



Canine Research

Epidemiological characterization of bites: A retrospective study of dog bites to humans in Chile during 2009

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ABSTRACT

Accidents involving dog bites to humans have high incidence worldwide. According to studies conducted in different countries, dogs are responsible for 60%–95% of all bites. This type of incident is a growing public health issue in Chile and an important economic burden for health systems. The problems that arise from bites include physical injuries, psychological trauma, and zoonosis. The objective of the present study was to characterize epidemiologically all bite incidents in Chile that were recorded in 11 public emergency services and analyze the information provided in health care forms from 5195 bites recorded in six regions of Chile. Our results show that dogs were responsible for 91.6% of bite incidents. The victim knew the offending dog in most cases (63.7%). The highest percentage of people bitten was between ages 5 and 9 years, with a rate of 125 bites per 100,000 inhabitants ($P \leq 0.05$). 86.6% of the cases in the study were single bites. Although the national health system has records of bite-related incidents, few studies provide relevant information on animal bites. This is a public health issue and we should know the magnitude of the problem, the species responsible for the bite, and the context in which accidents occur. The information obtained from the analyses performed in this study can contribute to develop prevention and control programs for bites, both in Chile and in other countries with similar sociocultural characteristics.

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Introduction

Dog bites represent an important public health problem (Ponsich et al., 2016). In the United States, dog bites were one of the 10 most prevalent nonfatal injuries that affected children between 5 and 9 years of age in 2016. Nonfatal dog bites are incidents that produce injuries in the victim without death (National Center for the Prevention and Control of Injuries, 2018).

The main consequences of animal bites include physical injuries, psychological trauma, transmission of zoonoses (Ishaya et al., 2014), infections (Dedy et al., 2016; Talley et al., 2016),

risk of fatality associated with inadequate or insufficient treatment that may lead to sepsis and sequelae (Bingham et al., 2010) and economic costs, both for the country in question and for the victims themselves (Bariya et al., 2015). The most relevant canine zoonosis is rabies. This disease is transmitted more easily by unattended dogs in underdeveloped and developing countries (Dhiman et al., 2016). Chile declared itself free from canine rabies virus variants V1 and V2 in 2010 before the WHO and the World Organisation for Animal Health (Instituto de Salud Pública, 2018; Ovalle, 2014; World Health Organization, 2013). However, there are other endemic variants in wild animals that can be transmitted to other animals and people (Favi et al., 2008). Rabies remains endemic in insectivorous bats in Chile, with sporadic cases in domestic animals (dogs and cats) in which the causal agent is the reservoir bat species *Tadarida brasiliensis* (Alegria-Moran et al., 2017).

The incidence of bites is estimated to be 100 times higher in developing countries than in developed countries (Georges and

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Table 1
Total bite records by region 2009

Region	No of bites	% Records with information	Human population (n)	Dog population (n)
Arica–Parinacota	461	15.8%	186,147	35,798
Coquimbo	176	2.3%	708,369	136,225
Valparaíso	1096	28.6%	1,735,095	333,672
Metropolitana	2945	29.7%	6,819,411	1,311,425
Bío Bío	198	100%	2,022,995	389,038
Aysén	319	52.4%	103,738	19,950
Total	5195	Average = 38.1		

Acosta-Jamett et al. (2010) and Departamento de Información y Estadística de Salud. Ministerio de Salud de Chile (2017).

Adesiyun, 2008; Si et al., 2008) due to factors such as geographic location, industrialization, and cultural level (Rothe et al., 2015). This situation is marked in developing countries such as Chile, where 61% of households own a dog.

The human to dog ratio in Chile is 1:1.7 in rural areas, 1:4.1 in towns, and 1:5.2 in cities (Acosta-Jamett et al., 2010). There is widespread substandard animal oversight in the country, which is reflected in the number of owned dogs that roam unsupervised through the streets (52.4%). Only 16.8% of the animals with owners are supervised full time (Ibarra et al., 2006).

