

## Trends in in-hospital admissions due to dog bites in Ireland from 2012-2021

E. Ryan, A. O'Farrell,<sup>2</sup> P.S. O'Súilleabháin,<sup>3</sup> and D. McKeown<sup>2</sup>.

1. Department of Agriculture, Food and the Marine, Agriculture House, Kildare St, Dublin 2, Ireland.
2. National Health Intelligence Unit, Research and Evidence, Strategic Planning and Transformation, Jervis House, 4th Floor, Dublin 1, Ireland.
3. Department of Psychology, University of Limerick, Ireland
4. Health Research Institute, University of Limerick, Ireland

### Abstract

#### *Aim*

Dog bites are a global health issue. The aim of this study was to determine the incidence and characteristics of dog-bite related hospital admissions over a 10-year period.

#### *Method*

All in-patient emergency admissions with a dog bite diagnosis (ICD 10-AM W54) were extracted from the Hospital In-Patient Enquiry (HIPE) system. Statistical analysis was carried out in JMP.

#### *Results*

There were 3,158 emergency in-patient hospitalisations with a dog bite diagnosis. The rate increased significantly from 5.6 (95% CI 5.0-6.3) per 100,000 population in 2012 to 8.7 (95% CI 7.9-9.5) per 100,000 population in 2021,  $p=0.04$ ). The rates were highest among children (0-14 years). The most common principal diagnoses were open wounds (2397, 75.9%) and fractures (246, 7.3%).

#### *Discussion*

An increasing rate of dog-bite hospitalisations has been observed across the last decade. This suggests that dog control legislation and enforcement requires improvement. These findings support the case for improved policy interventions.

## Introduction

There are no global estimates of dog bite incidence, however studies suggest that dog bites account for millions of injuries annually.<sup>1</sup> Dog bites are a global health issue that can lead to severe health outcomes including open wounds, fractures leading to temporary or permanent disability, psychological trauma, distress, anxiety, and premature mortality risk.<sup>2</sup>

Following a number of media reports on dog attacks on children and livestock in Ireland in 2022, the Government established a Working Group on the Control of Dogs<sup>3</sup> tasked with making policy recommendations to improve dog control and reduce the number of dog bites.

There is limited information on dog bites in Ireland due to the lack of a comprehensive reporting system. A previous paper by O'Suilleabháin<sup>4</sup> looked at in-patient hospitalisations due to dog bites over a study period of 1998-2013 to determine whether the introduction of the Control of Dogs Regulations, 1998<sup>5</sup> had an impact on the incidence of severe dog bites requiring hospitalisation. The study reported that the legislation likely had no impact and that the incidence of dog bites increased after introduction of the Act.<sup>5</sup>

The aims of this study were to analyse emergency in-patient hospital admissions to determine the incidence of serious dog bites per 100,000 population over a more recent 10-year study period (2012-2021) and to describe the demographic profile of those admitted with a dog bite diagnosis. The results of this study will be used to inform policy development to improve dog control and seek to reduce the incidence of dog bites in Ireland.

