









Dog bite injuries in children seen at a tertiary care hospital in Bolivia

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ABSTRACT

Introduction. The objective of this study is to describe the characteristics of dog bite injuries in children seen at a children's hospital in Bolivia.

Population and methods. This was an observational, retrospective study in patients seen between 2017 and 2021.

Results. A total of 769 patients were studied. Dog bite injuries accounted for 5.6% of emergency visits and 0.8% of hospitalizations. They were more frequent in children younger than 5 years (55.1%), in whom the following were observed: greater injury severity ($p = 0.008$), history of animal provocation ($p = 0.048$), known attacking animal ($p < 0.036$), domestic accident ($p = 0.021$), greater frequency of post-exposure prophylaxis with anti-rabies serum ($p = 0.005$), and maxillofacial area as the main region involved ($p < 0.001$). There were 3 deaths due to human rabies and 1 due to hypovolemic shock.

Conclusion. Dog bite injuries are a frequent cause of visit to the emergency department and hospitalization in pediatrics and have specific characteristics in children younger than 5 years.

Keywords: hospitals; wounds and injuries; pediatrics; dogs; rabies.

doi: <http://dx.doi.org/10.5546/aap.2022-02928.eng>

To cite: Copana-Olmos R, Calderón-López ME, Jove-Veizaga A, Ochoa-Ledezma E, et al. Dog bite injuries in children seen at a tertiary care hospital in Bolivia. *Arch Argent Pediatr* 2023;121(6):e202202928.

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Funding: None.

Conflict of interest: None.

Received: 11-23-2022

Accepted: 3-6-2023



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INTRODUCTION

Dog bites cause injuries ranging from scratches to potentially fatal wounds¹ and entail significant health care costs. In low- and middle-income countries (LMICs), the incidence of dog bites is higher; children are more vulnerable to these attacks.² Based on some known characteristics, such as sex, age group, location, characteristics of the attacking animal, and history of provocation, injuries caused by animals are mainly from dogs, although bites from cats and wild animals have also been reported.²

Among rabies cases, 99% are caused by dog bites. In LMICs, the estimated annual incidence is 0.06–0.08 cases per 100 000 inhabitants; almost half of them occur in children ≤ 15 years of age.^{3,4} Given that prevention and surveillance are the main pillars in rabies control, the Pan American Health Organization (PAHO) recognizes the lack of scientific publications on dog bites in LMICs and the limitations in implementing adequate preventive measures, implementing new measures, or assessing the effectiveness of current measures,⁵ so this study will contribute to the knowledge of these conditions. The objective of this study is to describe the characteristics of dog bite injuries in children younger than 15 years seen at a referral children's hospital in a LMIC.

POPULATION AND METHODS

Design

This was an observational and retrospective study in patients seen at Hospital del Niño Manuel Ascencio Villarroel (HNMAV), in the city of Cochabamba, Bolivia, between 2017 and 2021. This is a tertiary care hospital with approximately 3000 hospitalizations and 40 000 outpatient visits per year.

Sample, sampling, and selection criteria

The reference population is 25 104 patients who visited the emergency department during the study period. Patients diagnosed with dog bites (less than 7 days before) who were referred from another facility or who attended the emergency department between January 1st, 2017 and December 30th, 2021 were included. Repeat cases, follow-ups, or patients with more than 10% data loss were excluded.

Variables

Recorded variables corresponded to the demographic characteristics of the study population, such as age, sex, location in the

metropolitan region, and the variables that allowed us to characterize dog bites, such as type of exposure, history of provocation, known animal, domestic accident, severity of the injury, type of attacking animal, animal with rabies vaccine, and animal condition.

Procedures

The medical records of selected patients were reviewed. The required variables were collected by an independent investigator and data were anonymized before being entered into a database.

Statistical analysis

The IBM® SPSS® Statistics software, v26.0, was used to analyze variables in a descriptive manner and develop frequency tables. The statistical difference between variables was established using Fisher's exact test and, for continuous variables with a normal distribution, the Mann-Whitney U test was used.

Ethical considerations

This is a study on human beings, which requires information containing personally identifiable data; therefore, we obtained the approval from the Bioethics Committee of HNMAV (CITE/CI/HNMAV/CET/1/2022). Given the study's retrospective nature, no informed consent was requested. The data and records generated during the study are confidential and cannot be used for any other purpose.