All of these factors affect the odds that people may be bitten, especially in the streets. In Chile, 240 bites per 100,000 people per year were recorded, on average, between 2010 and 2014 (Departamento de Información y Estadística de Salud. Ministerio de Salud de Chile, 2017). Another example of a developing country with a high prevalence of bites is Cambodia, where the annual incidence of bites is 5000 bites per 100,000 people per year (Ponsich et al., 2016). This country is different than Chile in terms of income per person, educational access and level, but the human-dog ratio (4.1:1, CH and 3.1:1, CA) and percentage of participation of dogs in bite incidents (91.6% CH and 99% CA) are similar between these countries. The high number of bites in both countries assumed to be related in part to the high number of dogs roaming unchecked through the streets, a common condition in developing countries (Acosta-Jamett et al., 2010; Dalla Villa et al., 2010; Ponsich et al., 2016). This scenario is different from that of the United States, which records an annual rate of approximately 107 bites per 100,000 inhabitants (Quirk, 2012).

Lack of responsible pet ownership aggravates the public health problem because of the presence of uncontrolled, unsterilized dogs in public places (Totton et al., 2010). Likewise, poor animal ownership practices, especially the temporary or permanent abandonment of dogs, affect animal health and the welfare of companion animals in general (Rojas et al., 2018).

There are generally few programs for the prevention of bites in less-developed countries compared with developed countries such as the United States, the United Kingdom, Netherlands, China, and Canada, (Meints and De Keuster, 2009; Morrongiello et al., 2013; Schwebel et al., 2011; Schwebel et al., 2014; Shen et al., 2016; Szecsi et al., 2010).

Information from studies on bite characterization and the associated risk factors done in Chile has been insufficient to implement an integrated management plan with a multidisciplinary approach. The strategies for the prevention of bite incidents

are varied around the world; in those countries where rabies continues to be endemic, the strategies for bite prevention are part of the strategies to control rabies. In those countries in which canine rabies has been eliminated, bites are considered to be a public health problem by themselves. Prevention has been structured mainly by initiatives of diffusion and education of the population by private institutions, nonprofit organizations, and academic and union organizations related to these topics. This is seen especially in developed countries, where there are educational programs such as “Be a Tree” (Canada), “Blue Dog” (Belgium), “Dog Bites Program—American Veterinary Medical Association” (USA), among others.

The present study is relevant for an analysis of bite incidents caused by animals because it offers useful and necessary epidemiological information, characterizing the dogs involved in bite incidents, the victim, the injury caused, and the seasonality.

Materials and methods

We conducted a descriptive study based on the analysis of 5195 public health forms informing about bite accidents in 11 pediatric and adult emergency services of six regions in Chile (Arica-Parinacota, Coquimbo, Valparaíso, Metropolitan, Biobío, and Aysén). The Chilean Ministry of Health provided support and easy access to care center and registration units. The availability and spatial distribution of health services and bite incidence and its geographical, regional, and seasonal frequencies were used as variables. A pediatric and an adult emergency service were considered for each of the five existing health service areas in the Metropolitan Region (North, South, East, West, and Central Health Services). Data were collected from records of treatments of bite incidents reported in public health service between January and December 2009. The information was obtained from the Emergency Care Data recorded in the emergency services selected for the study. The questions in the questionnaires were asked of the victims at the time of their first care after the canine bite and focused almost entirely on the victim's personal information (age group, sex, anatomical location of the lesion, among others). Records containing information about the context, bite, and dog involved were provided by the patient and thus differed in content and quality. Collection of information from the health records of the emergency services was done by

Table 2
Percentage distribution of bites according to aggressor animal, total regions, 2009

Animal bite information	Number of bites (n)	Percentage (%)
Known	1812	63.69% ^a
Unknown	1033	36.31% ^b
Total	2845	100.00%

The letters a and b show statistics differences ($P \leq 0.05$).