## Methods

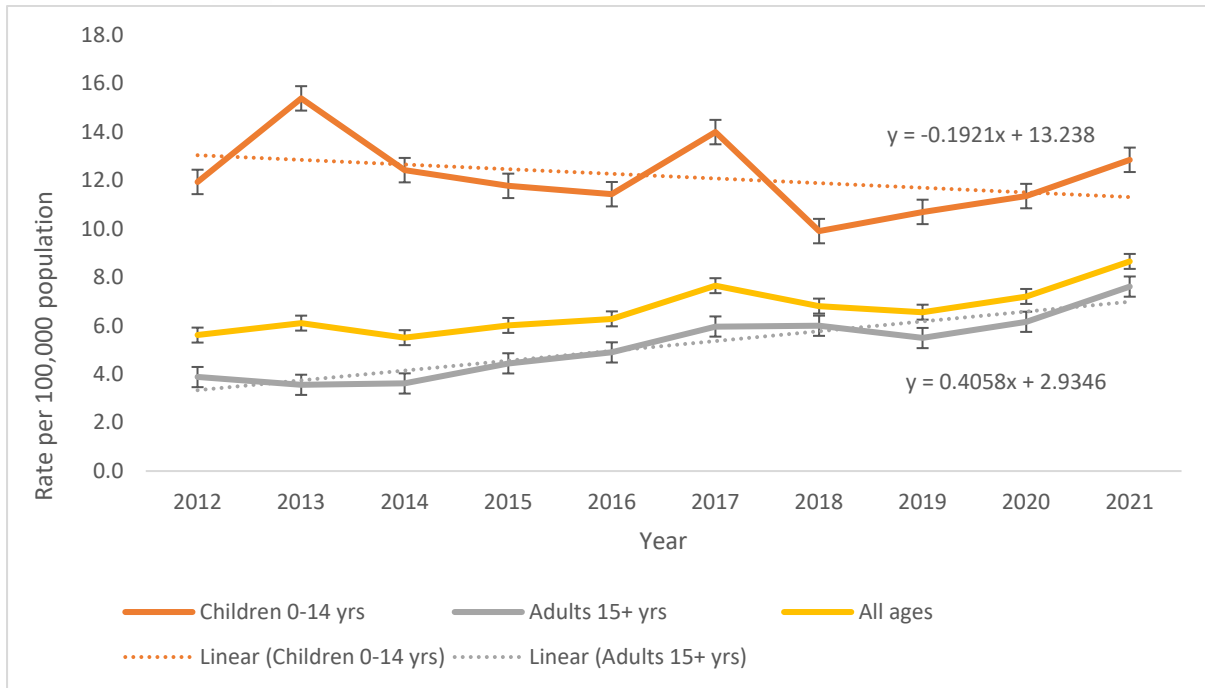
All emergency in-patient hospital discharges during the period 2012-2021 with a dog bite diagnosis were identified (ICD-10 code W54) using the International Classification of Diseases Australian Modification (ICD-10 AM)<sup>6</sup> and extracted from the Hospital In-Patient Enquiry (HIPE)<sup>7</sup> system using the Health Atlas Ireland<sup>8</sup> portal. HIPE is a national administrative database containing patient-level records of all admissions to acute public hospitals in Ireland. All acute public hospitals participate in HIPE<sup>7</sup>. The HIPE database contains information on the patient's age, sex, area of residence, date of admission and discharge, together with their principal diagnosis and up to 20 other diagnoses, coded by trained clinical coders using the International Classification of Diseases Tenth Revision (ICD-10-AM) diagnoses.

The data was analysed in JMP<sup>9</sup> statistical package and trend analysis was carried out in R<sup>10</sup>. ANOVA and Pearson's  $\chi^2$  allowed univariate and bivariate analysis to describe the patient population. Direct age-standardised incidence rates per 100,000 population per year were calculated to identify trends in incidence over time. The rate was standardised using the EU

standard population. The Cox and Stuart method was used to identify changes in trends over time. Indirect age standardised incidence rates per county were calculated to compare county rates that were higher or lower than the national average using the national average as the reference rate.

## Results

A total of 3,158 emergency in-patient hospitalisations with dog bite related injuries were recorded during the 10-year study period. As shown in Figure 1, the incidence of dog bite related emergency admission increased from 5.6 (95% CI 5.0-6.3) per 100,000 population in 2012 to 8.7 (95%CI 7.9-9.5) per 100,000 population in 2022, with a significant increasing trend over time (Cox and Stuart Trend test,  $Z=2.0$ ;  $p=0.04$ ). The rates were highest among children (0-14 years) compared to adults (15+yrs). The mean age over the study period was 31.1 years (SD 25.7) with a significant increasing trend in average age over time from 29.1 years in 2012 to 35.2 years in 2021 (F-ratio 7;  $p<0.0001$ ). Table 1 outlines the characteristics of the patients. Of the patient population, a total of 1604 (50.8%) were female and 1554 (49.2%) were male with no significant difference in the sex ratio over the 10-year study period (Pearson's  $\chi^2$  10.0;  $p=0.35$ ). The most common principal diagnostic categories (i.e., the reason for which the patient was admitted) were "injuries and poisonings." Injuries consisted primarily of open wounds (2397, 75.9%) and fractures (246, 7.3%). A high proportion of the patients, over half required a procedure under general anaesthesia (1779, 56.3%). A small number of patients (14, 0.05%) had a diagnosis of sepsis which is a life-threatening medical emergency condition. The majority of the patients were admitted from home (3008, 95.2%) and most were discharged home (2995, 94.8%). Over 80% were emergency admissions (2709, 85.8%) and 407 (12.9%) were elective admissions with 42 (1.3%) related to maternity and new-born. The average length of stay was 2.2 days (SD 4.8) and this did not change significantly during the study period (F ratio 1.3;  $p=0.22$ ). The number of bed days utilised over the study period was 7,069 of which 105 (3.3%) were ITU bed days. There were fewer than five deaths recorded.



