

Submitted: 10/06/2024

Accepted: 24/08/2024

Published: 30/09/2024

Epidemiology of cat bites to people in Uruguay: Effects of the age and sex of the victim, season of the year, and the COVID-19 pandemic

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ABSTRACT

Background: Cat bites to people are an important public health problem. However, very little information exists on the epidemiology of people bitten by cats at the level of an entire country in Latin America. Additionally, the COVID-19 pandemic significantly influenced people's lives and their relationships with pets, which could potentially affect the frequency of people bitten by cats.

Aim: The aim of this study was to determine the prevalence of people bitten by cats in Uruguay (2010 to 2020) according to the sex and age of the victim, season of the year, and to compare the prevalence in the pandemic year (2020) with that of the pre-pandemic years (2010–2019).

Methods: Cross-sectional study. Cat-bite notifications for the 2010–2020 period were analyzed using data from the Uruguayan Ministry of Public Health (Uruguay).

Results: The annual cat-bite rate for the 2010–2020 period was 2.1 per 100,000 people. The frequency of cat bites varied with the victim's sex ($p < 0.0001$), being greater in females ($n = 506$, 66.5%) than in males ($n = 255$, 33.5%). The age at being bitten by cats varied with the sex of the victim, with males being bitten at an earlier age than females ($p < 0.0001$). Among the age categories of 30–74 years, females were bitten more than males ($p < 0.05$). Overall, cat bites were much less frequent in the oldest age categories (over 75 years old, $p < 0.05$). The percentage of cat bites tended to change with the season of the year ($p = 0.08$), with most bites occurring in spring and summer. The frequency of cat-bite injuries was similar between 2020 and the pre-COVID-19 pandemic years.

Conclusion: In Uruguay, cat bite incidents were affected by the victim's sex (more in females) and age, as well as by the season. During the initial year of the COVID-19 pandemic, the rate of cat bites was no different from those in earlier years.

Keywords: One health, Human-animal bond, Aggression, Animal welfare..

Introduction

Bites from pets (dogs and cats) towards people are a serious public health concern. This issue is not only due to the physical injuries they cause (Quirk, 2012; Amiri *et al.*, 2020; Román *et al.*, 2023) but also because of the different zoonoses that these animals can transmit to humans (Esch and Petersen, 2013; Stelow, 2022). The aggressive behavior and injuries they cause to humans also affect the aggressor animals themselves, since many of them end up being abandoned or even euthanized (Fatjó *et al.*, 2007; Damián, 2021; Cardoso *et al.*, 2022; Stelow, 2022). Therefore, animal aggression towards people can be considered as a clear example of

the concept “One Health” and “One Welfare” (Brookes *et al.*, 2020; Damián, 2021).

Although both pets (dogs and cats) can cause damage and transmit diseases to humans, the species most frequently involved in attacks and bites on people is the canine, typically accounting for over 70% of the cases (Kassiri *et al.*, 2018; Abedi *et al.*, 2019; Amiri *et al.*, 2020). There is more published information about people bitten by dogs than by cats, which can be attributed to the frequency of attacks and the severity of the injuries. This research gap is particularly pronounced in Latin America, where studies are very scarce, especially for cats. Arias Caicedo *et al.* (2019) evaluated people bitten by cats in Colombia, considering age categories, but not