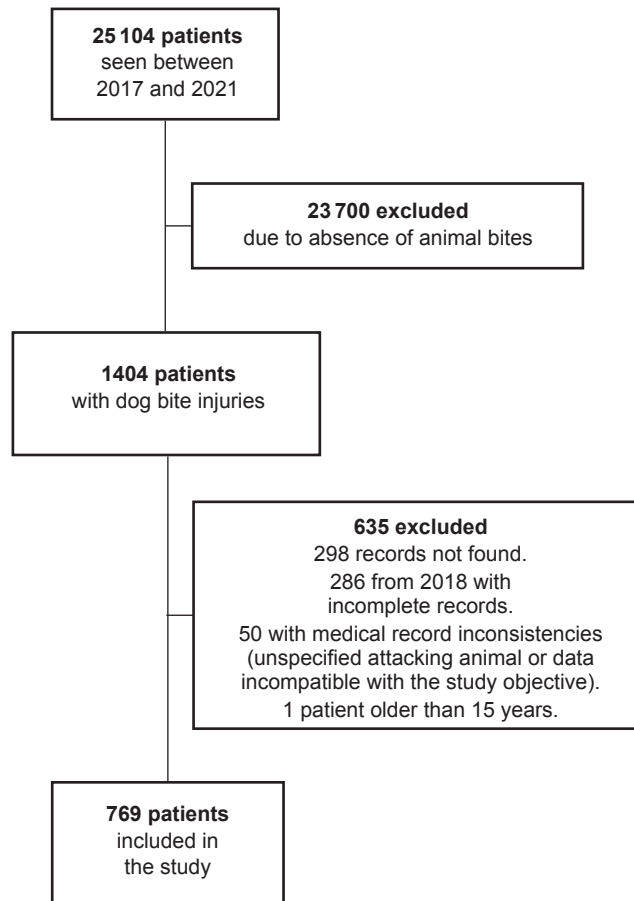
RESULTS

During the study period, 1404 patients with dog bite injuries were treated. The study sample size was 769 cases; this was determined by the total number of patients left after applying the inclusion and exclusion criteria (*Figure 1*).

Dog bite injuries accounted for 5.6% of morbidity at the emergency department, with an increase during the COVID-19 pandemic years. They also accounted for 0.8% of all causes of hospitalization and for 1.1% of causes of hospital mortality (3 deaths due to human rabies and 1 due to hypovolemic shock) (*Table 1*). Dog bite injuries were more frequent in the spring-summer months in the Southern Hemisphere (August to January).

These accidents were more frequent in children younger than 5 years, with a prevalence among boys. Also, 89.7% of cases occurred in the metropolitan regions (*Table 2*).

In relation to the characteristics of the accident,

FIGURE 1. Flowchart of patients included in the study

86.1% corresponded to single injuries and 53.4% were considered deep injuries. A total of 71.5% of the cases corresponded to bites; 21.5%, to scratches; and 2.9%, to direct contact or licks. In 44.5% of the cases, there was a history of provocation to the animal (play or intentional interaction) and, in 18.4%, the accident had not been witnessed. In addition, 60.9% of the accidents occurred in the home, so 81.3% of the dogs were known (2 cases for dangerous breed dogs). A

total of 44.7% of the dogs had received the annual rabies vaccine dose and had their vaccination card at the time of the accident; in 34 cases (6.5%), the dogs showed signs of suspected rabies; this was confirmed in 6 cases (1.1%) (*Table 2*).

Specific characteristics were observed in children younger than 5 years, such as greater injury severity ($p = 0.008$), history of animal provocation ($p = 0.048$), known attacking animal ($p < 0.036$), domestic accident ($p = 0.021$), post-

Table 1. Morbidity and mortality associated with dog bite injuries at a children's hospital (2017 to 2021)

		2017	2018	2019	2020	2021	TOTAL
Emergency department visits	All causes	6766	5832	4948	3461	4097	25 104
	Caused by dog bite	356 (5.3%)	299 (5.1%)	263 (5.3%)	217 (6.3%)	269 (6.6%)	1404 (5.6%)
Hospitalizations	All causes	2623	2817	2917	2220	2957	13 534
	Caused by dog bite	21 (0.8%)	34 (1.2%)	19 (0.7%)	12 (0.5%)	18 (0.6%)	104 (0.8%)
Mortality	All causes	65	60	80	66	80	351
	Caused by dog bite	1 (1.5%)	1 (1.7%)	0 (0%)	0 (0%)	2 (2.5%)	4 (1.1%)

