

Lesions caused by animals in the Autonomous Province of South Tyrol in 2010: Fact-finding for prevention

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Summary

Lesions caused by animals, in particular by dogs, are a health issue to which public opinion often reacts sensitively. To effectively manage and prevent these events, it is therefore essential to evaluate the public health impact of this phenomenon and to identify the main connected risk factors. The aim of the present survey in the Autonomous Province of Bolzano was to collect various epidemiological variables helpful in understanding the problem at local level. The incidence and impact on Health Services of human lesions by several animal species for the year 2010 is presented, as well as a more detailed analysis of dog bites, giving a profile of the victims and of the animals involved. Different factors (geographical, contextual, seasonal and relational) that can be associated with episodes where dogs react aggressively to humans are illustrated. On the basis of the collected data, recommendations are given to prevent risk situations.

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Introduction

Incidents due to lesions caused by animals, above all those due to dog bites, represent an important public health problem, with costs both in human and health care terms because of the consequences associated with post-traumatic stress and trauma of different levels of severity in the various countries of the world. Understanding of the phenomenon, and of the factors connected to these episodes, is the first step to prevent and limit these events.

Since 2009, in north east Italy and the countries bordering it, rabies has re-emerged with a significant economic impact on account of the measures that have to be taken to prevent the infection from spreading. The study of morbidity deriving from lesions caused by animals, in particular dogs, and the analysis of the site distribution of the events, can contribute to the assessment of the risks connected with lesions caused by animals and to the planning of targeted interventions for prevention.

Given the absence of investigations into the phenomenon of animal lesions caused by animals in the Province of Bolzano, in 2010 a study was undertaken for the whole territory of the Autonomous Province of Bolzano (APB).

Materials and Methods

Type of investigation

An observational (cross-sectional) retrospective study of the data for medical- veterinary surveillance was carried out in the APB in 2010 in an area including the four Health Districts of the Alto Adige Public Health Service, corresponding to the territory of the APB.

Data collection

As a source of data, the standardised report questionnaires compiled by the hospital emergency departments (HEDs) and the doctors of the province were used. These contain data for age, the sex of the persons injured, the site and context of the event and the type of animal involved.

In addition, other standardised questionnaires were collected and analysed concerning the assessment of the dogs responsible for the bites by the veterinary officers of the Veterinary Service of the Public Health Service.

To assess the context, the veterinary officers used a standardised method for quantifying the

Table I. Relative frequency of attacking dog/owner type according to assessment of veterinary officer.

Type	Number of assessments	% of cases
1. Balanced dog. Managed correctly: the reaction of the dog is understandable and can be justified by the context	127	55.0
2. Balanced dog: Management could be better, the owner needs to improve his/her skills	20	8.7
3. Balanced dog, however the owner is not able to manage the dog correctly	1	0.4
4. The owner is able to manage the dog, but the animal is scared/anxious/reactive	31	13.4
5. The owner needs to improve his/her skills and the dog is scared/anxious/reactive	40	17.3
6. The owner has no control over the dog and the animal is scared/anxious/reactive	3	1.3
7. Aggressive dog, however the owner has good control	0	0.0
8. Aggressive dog, the owner needs to improve his/her skills and management	5	2.2
9. Aggressive dog. The owner has no control over the animal. Retraining class is suggested.	4	1.7
Total	231	100.0

Table II. Distribution of total number of lesions according to animal species.

Animal species	Number of lesions	% of lesions	Lower lim 95% C.I.	Upper lim 95% C.I.
Dogs	390	84.8	81.1	87.9
Cats	52	11.3	8.6	14.6
Other animals	18*	3.9	2.4	6.3
Total	460	100.0		

*Three snake bites and one bat bite among the lesions caused by other animals.

temperament and psychological balance of the dog, as well as the skill of its owner in managing it, with a pre-established points scheme that made it possible to place the cases in nine categories of possible dog-manager combinations (see also Table I).

The data for the resident human population was obtained from the last survey, ASTAT 2009 (2). Data for visits to the Public Health Service were kindly provided by the provincial epidemiological authority.

Definition of case

All the episodes reported by the HEDs and by the doctors of the province concerning visits by a person for lesions caused by animals, regardless of the nature of the lesion (traumas, bites, scratches, bruises, etc.), between the 1st of January 2010 and the 31st of December 2010 in the APB were considered to be cases.