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distinguishing the sex of the victims within each age category, nor seasonal changes. In Brazil, Benavides *et al.* (2020) evaluated people bitten by cats at the country level but did not include the age or sex of the victims or seasonal variations. Barrios *et al.* (2019) evaluated people bitten by cats in six regions of Chile but only for a single year, without differentiating the sex of the victims within each age category, or seasonal variations. Moreover, comparing data on cat bites may be influenced by demographic, sociocultural, and/or socioeconomic factors, which also vary across countries (Toribio *et al.*, 2009; Babazadeh *et al.*, 2016; Arias Caicedo *et al.*, 2019; Benavides *et al.*, 2020; Barrios *et al.*, 2019; 2023). During the year 2020, the entire world was impacted by the COVID-19 pandemic. Although the COVID-19 pandemic affected people's physical health, it also had social and economic repercussions on various nations, consequently influencing emotional health (Kontoangelos *et al.*, 2020; Xiong *et al.*, 2020; Hamadani *et al.*, 2020; da Silva Neto *et al.*, 2021). These changes in people's emotional health can also contribute to changes in their pets' behavior (Bowen *et al.*, 2020, 2021; Takagi *et al.*, 2023). The COVID-19 pandemic resulted in a rise in stress-related behaviors in cats, and owners with low emotional health scores tended to report more behaviors linked to cat stress, including anxiety and aggression (Takagi *et al.*, 2023). However, according to the best of our knowledge, we are not aware of any studies that have evaluated how the COVID-19 pandemic may have influenced the frequency of cat bites towards humans. In this study, our objective was to know the frequency of people who were bitten by cats in Uruguay, as well as to determine demographic aspects of the age and sex of the people bitten. As an additional objective, we evaluated whether the initial year of the COVID-19 pandemic influenced the frequency of people bitten by cats.

Materials and Methods

For this study (cross-sectional), we used the same database (granted by the Unit of Zoonoses and Vectors, Epidemiology Division of the Ministry of Public Health in Uruguay) from 2010 to 2020 and similar procedures as reported by Román *et al.* (2023), with the difference that in this work we focus on bites caused by domestic cats. It is important to highlight that in Uruguay, all people who are bitten and assisted in any health care service have the obligation to report such events to the Ministry of Public Health. In this study, we present the results as the number of people bitten by cats, as well as the rate of bites based on every 100,000 inhabitants of the country's population.

Statistical analysis

The chi-square test (χ^2) of the goodness of fit was used to compare the frequency of bites according to the sex of the people.

Mann-Whitney U test was used to compare the age at which males or females were bitten, expressing these results as means (\pm 95% CI).

To evaluate how age categories and victim's sex were affected by cat bites, for this study, people bitten by cats were classified into sex (male or female), and into 6 age categories (0–14, 15–29, 30–44, 45–59, 60–74, >75 years), similar to what was reported by Patnaik (2013) and Amiri *et al.* (2020). The number of people bitten by cats by age category within each sex and year for the overall study was analyzed via a mixed-effect analysis of variance model (SAS Studio, SAS OnDemand for Academics). The fixed effects were age category and sex, and an interaction between sex and age was tested using GLIMMIX procedures with a Gaussian distribution. Post-hoc comparisons were made with the Tukey-Kramer test. Significance was considered at an $\alpha \leq 0.05$.

To evaluate the influence of the season, the percentage of people bitten by cats per season (summer, autumn, winter, and spring) within each year for the overall study was analyzed. These data were analyzed through an analysis of variance model (SAS Studio, SAS OnDemand for Academics), using GLIMMIX procedures with a gamma distribution. Post-hoc comparisons were performed using the Tukey-Kramer test. Significance was considered at an $\alpha \leq 0.05$.

Chi-Square test (and odds ratio: OR) was used to compare whether or not the COVID-19 Pandemic influenced cat bites in relation to sex and, as well as relationships between sex and cat bites in pre-pandemic (2010 to 2019) and post-pandemic (2020) years.

The Mann-Whitney U test was used to analyze the age of people who were bitten by cats from the years before the pandemic with respect to the pandemic year, expressing these results as means (\pm 95% CI).

Ethical approval

Not needed for this study.

Results

There were 779 notifications of cat bites between 2010 and 2020 (Table 1), which represents an annual rate of 2.15 injuries per 100,000 people in Uruguay.

People bitten by cats according to demographic aspects of age and sex

There was a significant effect of sex on the number of people who were bitten by cats ($p < 0.0001$), the frequency of females ($n = 506$, 66.5%) being greater than that of males ($n = 255$, 33.5%) when considered over the entire study period. In addition, the age at being bitten by cats varied with the sex of the victim, with males being bitten at an earlier age than females ($p < 0.0001$, Fig. 1A).