Table 2. Characteristics of the situations in which dog bites occurred as domestic accidents (n = 769)

	Characteristics or the accident situation	N (%)	Association with age group < 5 years (Fisher's exact test)
Age group ^(a)	1-5 years	420 (55.1)	N/A
	> 5 years	342 (44.9)	
Sex ^(b)	Male	470 (61.2)	0.086
	Female	298 (38.8)	
Metropolitan region ^(c)		685 (89.7)	0.365
Type of exposure	Bite	550 (71.5)	0.299
	Lick	10 (1.3)	
	Contact	12 (1.6)	
	Scratch	165 (21.5)	
	Several combined	32 (4.1)	
Severity of injury ^(d)	Superficial	217 (46.6)	0.008
	Deep	249 (53.4)	
Number of injuries ^(e)	Single	653 (86.1)	0.515
	Multiple	101 (13.3)	
	No injury	4 (0.5)	
History of provocation	Yes	342 (44.5)	0.048
	No	285 (37.1)	
	Not witnessed	142 (18.4)	
Known animal ^(c)		621 (81.3)	0.036
Domestic accident		414 (53.8)	0.021
Animal with rabies vaccine		344 (44.7)	0.435
Animal condition ^(f)	Suspicious	34 (6)	0.226
	Not suspicious	523 (92.9)	
	Animal rabies confirmed	6 (1.1)	
Prophylaxis with rabies vaccine		675 (87.8)	0.187
Post-exposure prophylaxis with anti-rabies serum		641 (83.4)	0.005

^(a) n = 762.^(b) n = 768.^(c) n = 764.^(d) 303 injuries whose severity was difficult to estimate based on medical record data.^(e) n = 758.^(f) 206 medical records did not include results of animal follow-up.

exposure prophylaxis with anti-rabies serum ($p = 0.005$), and maxillofacial area as the main region involved ($p < 0.001$) (Figure 2). It is worth mentioning that children ≤ 5 years of age were bit by dogs whose median age was 18 months (SD: 27.06), while those > 5 years of age, by dog with a median age of 24 months (SD: 34.93).