Statistical analysis

A picture of the phenomenon of lesions caused by animals was given for the province by means of a descriptive analysis, and the data for the annual incidence of lesions caused by animals, including those for dogs, was obtained. The site-time distribution of the events was analysed and described to assess the areas and population at

Table III. Distribution of total number of lesions according to residence in South Tyrol.

Residence of injured person	Number of lesions	% of lesions
Resident in South Tyrol	397	86.3
Non-resident	63	13.7
Total	460	100.0

greatest risk. A profile was given of the typical characteristics of the victim, of the dog involved, and the context of the case.

The rates calculated are rough or specific rates of cumulative incidence, calculated as the number of new cases involving residents of the Alto Adige in 2010 out of the number of inhabitants at the beginning of the year under consideration (healthy population at risk). To measure the strength of association between dichotomous variables, the *odds ratio* was calculated with an exact relative confidence interval of 95%, while the Chi-square test was used to evaluate the significance of the association.

To make a comparison between the age distribution of the persons injured by dogs and those injured by cats, the non-parametric Wilcoxon-Mann-Whitney test was used to compare the medians of two independent samples. To establish the degree of agreement between victim and master about the real context of the bite, Cohen's K-test was conducted. To assess the trend for annual incidence, Cuzick's non-parametric test for trends on ordered groups (1985) was used. For some percentages, the relative confidence intervals (exact confidence intervals for binomial variables) was calculated, with the hypothesis that the cases observed are a representative sample of a more generic population. Finally, for some quantitative variables, a few indices of synthesis were given, such as average, median, minimum, maximum and standard deviation (SD).

Software used

EPI Info 3.5.1; Stata 9; Microsoft Word, Excel; ESRI ArcMap.

Results

Tables II to IV summarise the situation for the phenomenon of lesions caused by animals in the Province of Bolzano. Dog lesions predominate over those caused by other animal species, and mainly involve residents.

Visits for medical treatment

Almost half of the cases were treated by the Bolzano Health District (Figure 1). The highest number of dogs in the APB (n= 14,048, 41% of the dogs registered in the provincial dog register) is also registered in this district.

The frequency of visits for medical treatment for lesions caused by animals is described in Tables V and VI. There were 398 visits to the HEDs (81.5%), while in 62 cases (13.5 %) the patient went to the general practitioner surgeries of the province.

In the Merano Health District there was the highest proportion of visits to general practitioner surgeries compared to HEDs, followed by Brunico, while almost all the reports of lesions caused by animals in Bolzano and Bressanone come from their HEDs.

With regard to the importance of lesions caused by animals compared to other causes of accident, in

Table VII it can be seen that animal lesions account for a minimal number of visits to the Public Health Service hospitals in the Health Districts of Merano, Bressanone and Brunico compared to other causes of visit, with the exclusion of the Bolzano Health District, for which data are not available.

Periods of greatest impact

The peak of visits for medical treatment for lesions caused by animals was found to be in the summer months (Figure 1).

Prognosis and severity of lesion

The prognosis was reported in 252 cases out of 460 visits (54.8%), with an average duration of recovery of 7.9 days (SD 5.2646, Min 1 - Max 56, Median 7).

In only eight out of 460 cases (1.74%) was hospital admission necessary. Of these, 5 were due to lesions caused by dogs and three for viper bites.

Dogs were the animals most commonly involved in severe lesion cases; unfortunately, a detailed description of the lesion was only occasionally reported, making in-depth analysis impossible.

Table IV. Distribution of number of lesions to residents by animal species.

Animal species	Number of lesions	% of lesions	Incidence/100,000 residents ^(a)
Dogs	337	84.9	66.9
Cats	47	11.8	9.9
Other animals	13	3.3	2.6
Total	397	100.0	78

^(a) Incidence calculated on population resident in South Tyrol in 2010 = 503,399 inhabitants