People bitten by cats varied according to their sex ($p < 0.0001$), age ($p = 0.015$), and the interaction between sex and age ($p = 0.05$). Among the age categories of 30–74 years, females were bitten more than males ($p < 0.05$, Fig. 2). Overall, cat bites were much less frequent in the oldest age categories (over 75 years old) ($p < 0.05$), but this category did not show a significant difference from the youngest age category.

Table 1. People bitten by cats in Uruguay per year from 2010 to 2020.

Year	n	%
2010	40	5.1
2011	37	4.7
2012	24	3.1
2013	78	10.0
2014	104	13.4
2015	71	9.1
2016	76	9.8
2017	85	10.9
2018	93	11.9
2019	99	12.7
2020	72	9.2
2010-2020	779	100

n: number of cat bites.
 %: percentages of cat bites.

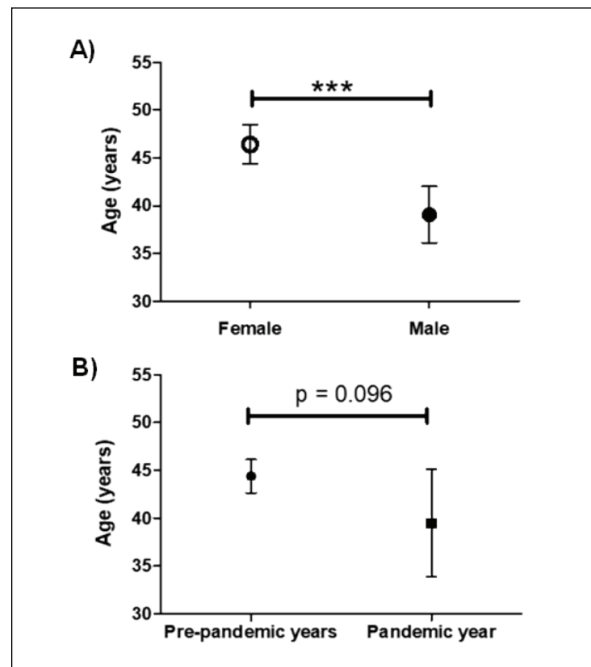


Fig. 1. A) Age (means \pm 95% CI) at which females and males were bitten by cats during the entire study period (2010–2020) in Uruguay. B) Age (means \pm 95% CI) at which people were bitten in previous years (2010–2019) and during the year of the COVID-19 pandemic (2020) in Uruguay.

Cat bites according to the season and pandemic year

The percentage of cat bites tended to change with the season of the year ($p = 0.08$), most bites occurred in spring and summer, and fewest in autumn, while winter occupied an intermediate position, showing no

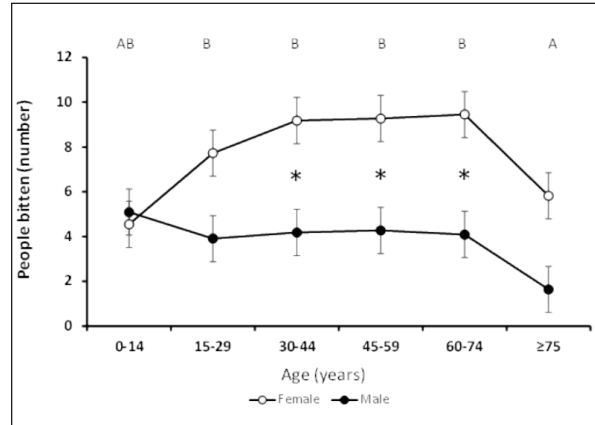


Fig. 2. Cat bites in Uruguay during the period 2010–2020. The percentage of people bitten (mean \pm SEM) was examined across various age categories and sex (male: -●- or female: -○-). Different capital letters between age categories represent points that differ significantly ($p < 0.05$). Asterisks placed between males and females for the same age categories represent points that differ significantly ($p < 0.05$).