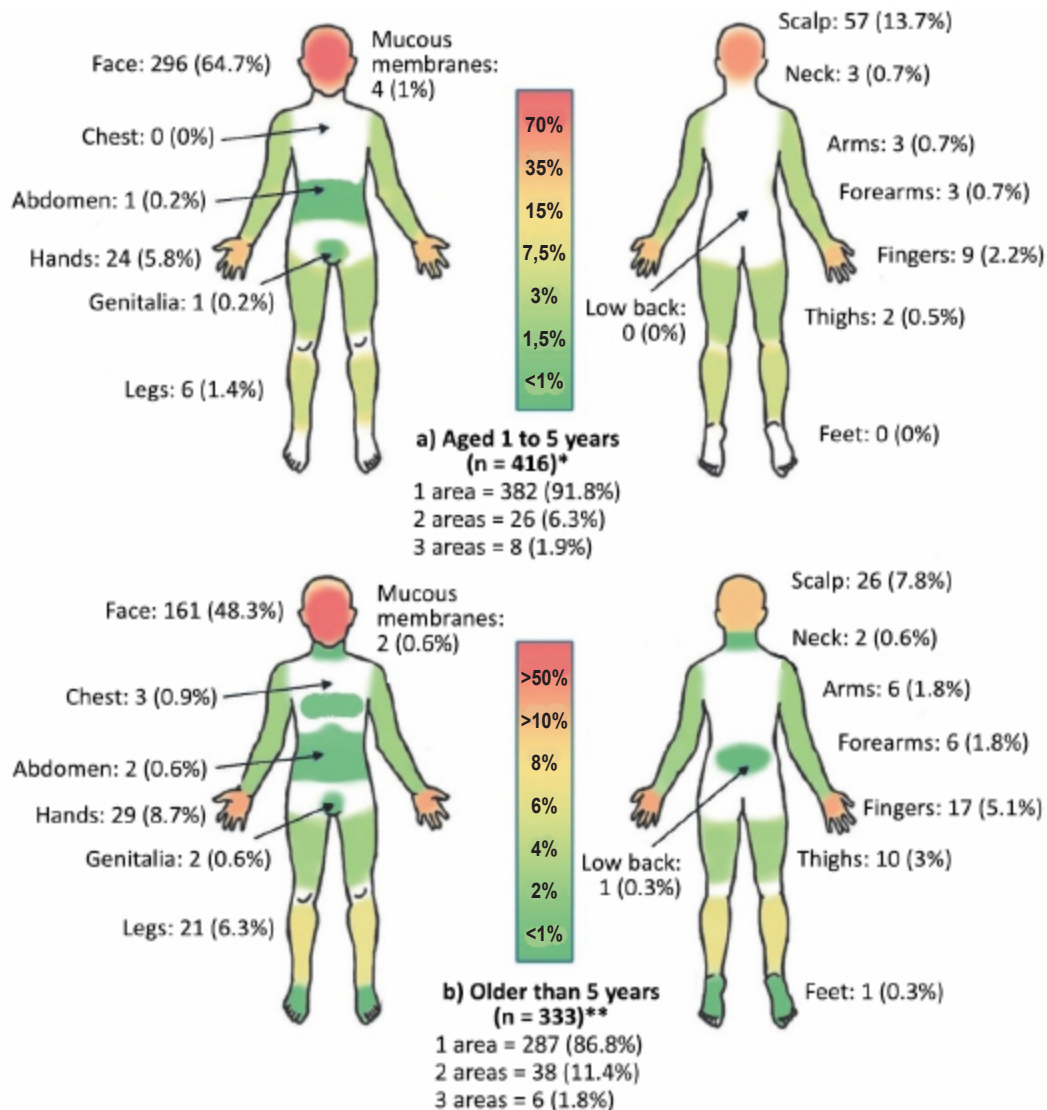
In general, there were differences between the affected anatomical regions by age group ($p = 0.038$). In children younger than 5 years, there was a significant predominance of maxillofacial injuries, such as head/face (78.4%), followed by injuries in the hands/fingers (8%). In children older than 5 years, there was also a high predominance of head/face injuries (56.1%), followed by injuries in the hands/fingers (13.8%). In this age group, injuries in the legs and thighs increased up to 10.3% combined, compared to

1.9% of these injuries in children younger than 5 years (Figure 2).

All patients received specific treatment, antibiotics, wound care, and analgesics as per the standard management of the department based on an individual analysis. As to anti-rabies post-exposure prophylaxis, the rabies vaccine was administered to 87.8% and anti-rabies serum, to 83.4% (Table 2). At the end of the surveillance period, follow-up was confirmed in only 51% of cases; human rabies was suspected in 12 patients (1.4%), with 3 confirmed cases and a rabies incidence of 0.03/100 000 (1 900 000 inhabitants).

DISCUSSION

Our study demonstrates that dog bite injuries are frequent in children^{6,7} and have specific characteristics in children younger than 5 years,

FIGURE 2. Heat map of single injuries caused by animal attacks, by age group (n = 762)

* 4 children aged 1 to 5 years.

** 9 children older than 5 years without injuries at the time of the physical examination, with animal licks or direct contact with an animal.

such as severity, animal provocation, the domestic context of the accident, and the anatomical distribution of injuries. Similar to other studies conducted in LMICs, the incidence is high, but the resources to implement effective prevention programs are scarce.⁶⁻⁸ There is a relationship between dog bites and the quality of life in these countries, their education, investments in preventive programs, and national programs, policies, and laws,⁶⁻⁸ for example, in Bolivia, there is no responsible pet ownership policy in place.

A discrete increase in the incidence of bites and other injuries is observed between August and January, the months with less school activity and more time spent at home due to the holidays and Christmas and New Year festivities, during which children are usually neglected.^{9,10} It is worth noting that, between March and July 2020, Bolivia established a strict lockdown policy, with closures of school activities until the end of 2021, and this was related to an increase in the number of cases.