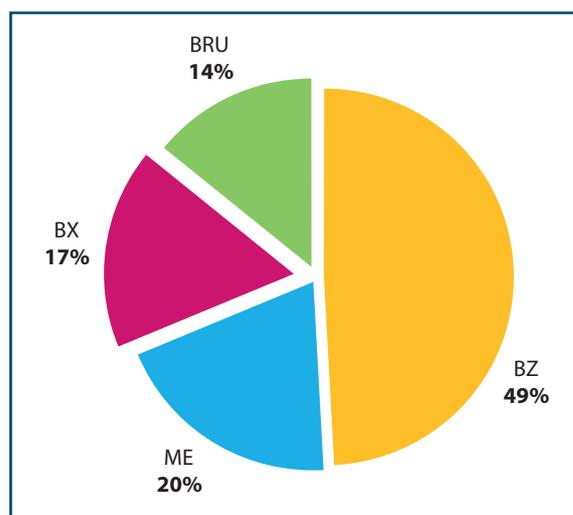


Figure 1. Distribution of animal lesion cases according to Health District.

Table V. Distribution by Health District and type of medical care visit.

Health District	Number of visits to Hospital Emergency Dept (HED)	Number of visits to General Practitioner	Total	% of visits	% visits to District HED on total number of visits to HED
Bolzano	211	15	226	49.1	53.0
Bressanone	71	8	79	17.2	17.8
Merano	65	25	90	19.6	16.3
Brunico	51	14	65	14.1	12.9
Total	398	62	460	100.0	100.0

Table VI. Distribution of visits to Hospital Emergency Departments by Health District.

Health District	Number of visits to HED	% of visits to HED ^(a)	Lower lim 95% C.I.	Upper lim 95% C.I.
Bolzano	211	93.4	89.3	96.2
Bressanone	71	89.9	81.0	95.5
Merano	65	72.2	61.8	81.1
Brunico	51	78.5	66.5	87.7
Totale	398	81.5		

^(a) This percentage is calculated on the total number of medical care visits of each health district.

Table VII. Distribution by reason for visit to Hospital Emergency Departments, Bolzano Health District excluded.

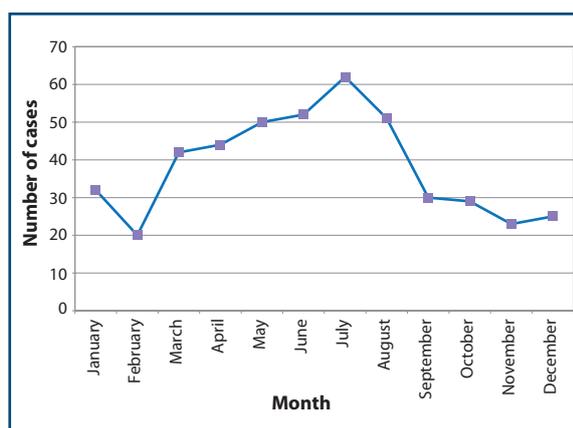
Reason for access	Number	%
Animal lesions	187	0.12%
Road accident	2,056	1.30%
Injury at workplace	6,936	4.50%
Domestic accident	11,691	7.50%
Violence by other person	551	0.40%
Self-harm, attempted suicide	45	0.00%
Sports accident	11,152	7.20%
Skiing accident	2,897	1.90%
Injury at school	1,347	0.90%
Other type of accident	12,886	8.30%
Other symptoms	106,156	68.20%
Total	155,717	100.00%

Characteristics of the injured person

As shown in Table VIII, there is not a great difference between the percentage of male and female persons injured. If, however, the species of the animal involved and the sex of the victim is considered, a significant relationship with the sex of the person injured is revealed (Table I). Taking the factor of sex into consideration, the odds of being injured by a dog for men was found to be 1.87 (exact 95% C.I. 1.08 - 3.32, $\chi^2 = 5.57$, $P = 0.018$). Women were shown to be twice as likely than men to be injured by a cat ($n = 35$ vs. $n = 17$, OR = 2.12, exact 95% C.I. 1.11 - 4.17, $\chi^2 = 6.01$, $P = 0.0142$); in most cases the victims were adult women.

The most serious cases of dog bites involved women. In five cases, all due to dog bites (1.4%), hospital admission was necessary. In 4 of these the person admitted to hospital was a woman. The age of all the women injured and admitted to hospital was above 60, while the man admitted was 26.

In 24 cases (6.2%), the person injured resided outside the province.

**Figure 2.** Seasonal pattern of animal lesions in South Tyrol (n=460).**Table VIII.** Distribution of lesions according to gender of victim.