Table 3
Percentage distribution of bites according to species, 2009

Biting animal species	Number of bites	Percentage
Dog	4583	91.6% ^a
Cat	281	5.62% ^b
Rodent	71	1.42% ^c
Other	66	1.32% ^c
Bat	2	0.04% ^d
Total	5003	

The letters a, b, c and d show statistics differences ($P \leq 0.05$).

Table 4

Percentage distribution of dog bites by gender of the person bitten, total regions, year 2009

Victim's gender	Number of bites	Frequency (%)
Female	2249	43.34% ^b
Male	2940	56.66% ^a
Total	5189	100%

The letters a and b show statistics differences ($P \leq 0.05$).

thesis students of the Veterinary Medicine Faculty of the Universidad Mayor. The data analysis was the subject of their thesis, which was supervised by professionals from the Public Health, Ethology, and Animal Welfare units from Universidad Mayor and the Chilean Ministry of Health.

Statistical analysis

The information was tabulated by region and service. Microsoft 2007 Excel was used to organize the data into bite frequency distributions and associated variables and analyze them, along with StatCalc Epi Info 6.0 (CDC Atlanta, USA). We used chi-square tests for comparisons, with a confidence level of 95%. Proportions (p) were estimated by maximum likelihood.

Results

We analyzed 5195 bite incident records obtained from the emergency services, which represent 14.84% (5195/34,989) of the total number of complaints filed for this incident during 2009 in Chile (Departamento de Información y Estadística de Salud, Ministerio de Salud de Chile, 2017). The study included 4583 bites by dogs, corresponding to 91.6% of the total incidents recorded. Of these 5195, 38.1% (1979 records) contained all answers to questions in the form.

Characteristics of dogs involved in bite incidents

Of the 2845 identified dogs that bit, 63.7% (1812/2845) were known by their victims. Only 36.3% (1033/2845) of victims did not know the dog that bit them ($P \leq 0.05$) (Table 1). Dogs represented 91.6% (4583/5003) of the bites in this study (Table 2). Cats were the second most common species for bites (5.62%) (281/5003) (Table 3).

Characteristics of the victims

A higher percentage of animal bite victims were men (56.6%) (2940/5189); women showed a significantly lower value ($P \leq 0.05$) (43.3%) (2249/5189) (Table 4). Interestingly, rodents bit women more often than men, with 60% (42/70) ($P \leq 0.05$) of rodent bites having women as victim (Table 5).

The highest percentage of total recorded animal bites ($P \leq 0.05$) was in the age range of 5 to 9 years (12.5 bites/10,000 inhabitants), followed by the range of 0 to 4 years (11.9 bites/10,000 inhabitants). Children between 10 and 14 years (9.9 bites/10,000 inhabitants)

Table 6

Classification of bites according to age range

Age (years)	Rate 10,000 (inhabitants)
0–4	11.9
5–9	12.5
10–14	9.9
15–44	4.6
45–64	4.6
>65	8.8

were in the third place. Of the total number of people attacked by all animals, the lowest percentages were concentrated in the age groups between 15–44 and 45–64 years (Table 6).

86.6% (2587/2988) of animal bites were part of a single-bite incident (Table 7) affecting different body sectors of the victims, distributed as follows: 33% (1717/5189) in the lower extremities, 32% (1640/5189) in the upper ones, not significantly different: $P > 0.05$. The head and neck with 14.9% (775/5189) of the bites formed a second category, followed by the thorax, abdomen, buttocks, and genitals, with lower frequencies (Table 8).

Location of bite according to gender

The highest frequency in men was found in the lower extremities (43.4%) (1000/2449), followed (with significant differences) by the upper extremities (38.4%) (887/2449) and the head and neck (18.7%) (433/2449). In women, the tendency was similar, but the frequencies of bites to lower versus upper extremities did not differ significantly ($P > 0.05$) (Table 9).