**Figure 1:** The national rate per 100,000 population for emergency in-patient hospitalisation, 2012-2021. The lines show the rates for children (orange), adults (grey), and all ages (yellow).

As shown in Figure 1, the national rate of in-hospital discharges per 100,000 population increased significantly from 2012-2021. The rate was significantly higher for those aged 0-14 years. The rate increase was higher among those aged 0-14 years over the study period with some yearly variation whereby higher rates were observed in 2013 and in 2017. The rate in all age groups represents a significant upward linear trend from 2018 onwards.

**Table 1:** Demographic profile and patient characteristics of those admitted with a dog bite diagnosis for the study period.

Characteristics	No.	(%)
<i>Age</i>		
<i>Age groups</i>		
0-14	1212	38.4%
15-29	390	12.4%
30-44	464	14.7%
45-59	516	16.3%
60+	576	18.2%
Total	3158	100.0%
Median Age (IQR)	29	IQR (7-54)
Mean Age (SD)	32.1	(SD) 27.7
<i>Gender</i>		
Male	1554	49.2%
Female	1604	50.8%
<i>Medical card status</i>		
Yes	1197	37.9%
No	1951	61.8%
Unknown	10	0.3%
<i>Length of stay and total bed days</i>		
Mean LOS (SD)	2.2	(SD) 4.8
Total bed days	7068	
<i>Surgical procedures requiring anaesthesia</i>		
Yes		
No	1779	56.3%
	1379	43.7%
<i>Admission type</i>		
Emergency	2709	85.8%
Elective	407	12.9%
Maternity including new born (<5)	42	1.3%
<i>Top 5 principal diagnoses categories</i>		
S00-T98 Injury, poisoning and certain other consequences of external causes	2858	90.5%
L00-L99 Diseases of the skin and subcutaneous tissue	170	5.4%
Z00-Z99 Factors influencing health status and contact with health services	34	1.1%
M00-M99 Diseases of the musculoskeletal system and connective tissue	26	0.8%
O00-O99 Pregnancy childbirth and the puerperium	15	0.5%