Gender	Number of lesions	% of lesions	Lower lim 95% C.I.	Upper lim 95% C.I.
Male	224	48.7	44.1	53.4
Female	236	51.3	46.6	55.9
Total	460	100.0		

Table IX. Distribution of number of lesions according to gender of victim and animal species.

Gender	Dog	Other species	Total
Male	199	25	224
Female	191	45	236
Total	390	70	460

On average, the injured person was 39.7 years old, but there were cases of both very young children and very old people (SD 22.5350, Min 1-Max 88, Median 41, Mode 9).

Figure 3 shows that the age group most frequently injured by dogs was children from 5 to 9 years old, with a slightly greater prevalence of females.

Figure 4 shows the rate of incidence of dog lesions for 2010. The age group with the highest percentage of individuals injured by animals is that of ages 5 to 9 with an incidence rate of 129.6 cases per 100,000 inhabitants.

For cats, most cases concern age groups over 22. The age of persons injured by dogs is significantly different from that of persons injured by cats (the Wilcoxon-Mann-Whitney non-parametric test for comparison between medians, median = 41 vs 50.5, $P = 0.0015$). Further aggregation of the age groups gives the distribution of cases shown in Table IX. It can be seen that although the total number of lesions for minors is less than for adults, incidence in the former remains the highest.

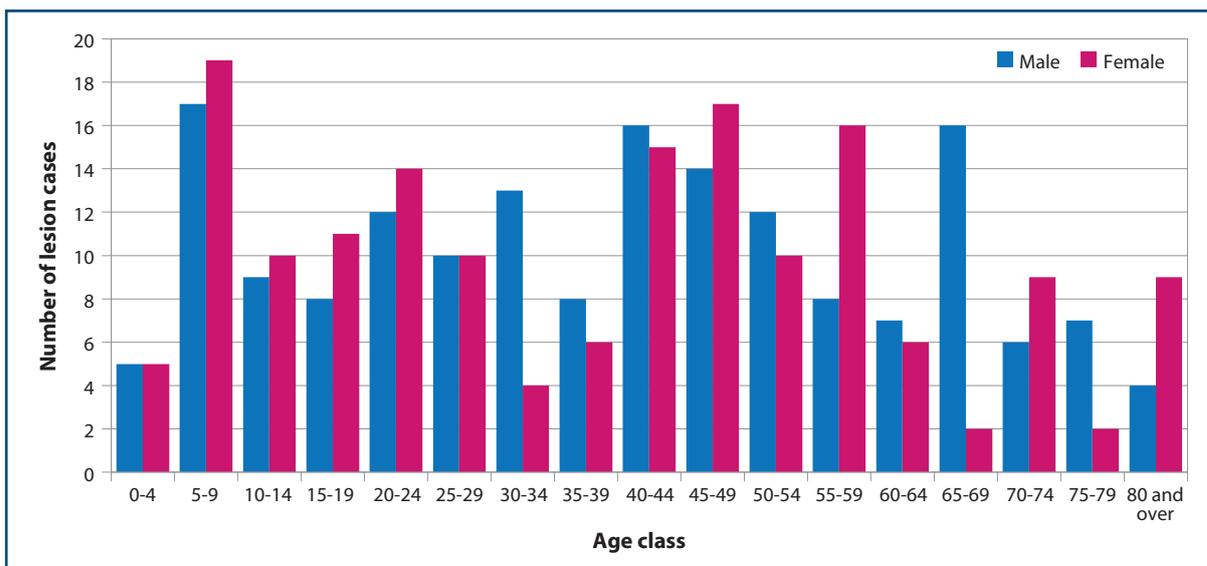


Figure 3. Absolute frequency of dog lesions according to age group and gender of injured person (n=390).