Discussion

The study was based on the review of records for dog bite admissions available in health care facilities in the regions under study. We selected six regions, which together may be representative of the main characteristics of the situation in Chile (Figure). Aysén and Coquimbo have a large number of livestock and a mainly rural population. The desert of the Arica-Parinacota region concentrates a high density of people in towns and mixes the different customs and habits of interaction of the different cultures from the bordering countries (Bolivia, Peru, and Argentina). The Valparaíso, Metropolitan, and Bío Bío regions are large densely populated cities. Finally, Valparaíso is a hotspot, a city with mainly urban characteristics and one of the highest densities of dogs in the streets of Chile.

38.1% (1979/5195) of the total files contained all the information requested in the admission form (Table 1).

There is a standard form of the Chilean Public Health service used in health establishments to collect information on the victims of bite incidents and the biting animals (Table 10). The information noted in the forms is frequently not complete; the percentage of records with complete answers varied in between regions from 2.3% in the Coquimbo Region (4/176) to 100% in the Bío Bío region (198/198) (Table 1). This dispersion of information in the records did not prevent an analysis of accidents and their characterization, estimating that the information constitutes a

Table 5

Percentage distribution of bites by species and gender of person bitten, total regions, 2009

Victim's gender	Dog (n)	Dog (%)	Cat(n)	Cat (%)	Bat (n)	Bat (%)	Rodent (n)	Rodent (%)	Other (n)	Other (%)	Total (n)	Total (%)
Female	1929	42.13% ^b	152	54.09% ^a	0	0.00% ^a	42	60.00% ^a	36	54.55% ^a	2159	43.20%
Male	2650	57.87% ^a	129	45.91% ^a	2	100% ^a	28	40.00% ^b	30	45.45% ^a	2839	56.80%
Total	4579	100%	281	100%	2	100%	70	100%	66	100%	4998	100%

The letters a and b show statistics differences ($P \leq 0.05$).

Table 7
Percentage distribution of bites according to type of bite, total regions, year 2009

Bite type	Frequency (n)	Frequency (%)
Single	2587	86.58% ^a
Multiple	401	13.42% ^b
Total	2988	100%

The letters a and b show statistics differences ($P \leq 0.05$).

Table 8
Percentage distribution of bites, according to anatomical location, year 2009

Bite's anatomical location	Frequency (n)	Frequency (%)
Low extremity	1717	33.05% ^a
Superior extremity	1640	31.57% ^a
Thorax	84	1.62% ^c
Abdomen	31	0.60% ^d
Buttocks	78	1.50% ^c
Genitals	17	0.33% ^d
Head and neck	775	14.92% ^b

The letters a, b, c and d show statistics differences ($P \leq 0.05$).

sample of their occurrence in the country. However, the diversity and deficiency of files is a relevant precedent to be considered by the health authorities to make changes in the existing form, its standardization, and the training of personnel. This pattern also occurs in other countries. [Bernardo et al. \(2002\)](#) indicated that several studies ([Bernardo et al., 1998, 2000](#)) found that an important part of the information was not recorded in the bite record forms used in the health centers they analyzed in the United States. The low completion rate of the questionnaires could be due to the large number of patients who come to the emergency services and the short time that the staff has to be able to complete the form. There are a significant number of diseases of mandatory reporting that the people in charge of filling these forms must also perform, making the process even more difficult because of time constraints and priorities. For this reason, we suggest that due to its high importance in public health, exclusive places for reporting this type of accident should be created. The improvement in the collection of information in the questionnaires would be very useful to improve the systems of prevention and argumentation for decision-making of the government related to this type of problem. Both the problem of completion of questionnaires and the importance of this process in the control and improvement of this topic are coincident with other previous studies ([Bernardo et al., 2000, 2002](#)).