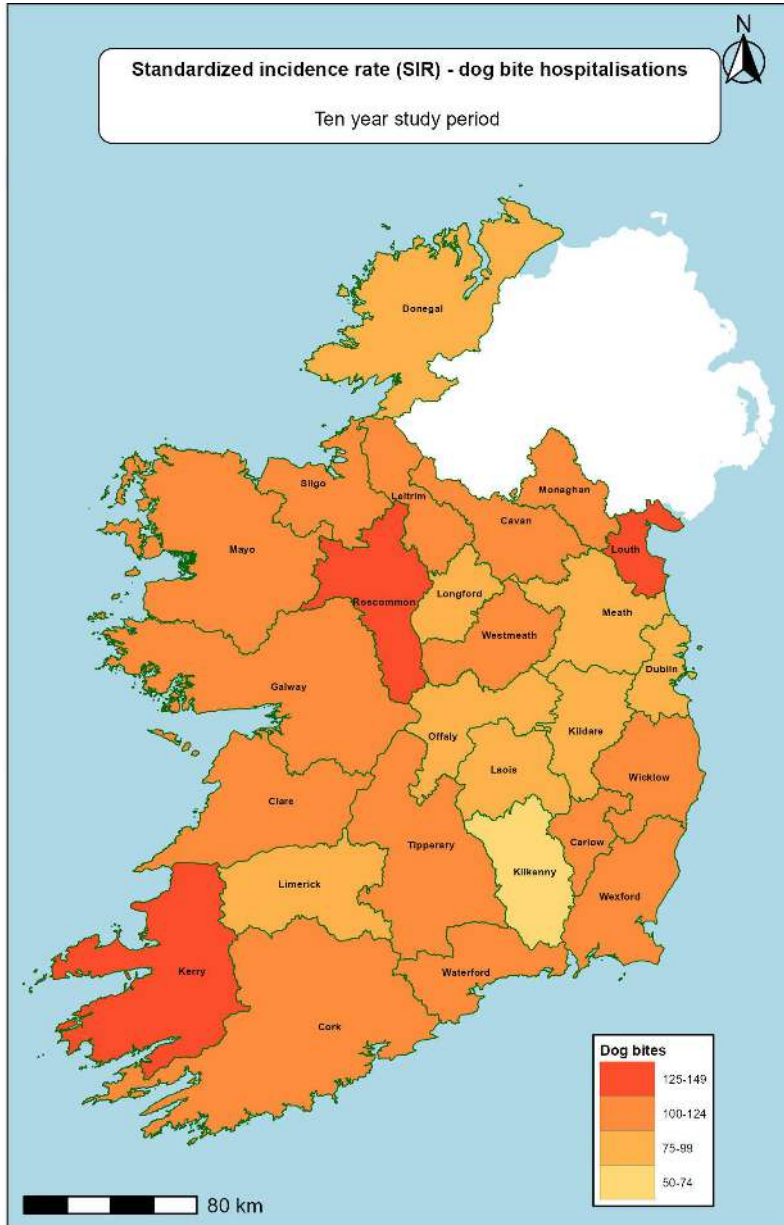
### *Rate by county*

There was a difference in rate per 100,000 population by county (Table 2 and Figure 2) with the highest in-hospital incidence rate in counties Louth, Kerry and Roscommon. These spatial trends were consistent throughout the study period.

**Table 2.** Age standardised Incidence rate (ASIR) for dog bite admissions per 100,000 population person at years risk by county of residence.

COUNTY	No. of dog bites	Standardised Incidence Rate	95 %CI Lower	95% CI Upper
Louth	124	145.2	145.0	166.0
Kerry	135	138.2	138.0	158.5
Roscommon	58	133.7	133.5	153.7
Carlow	47	124.8	124.6	144.2
Clare	98	124	123.8	143.4
Waterford	90	121.4	121.2	140.6
Leitrim	26	121.1	120.9	140.3
Mayo	105	120.2	120.0	139.3
Monaghan	48	116.8	116.6	135.7
Galway	193	114.9	114.7	133.7
Cork	406	113.2	113.0	131.8
Wexford	113	113.2	113.0	131.8
Sligo	49	112.9	112.7	131.5
Cavan	56	111.9	111.7	130.4
Tipperary	120	111.6	111.4	130.1
Westmeath	65	109.6	109.4	128.0
Wicklow	96	100.2	100.0	117.9
Ireland	3158	100	99.8	117.6
Laois	54	95.8	95.6	113.1
Meath	124	94.6	94.4	111.8
Longford	24	88	87.8	104.7
Limerick	111	86.1	85.9	102.6
Kildare	122	82.2	82.0	98.4
Donegal	88	82.1	81.9	98.3
Dublin	727	82	81.8	98.1
Offaly	41	77.8	77.6	93.6
Kilkenny	38	57.9	57.8	71.7

**Figure 2:** Age standardised incidence rate per 100,000 by county.



*Common diagnoses*

The majority of the patients had an open wound (2397, 75.9%) with 751 (23.8%) of the patients having a facial wound. Over half of the patients (1779, 56.3%) had injuries that required the administration of a general anaesthetic and 1317 (41.7%) had plastic surgery carried out.

## Discussion

The study found an increase in the incidence of dog-bite hospitalisations in Ireland over a 10-year period. This increase was driven by an almost doubling of incidence in adults. This finding is similar to that by Tulloch et al where they found that the increase in incidence was driven by a tripling of incidence in adults.<sup>11</sup>

The report of the Working Group on the Control of Dogs<sup>3</sup> approved by the Irish Government in March 2023 includes 15 policy recommendations on this issue. These include reviewing and updating the 1986 Control of Dogs Act, increasing the number of dog wardens, carrying out a responsible dog ownership public awareness campaign and promoting greater cooperation between agencies responsible for enforcement of the legislation. This study provides an evidence base for these policy discussions. They also provide a baseline against which any changes in the incidence of dog bites requiring hospitalisation in future years can be measured, which could be one of the indices by which the effectiveness of new policy interventions could be evaluated.

This issue is not confined to Ireland and the challenges of measuring dog bite incidence and of evaluating the impact of policy interventions have been considered by researchers elsewhere. In England in 2021, Tulloch and colleagues<sup>11</sup> examined the incidence and sociodemographic characteristics of those hospitalised for dog bites in England from 1998 to 2018. They found that the incidence of dog bite admissions in England rose from 6.34 in 1998 to 14.99 per 100,000 population in 2018, with a tripling of the incidence in adults driving this increase. They also reported significant geographical variation across England. These figures would suggest that our figures are lower than those of the UK but both findings are based on crude estimates based on hospital in-patient data that is influenced by in-patient admission patterns and proximity to A&E and hospitals. The World Health Organisation estimate that dog bites globally lead to ‘tens of millions of injuries’.<sup>12</sup>

The number of deaths recorded was fewer than five. This was broadly consistent with the recent analysis of deaths related to dog bites in England and Wales<sup>13</sup>.