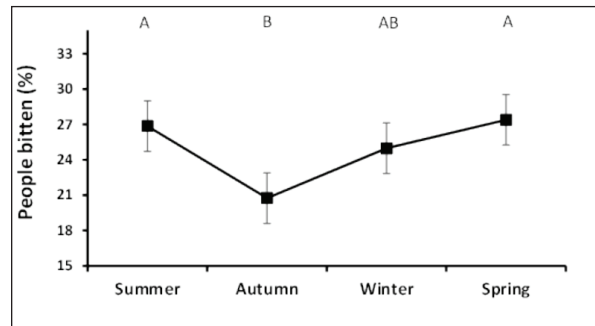


Fig. 3. Percentage of people bitten by cats (mean \pm SEM) in Uruguay during the period 2010 to 2020 by season of the year. Different capital letters between seasons of the year represent points that differ significantly ($p < 0.05$).

significant differences with respect to other seasons (Fig. 3).

The number of cat bites during the first pandemic year (2020) was in the range of pre-pandemic years (Table 1).

There was no association between the pandemic and the sex [$p = 0.594$; OR = 1.1533 (95% CI: 0.6822–1.9499)], the percentage of females versus males in the years to the pandemic (66.34% vs. 33.66%) was similar in the year of the first pandemic year (69.44% vs. 30.56%).

Furthermore, the age of the victims during the pandemic’s first year tended to be lower compared to pre-pandemic years (Fig. 1 B).

Discussion

This is the first study to report cat bites towards people in Uruguay, covering the entire territory of the country, all age categories, and both sexes, as well as the seasonal variations. According to data from the region, in Uruguay, the annual rate of bites per 100,000 inhabitants was 2.15, which is similar to that of Chile (2.42, Barrios *et al.*, 2019), but lower than that of Colombia (15.8, Arias Caicedo *et al.*, 2019) and Brazil (41, Benavides *et al.*, 2020). Beyond Latin America, there are limited reports that have assessed the rate of cat bites per inhabitant at the country level. In this context, the annual cat bite rate per 100,000 inhabitants in Uruguay was similar to that of the USA (2.34, Langley *et al.*, 2014), slightly lower than the findings in Valencia, Spain (6.36, Palacio *et al.*, 2007), but markedly lower than that of Iran (70.6, Amiri *et al.*, 2020). Although in Uruguay it is mandatory to report cat bites, is possible to underreport if treatment is done at home, a phenomenon documented for dog bites in various countries (Overall and Love, 2001; Quirk, 2012), including Uruguay (Román *et al.*, 2023). Based on this data, it is evident that the rate of bites by cats depends on the continent, and even within the same continent (e.g., Latin America) there is great variability among countries. Globally, and in light of the findings of this study, it is suggested that Uruguay, like Chile and the USA, occupies a relatively low position, underscoring that while cat bite injuries pose a public health concern, they remain significantly less prevalent compared to dog bite injuries in this country (Román *et al.*, 2023).

According to the sex of the victim, our study observed a higher frequency of cat bites in females compared to males. These findings align closely with the results reported by Arias Caicedo *et al.* (2019) in Colombia and Campagna *et al.* (2023) in the USA. Conversely, Barrios *et al.* (2019) in Chile did not identify any significant differences according to the sex of the victims in relation to cat bites. In contrast, studies by Palacio *et al.* (2007) in Spain and Amiri *et al.* (2020) in Iran indicated a higher frequency of cat bites in males than females. The variations observed across countries regarding the influence of sex on cat bites may be attributed to a range of factors, including cultural, social, demographic, and economic variables. These disparities underscore the need for further research to elucidate these findings and explore new avenues for future research. For example, it is possible that in Uruguay, a higher number of women exhibit a preference for adopting and cohabiting with cats compared to men, since this has been reported in other countries (Alba and Haslam, 2015). It is also plausible that women develop a stronger bond with their cats or that they become more involved in their care (Bergler, 1989; Adamelli *et al.*, 2005) potentially leading to an increased likelihood of being bitten by them. It is also reported that cats prefer to interact with women than

with men (Mertens, 1991; Turner, 2021), which could also influence these situations. Unfortunately, such information in Uruguay is currently unavailable.