From files with information, 91.6% (4583/5003) of bite incidents were produced by dogs; cats followed with 5.6% (281/5003) of incidents. This pattern was repeated in all the studied regions and coincides with international findings, such as the studies by [Babazadeh et al. \(2016\)](#), [Dehghani et al. \(2016\)](#), and [Esmaeilzadeh et al. \(2017\)](#). This prevalence occurs because the dog is the most

frequent companion animal, there is deficient care such as low level of supervision, and there are also a high presence of dogs in public spaces. These factors are coincident with various studies carried out in different parts of the world ([Kassiri et al., 2014](#); [Maksymowicz et al., 2016](#); [Sabouri Ghannad et al., 2012](#)). It is clear that it is of paramount importance to establish control measures for this animal population, as not only do they drive the rate of bite incidents but also they are a vector for the propagation of disease ([Acosta-Jamett et al., 2010](#)). Chile, however, has failed to succeed in regard to this and needs to develop canine control policies that facilitate the adoption of control measures that are manageable and agreeable both to humans and to animals so that these measures are not met with resistance by the part of population that lives with these dogs ([Acosta-Jamett et al., 2010](#)).

A greater proportion of men were bitten by dogs (57.87%) (2650/4579), which concurs studies conducted in the United States ([Reisner et al., 2011](#); [Quirk, 2012](#)), in Iran ([Sabouri Ghannad et al., 2012](#)), and in Ireland ([Ó Súilleabháin, 2015](#)).

We found the highest percentage of affected in the 5- to 9-year age range (12.5 bites/10,000 inhabitants). Published studies have used a variety of age ranges, which makes it difficult to compare with our results. Still, and taking the aforementioned caveat into consideration, it can be argued that the 5- to 9-year age range shows the highest percentage of bites in a number of studies, [Reisner et al. \(2011\)](#), indicated in a study conducted in the city of Philadelphia that the highest percentage of children treated in emergency services was younger than 7 years. [Quirk \(2012\)](#) indicated that the United States also shows an age range less than 15 years as the most affected, decreasing gradually as age increases. [Sabouri Ghannad et al. \(2012\)](#) described that the most affected range in Iran was between 10 and 19 years. This limited coincidence with similar studies may be attributable to the differences in age stratification.

The forms included the information on whether the person bitten knew the animal that bit them in 54.7% (2845/5195) of the total records. Of this number, 63.7% (1812/2845) featured an animal known to the victim. However, the information provided on the forms did not allow us to estimate the condition of the animals (street dog, "community" dog, or vagabond). In those events, the person bitten remains under observation for a period of 10 days to rule out rabies, in accordance with the national rabies surveillance law. This is important because although Chile is free of the canine variant of rabies, it is essential to continue this surveillance process to control the wild variant, which is still present in insectivorous bats. The percentage of the victims who knew the dog that had bitten them agrees with a study conducted in China by [Chen et al. \(2016\)](#), who reported that a majority of cases of bites occurred in the residence of the dog, that is, by a dog known by or close to the victim.

Given that Chile is free of canine rabies, the probability of human rabies transmitted by dogs is low. The Chilean law on rabies

Table 9
Percentage distribution of bites by gender of the person bitten, according to anatomical location of the bite, year 2009

Anatomical location	Female (n)	Female (%)	Male (n)	Male (%)
Superior extremity	751	42% ^a	887	38.4% ^b
Low extremity	715	42% ^a	1000	43.4% ^a
Thorax	23	1.3% ^d	61	2.6% ^d
Abdomen	14	0.8% ^d	17	0.7% ^f
Buttocks	41	2.3% ^c	37	1.6% ^e
Genitals	3	0.2% ^e	14	0.6% ^f
Head and neck	341	19.1% ^b	433	18.7% ^c
Total	1888	43.34% ^b	2449	56.66% ^a

The letters a-f show statistics differences ($P \leq 0.05$).