The study found geographical variation in standardised incidence rate between counties. The highest levels were in Counties Louth (145.2), Kerry (138.2) and Roscommon (133.7), while the lowest were in Counties Kilkenny (57.9), Offaly (77.8) and Dublin (82). It is possible that proximity to a hospital may play a role, for example, Co Louth contains a major regional hospital in a relatively small county. Areas of higher social deprivation have been associated with a higher risk of dog bites elsewhere<sup>14</sup> however, due to the low spatial resolution of the data (i.e., county level data), the association with small area level deprivation could not be investigated.



Over half of the patients admitted had a surgical procedure that required general anaesthesia. This would appear high. A US study<sup>15</sup> on among children with a dog bite reported that less than 20% required surgery. This figure is not comparable in that it includes all those with an ED visit whereas our data is restricted to in-patient admissions only. Further studies on A&E attendances would be useful to determine the impact of dog bites on tertiary hospital services.

A significant finding in this study was the higher incidence among children which was sustained over the study period. This is consistent with previous studies in Ireland<sup>4</sup> and is comparable to international literature<sup>16-17</sup>. A study in the by Loder in the US<sup>16</sup> on ED attendances with a dog bite diagnosis was highest in children and a similar study in Spain<sup>17</sup> found that dog bite incidents were mostly associated with injuries directed to the head and neck in children and to the extremities in adults. Our results highlight the need for policy interventions to specifically consider ways to address this risk particularly among children.

A consistent rise in the rate of dog bites requiring hospitalisation was found over the study period. This follows on from similar findings in the period 1998 to 2013<sup>4</sup>, during which rates also increased. Taken together, the two studies show a consistent secular trend of increasing dog bites requiring hospitalisation in Ireland from 4.65 per 100,000 in 1998 to 8.7 per 100,000 in 2021. The actual burden of dog bites is undoubtedly greater than that estimated from hospital discharge records. This is a major public health issue which has demonstrably not been sufficiently addressed by the existing legislation and its implementation. Our findings emphasise the importance of improving dog control legislation and enforcement and of developing effective related risk-reduction policies in Ireland to protect the public.

As new policies are implemented and updated legislation enacted, it will be vital that policy makers can evaluate the impact of any changes. This can be done by carrying out follow up studies at regular intervals. Related issues such as the effectiveness of dog control policy options, responsible dog ownership campaigns, mitigation of dog attacks on livestock, and breed specific legislation were beyond the scope of this study. However, it will important for policy makers to consider related literature and comparable international experiences in order to inform and provide an evidence base for legislative interventions.

There was a number of limitations to our study. It was not possible to obtain data relating to the socio-economic status or ethnicity, preventing the investigation of the potential role of these factors in affecting risk. The spatial resolution (county level) was too low to detect any relationship between risk and socio-economic status of areas. The data related to patients admitted to hospital, victims of dog bites who presented at GP practices or Accident and Emergency or those not requiring medical attention were not included in this dataset. Details about the type of dogs involved in the biting incidents were not recorded, nor were details about the circumstances of the attack. Consistent with existing research and considering the

challenges of dog breed identification, it is important that future research include data collection which records known predictors of dog-bite incidence, hospital admissions and fatalities.

The incidence of dog bites requiring hospital admission has increased significantly over the study period with children at higher risk. These results provide evidence to support the need to examine and update dog control legislation and to develop more effective dog control policies in Ireland. Further research will be needed to enable the evaluation of such policy interventions in the coming years.

#### **Declaration of Conflicts of Interest:**

Eoin Ryan is chair of the Working Group on the Control of Dogs, whose report is referenced below<sup>3</sup>. A. O'Farrell and D. McKeown have no actual or perceived conflict of interest. P.S. O'Suilleabhain has been involved in non-financial advocacy seeking to reform current dog-bite mitigation regulations.

#### **Corresponding author:**

Anne O'Farrell,  
National Health Intelligence Unit,  
Research and Evidence, Strategic Planning and Transformation,  
Jervis House, 4<sup>th</sup> Floor,  
Dublin 1.  
E-Mail: [anne.ofarrell@hse.ie](mailto:anne.ofarrell@hse.ie)

#### **Acknowledgments**

We would like to thank Tiana Toolin for her help in producing the map for our study and for Dr. Ger Sayers for proof-reading the paper and for her helpful comments.

