, Salehiniya H, Ghayour A-R, et al. Epidemiological Patterns of Animal Bites in the Najafabad, Center of Iran (2012–2017). Ann Glob Health. 2020;86(1):38. https://doi.org/10.5334/aogh.2776
24. Barrios CL, Vidal M, Parra A, Valladares C, González C, Pavletic C. Epidemiological characterization of bites: A retrospective study of dog bites to humans in Chile during 2009. J Veterinary Behavior. 2019;33:31–7. https://doi.org/10.3390/ani11010096
25. Lynn C. European Study of Dog Bite Fatalities Suggests Rise in Deaths Could be Due to Increasing Number of Dangerous Breeds. DogsBite.org 2021 May 5 [cited 2022 Aug 3]. Available from: URL: https://blog.dogsbite.org/2021/05/european-study-of-dog-bite-fatalities-1995-2016.html
26. Review: Effects of Climate Change on Infectious Diseases – Princeton Public Health Review; 2023 [cited 2023 Mar 5]. Available from: URL: https://pphr.princeton.edu/2018/01/28/review-effects-of-climate-change-on-infectious-diseases/
27. Grobusch LC, Grobusch MP. A hot topic at the environment-health nexus: investigating the impact of climate change on infectious diseases. Int J Infect Dis. 2022;116:7–9. Available from: URL: https://www.ijidonline.com/article/S1201-9712(21)01250-9/fulltext
28. McDermott A. News Feature: Climate change hastens disease spread across the globe. Proc Natl Acad Sci USA. 2022;119(7). https://doi.org/10.1073/pnas.2200481119