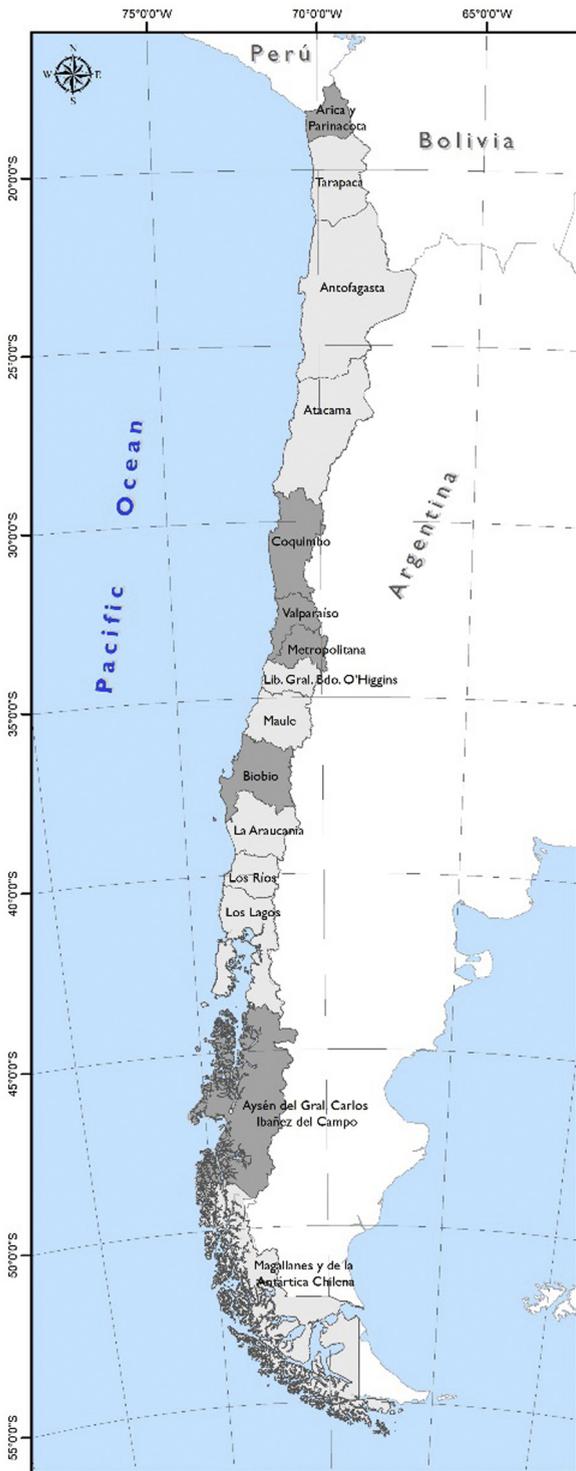


Figure. Map of the regions of Chile included in the study.

Table 10

Dog bites by victim's age, victim's gender, biting species, bite type, and anatomical location of bite

Victims information		
Victim's age (years).	Rate 10,000 (inhabitants)	
0–4	11.9	
5–9	12.5	
10–14	9.9	
15–44	4.6	
45–64	4.6	
>65	8.8	
Victim's gender	Number of bites	Frequency (%)
Female	2249	43.34% ^b
Male	2940	56.66% ^a
Total	5189	100%
Bite information		
Biting species	Number of bites	Percentage
Dog	4583	91.6% ^a
Cat	281	5.62% ^b
Rodent	71	1.42% ^c
Other	66	1.32% ^c
Bat	2	0.04% ^d
Total	5003	
	Frequency (n)	Frequency (%)
Bite type		
Single	2587	86.58% ^a
Multiple	401	13.42% ^b
Total	2988	100%
Anatomical location of bite		
Low extremity	1717	33.05% ^a
Superior extremity	1640	31.57% ^a
Thorax	84	1.62% ^c
Abdomen	31	0.60% ^d
Buttocks	78	1.50% ^c
Genitals	17	0.33% ^d
Head and neck	775	14.92% ^b

The letters a, b, c and d show statistics differences ($P \leq 0.05$).