#### **References:**

1. World Health Organization (WHO). *Animal bites*. <https://www.who.int/news-room/fact-sheets/detail/animal-bites>
2. Rajshekar M, Blizzard L, Julian R, Williams AM, Tennant M, Forrest A, Walsh LJ, Wilson G. The incidence of public sector hospitalisations due to dog bites in Australia 2001-2013. *Aust N Z J Public Health*. 2017 Aug;41(4):377-380. doi: 10.1111/1753-6405.12630. Epub 2017 Jul 16. PMID: 28712151.

3. Government of Ireland. *Report of the Working Group on Control of Dogs*.  
<https://www.gov.ie/en/publication/0d6d7-working-group-on-control-of-dogs/#report-of-the-working-group-on-the-control-of-dogs>
4. Ó Súilleabháin P. Human hospitalisations due to dog bites in Ireland (1998-2013): Implications for current breed specific legislation. *Veterinary Journal* 2015 Jun;204(3):357-9. doi: 10.1016/j.tvjl.2015.04.021. Epub 2015 Apr 22. PMID: 25957919.
5. Irish Statute Book. *Control of Dog Regulations 1998*.  
<https://www.irishstatutebook.ie/eli/1998/si/442/made/en/print>
6. Australian Consortium for Classification Development (ACCD) 2018. The Australian Classification of Health Interventions (ACHI) – Tenth Edition - Tabular list of interventions and Alphabetic index of interventions, Lane Publishing, Adelaide, 2018.
7. Healthcare Pricing Office. *Hospital In-Patient Enquiry (HIPE) system (2020)*.  
[http://hpo.ie/hipe/hipe\\_data\\_dictionary/HIPE\\_Data\\_Dictionary\\_2020\\_V12.0.pdf](http://hpo.ie/hipe/hipe_data_dictionary/HIPE_Data_Dictionary_2020_V12.0.pdf).
8. Health Atlas Ireland (2023). National Health Intelligence Unit.  
<https://www.healthatlasireland.ie/>. Accessed October 2023.
9. JMP statistical package. Version 16. SAS Institute. Cary NC, USA.
10. R statistical package. Version 4.1.3. R Core Team (2021). R. A language and environment for statistical analyses. <https://www.R-project.org/>.
11. Tulloch J, Owczarczak-Garstecka S, Fleming K, Vivancos R, Westgarth C. English hospital episode data analysis (1998–2018) reveal that the rise in dog bite hospital admissions is driven by adult cases. *Sci Rep*. 2021 Jan 19;11(1):1767. doi: 10.1038/s41598-021-81527-7.
12. World Health Organization. *Animal Bites*. <https://www.who.int/news-room/fact-sheets/detail/animal-bites> (2018).
13. Tulloch J, Oxley, J. Christley R, Westgarth C. Dog-related deaths registered in England and Wales from 2001 to 2021. *Public Health* 2023, 215: 91-93  
[doi.org/10.1016/j.puhe.2022.12.005](https://doi.org/10.1016/j.puhe.2022.12.005).

14. Hooper J, Lambert P, Buchanan-Smith H, Robertson T. Exploring Social and Locality Variations of Dog Bites in Scotland Using Administrative Data Sources. *Int J Popul Data Sci.* 2022 Aug 25;7(3):1810. doi: 10.23889/ijpds.v7i3.1810. PMID: PMC9644682.
15. Lee CJ, Tiourin E, Schuljak S, Phan J, Heyming TW, Schomberg J, Wallace E, Guner YS, Vyas RM. Surgical Treatment of Pediatric Dog-bite Wounds: A 5-year Retrospective Review. *West J Emerg Med.* 2021 Oct 27;22(6):1301-1310. doi: 10.5811/westjem.2021.9.52235. PMID: 34787555; PMCID: PMC8597704.
16. Loder R. The demographics of dog bites in the United States. *Heliyon*, 2019, 5(3): <https://doi.org/10.1016/j.heliyon.2019.e01360>.
17. Rosado B, Garcia-Belenguer S, Leon M, Palacio J. A comprehensive study of dog bites in Spain, 1995–2004 *Veterinary Journal.* 2009 179(3): 383-391, <https://doi.org/10.1016/j.tvjl.2008.02.002>.