Another interesting aspect to consider is that animal bites towards people in Uruguay depending on the aggressor species and the sex of the victims. According to this study, females were more frequently bitten by cats than males. However, in cases involving dogs as the aggressor, more males were bitten than females (Román *et al.*, 2023). Moreover, in instances of cat bites, as observed in this study, females between the ages of 30–74 years were more commonly bitten than males. Our results align with those reported by Campagna *et al.* (2023) in the USA. The pattern of cat bites in relation to age and sex differs from that of dog bites, where males under 14 years of age are predominantly affected (Román *et al.*, 2023). While it is widely accepted that individuals under 14 years of age, particularly males, are more susceptible to dog bites due to their behavior (Mathews and Lattal, 1994; Overall and Love, 2001; Rosado *et al.*, 2009; Román *et al.*, 2023), the factors influencing cat bites in terms of age and sex remains less understood. Given the limited information available on the relationship between the sexes and the likelihood of being bitten by cats, further research exploring these aspects would be valuable.

To the best of our knowledge, this is the first study that reports seasonal variations in cat bites in Latin America. It is noteworthy that seasonal patterns were observed in cat bites, seasons with the highest incidence recorded during the summer and spring months. Our findings are consistent with those reported in Valencia (Spain) by Palacios *et al.* (2007). In addition, the seasonal distribution of cat bites mirrors that of dog bites in our country during the same timeframe (Román *et al.*, 2023). A Spanish study by Rosado *et al.* (2009) and one in the U.S.A by Overall and Love (2001), also noted a peak in dog bites during the summer months. While cats exhibit a clear seasonal reproductive cycle (Jennett *et al.*, 2016), and given that in Uruguay the majority of adult cats are neutered (Barrios *et al.*, 2023), we consider that seasonal fluctuations in cat bites may not be linked to reproduction. Behavioral changes in cats linked to seasonal variations have been reported. Parker *et al.* (2022) found fluctuations in cat activity based on the season, with the most significant changes occurring between day and night during summer and spring. Palestirini *et al.* (2022) reported reduced feed consumption in cats during the warmer months. However, the potential connection between these seasonal behavioral variations in cats and aggressive behavior leading to bites on individuals remains unclear. The surge in cat bites during the warmer months, when people typically spend more time at home due to vacation periods, may predispose cats to stress, potentially resulting in heightened aggression during these seasons. However, future studies are needed to delve deeper into these matters.

This is the first study to evaluate the influence of the COVID-19 pandemic on cat bites. Our findings indicate that the COVID-19 pandemic did not influence the frequency of cat bites in Uruguay. These results are consistent with those reported for dog bites in Uruguay (Román *et al.*, 2023). However, during the first pandemic year, the age of the bite victims tended to be lower compared to pre-pandemic years. The reduced mobility enforced by the COVID-19 pandemic likely increased the time individuals spent at home, increasing the time with their pets, such as cats. This circumstance may explain why cat bites during the pandemic predominantly affected younger individuals. However, it is important to consider that although there was a trend, there were no significant differences, so we must be cautious with these results. Despite the relatively mild movement restrictions in Uruguay during the pandemic compared to other countries, the trend was still evident. In addition, we found that the COVID-19 pandemic influenced the age of individuals bitten by cats. This study shows evidence of how cat bites on individuals can be influenced by the pandemic, highlighting the interplay between cat bites and the pandemic as a manifestation of the “One Health, One Welfare” concept.

In conclusion, cat bites represent a public health concern in Uruguay, with a rate of 2.1/100,000 inhabitants. Females between 30 and 74 years of age were the most affected demographic group, with the majority of bites occurring in the spring and summer seasons. During the first year (2020) of the COVID-19 pandemic, the number of individuals bitten by cats was similar to that of previous years, but there was a tendency for bites to occur at younger ages.

Acknowledgments

The authors are grateful to the Ministry of Public Health of Uruguay for providing the data to carry out the study.

Conflict of interest

The authors declare that they have no conflict of interest.

Funding

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Authors' contributions

J.P.D. designed the study; analyzed the data and wrote the manuscript. J.R., F.B., and G.W. revised the manuscript. All authors have read and agreed to the published version of the manuscript.

Data availability

All data are provided in the manuscript.

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