Goldman (2012) who reported that a majority of bites affect little children. The most frequent location of bites is the lower extremities (33%) (1717/5189), which is consistent with the studies by Sabouri Ghannad et al. (2012), Maksymowicz et al. (2016), and Sarcey et al. (2017). These results may be associated with the small stature of children of these ages, which leaves the head near the muzzle of the dog, which could increase the risk of suffering an incident with injuries in this area (De Keuster et al., 2006). Another factor that may be influencing these results is the highly curious and invasive behavior of children, which may predispose them to suffering head injuries (Filiatre et al., 1990). All these are reinforced by what was proposed by Daniels et al. (2009) who indicated that children younger than 10 years are 7 to 20 times more likely to suffer a lesion in this location. It is interesting that 86.58% (2587/2988) of accidents bites recorded were single or unique versus 13.42% (401/2988) multiple bites.

Bite accidents have a seasonal pattern; they were more frequent during spring and summer in practically all regions of Chile. This is especially evident in the southern regions, where seasonal differences are marked, which coincides with other studies conducted in this area (Qi et al., 2018; Sabhaney and Goldman, 2012; Villagra et al., 2017). These results could be related to the behavior that people adopt with season. When the temperature increases in the spring and summer, people tend to visit more parks, public roads, and other outdoor places than in winter, which increases the probability of suffering a bite, especially in a country where there is a large population of dogs without containment in the streets. In addition, people who

prevention requires all bite cases treated in public and private health centers to be reported and treatment of the person if the dog is unknown or cannot be found. Our results indicate that around two-thirds of victims would require postexposure antirabies treatment (34.8%) (1812/5195).

This study found that head and neck bites are more common in the age stratum from 0 to 4 years, which coincides with international information by Reisner et al. (2011) who described most incidents affecting children younger than 7 years and Sabhaney and

circulate in public places in summer wear light clothes, increasing the risk injuries that cause more damage, and therefore, there are more records in the emergency medical institutions, which is reflected in the present study (Qi et al., 2018; Villagra et al., 2017).

Study limitations

This study is a retrospective study, based on public health records. We could not analyze place of occurrence (urban vs. rural), context of the bite, time elapsed between bite and reporting, or the breed of the biting animal (Mora et al., 2018) because of the absence of this information in the reporting forms. These are relevant topics for studies on dog bites (Schurer et al., 2015). Cases with a fatal outcome are not discussed here because such information is stored in a different database. It is pertinent to add that some of the shortcomings that we mention stems from the need to have brief questionnaires for the use of emergency ward staff.

Regarding the overall population in each region we studied, we must comment that, while we have been able to access the number of inhabitants of each of the regions in question in 2009, we cannot exactly filter the total number of people who attended any emergency service during the study period. Although we know how many people lived in each of the regions in 2009, we did not have access to the information on how many were treated in each emergency service. Likewise, the data to which we had access did not specify if the bites were the product of one or more animals, an item that would be convenient to analyze in a future study.

We recommend improvement of bite accident reporting methods to include the aforementioned data currently omitted.

Conclusions

We analyzed 5195 bite incident files during this period, of which 38.1% had sufficient background to enable the characterization of the event. The dog was the predominant animal causing these incidents, and in 63.7% of cases, it was known by its victim. Men were involved in 56.7% of cases; the most affected group was aged between 5 and 9 years, followed by those aged 0 to 4 years. Wounds were generally singular (86.6%) and affected extremities. Wounds affected the head and neck of children aged between 0 and 4 years. Bites occurred predominantly during spring and summer.

In public health services where bite victims were treated, forms which collect the necessary information are not properly completed with victim information, characteristics of the incident, and the dog that bit. This pattern made it impossible to establish the exact quality of the information, which would allow an adequate epidemiological surveillance and implement measures based on actual problems.

It is necessary to implement an integrated management program for bite prevention, reinforcing responsible pet ownership, improving supervision conditions, as well as promoting habits and behavior aimed at preventing the occurrence of bite accidents.

In conclusion, we suggest a continued study into the diverse factors that contribute to the occurrence of this kind of accident, such as the lack of responsible pet ownership, with the aim of improving the current system to prevent canine bite accidents in Chile.

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