Mortality due to animal attacks accounts for 1.1% of the total number of cases, while lethality in our study was 2.8 cases per 1000 accidents. In countries such as Canada and the United States, mortality is zero;¹¹ however, in Latin American countries such as Uruguay, Argentina, and Mexico, isolated cases of mortality have been reported.⁸⁻¹² The higher incidence of cases among children may be because they are more prone to accidents due to their curiosity, inexperience, lack of ability to defend themselves and to interpret the mood and intentions of a dog, and may even provoke them by behaving in a noisy and threatening manner.⁴

Accidents are more frequent in metropolitan regions, where there is a higher human and animal population density. A study conducted in Zimbabwe showed that 49% of the inhabitants had at least a dog or a cat; the estimated human population of 2.8 million people had approximately 175 000 dogs living with them, a situation that is similar to our population, since most accidents take place in the home.¹³ In Nepal, a similar problem has been described in relation to stray dogs.¹⁴ Brazil has reported a high incidence of animal attacks in urban areas in relation to social vulnerability, disorderly urbanization, and the large number of pets.^{15,16} In Israel, more than half of the cases were managed in the Central District, which hosts the highest concentration of population and hospitals compared to the Southern and Northern Districts;¹⁷⁻²⁰ the incidence of cases was higher in children younger than 5 years and in boys, and the authors' conclusions were similar to ours.²⁰ In the United States, the higher incidence was observed in toddlers younger than 2 years.²¹

The circumstances of the accident in our study, as in others, point to the home as the most frequent place. In general, the attacking animals are known and have been vaccinated, with an average age of 30 months.^{16,17} In contrast, in countries such as the United States, the incidence of street accidents caused by unknown animals was higher.²¹

In children younger than 5 years, injuries were mostly on the face and head (maxillofacial area), consistent with a study from Spain; however, neck injuries in our study represented a low percentage.¹⁵ There is a predilection for these regions due to children's shorter stature, larger head size, and tendency to crawl or play on the ground.¹⁷ In older children, there was also evidence of greater involvement of the extremities and genitalia, similar to what was reported in other

studies,¹⁷ which also indicated a higher proportion of injuries in the dominant arm.^{18,19}

The National Prophylaxis Standard for Human and Domestic Animal Rabies²² considers these are low-risk injuries and, when the animal is known/vaccinated, the attacking dog may be monitored for 14 days, avoiding the administration of post-exposure prophylaxis; however, rabies vaccines and serum are administered in 90% of the cases.²² The current Bolivian standard for the administration of rabies vaccine and serum recommends their use in case of wild or unknown animals, or known animals which have not been vaccinated, or for single injuries of the head/hand/neck, or for deep/penetrating/multiple injuries in any part of the body. Monitoring of the child that has been bit and the attacking animal is the responsibility of the local health center, which provides follow-up of the animal for 14 days, under the supervision of the Department of Health.^{9,10,22} According to the PAHO, in Bolivia, 2017 was the year with the highest number of dog and human rabies cases in the past 10 years. An average of 480 cases of dog rabies are reported annually. Despite the great efforts made in terms of vaccination, our study showed that only 44.7% of the dogs were vaccinated, which is consistent with the analysis of insufficient control measures for rabies.²²⁻²⁴

This study has limitations due to the small number of subjects included because it was a study based on data from a single hospital. In addition, given its retrospective nature, there were limitations in relation to the quality of the information recorded and the physical presence of records (medical records not found); also, some variables that could be of relevance were not analyzed. Despite this, our conclusion is that animal injuries are a frequent cause of care-seeking and hospitalization in pediatrics. Based on the characteristics of the circumstances of the accidents and the distribution of the injuries, it will be possible to better develop proposals or prevention projects, identify children at risk of greater involvement and severity, and thus reduce mortality due to human rabies. Prevention programs should be targeted at the supervision of children, responsible pet ownership, accident follow-up, implementation of policies for proper use of rabies vaccines and serum as post-exposure prophylaxis. Further studies are required in other populations to determine if our findings can be extended to other regions of the country. ■

Acknowledgments

We would like to thank Elvia Villarroel, M.D. (resident of pediatrics of HNMAV) for her help completing the database, and to Hirma Calle, B.S. (in charge of epidemiological surveillance at HNMAV) and Rubén Castillo, M.D. (Unit of Epidemiology of the Department of Health of Cochabamba, Bolivia) for their help to access the data on epidemiological surveillance, animal follow-up, vaccines, and serums, and their guidance during the study conduct.

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