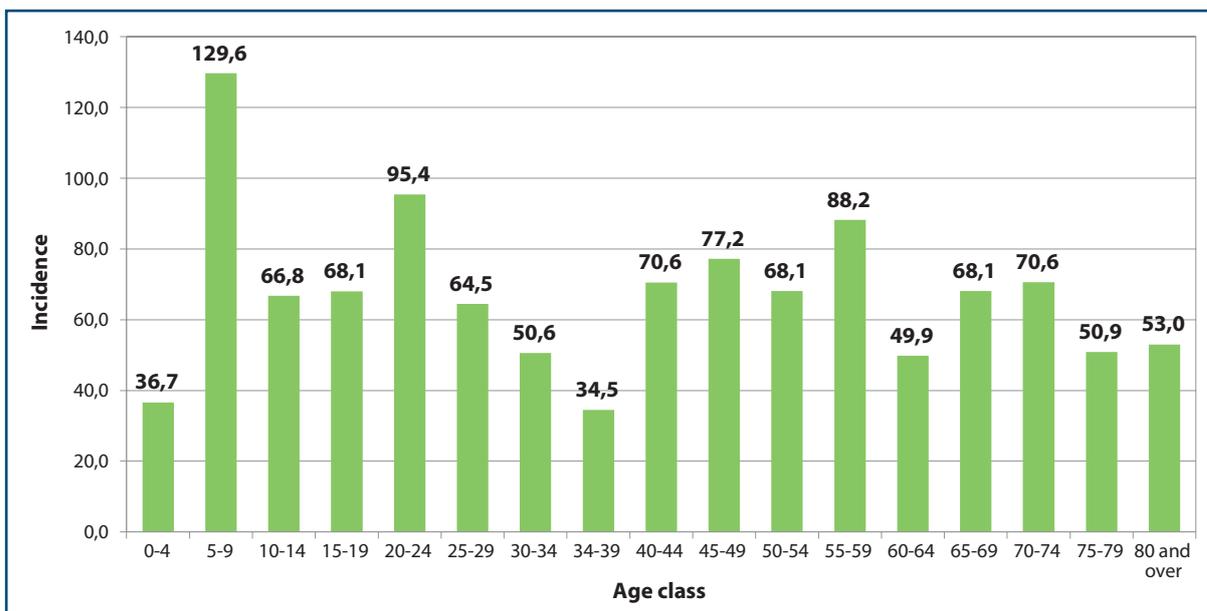


Figure 4. Age specific incidence of dog lesions (per 100,000 inhbt.). Resident cases (n=337).

Analyses of cases of dog lesions

In 2010, 390 cases of lesions caused by dogs were reported in the APB, with an incidence of 66.9 per 100,000 inhabitants. It was possible to establish the trend over time only for the Health District of Bolzano (Figure 5), in which a diminishing trend in annual incidence in the last 15 years can be observed (number of cases of lesions out of the mean population for the relative year). Cuzick's non-parametric test for trend on ordered groups (1985) shows a significant decline in annual incidence over time ($z = -3.49, P > |z| = 0.000$).

In three Health Districts (Bolzano, Bressanone and Brunico) the proportion of 'biting' dogs compared to

the number of dogs in the relative district is similar, while in the Health District of Merano it is almost half.

Geographical distribution

Figure 6 shows that the urban zones, in particular Bolzano and its environs, have the greatest frequency of cases. In only 18 (4.6%) cases did the dog's owner reside outside the province.

Relationship of the injured person to the dog

In Table X it can be seen that in 41.7% of dog bite cases the dog was known by the victim and was

owned by the person bitten or had regular contact with the injured person.

Characteristics of the dog

There were 32,236 dogs (Males = 17,462, Females = 14,774) in the register at the beginning of the study. In the cases in which the dog's sex was known (n = 292, 74.8%), significantly more male dogs than female dogs were involved: 215 males (73.6%; 95% C.I. 68.2%-78.6%), 77 females (26.4%; 95% C.I. 21.4%-31.8%). There was strong evidence of an association between the male sex of the dog and the greater possibility of a lesion to the person (OR 2.38, 95% C.I. 1.82-3.12, χ^2 MH 44.95, $P < 0.0001$).

Table X. Distribution of dog lesions by age group.

Age group	Number of dog lesions	Proportion %	Lesions in residents	Incidence per 100,000 inhs. (only residents)
Elderly (>65)	57	14.6	55	61.2
Adults	247	63.3	206	65.7
Minors (<18)	86	22.1	75	74.9
Total	390	100	337	66.9

In 5 cases (1.4%) admission to hospital was necessary after a dog bite. The breeds involved were: 1 Rottweiler, 1 Collie, 2 mongrels and 1 of unknown breed. In 4 of these 5 cases the sex of the dog was known and was male.

The average age of the dogs in the cases for which the age was reported (n = 256) was 4.9 years (SD 3.396; Min 0 - Max 19; Median 4).

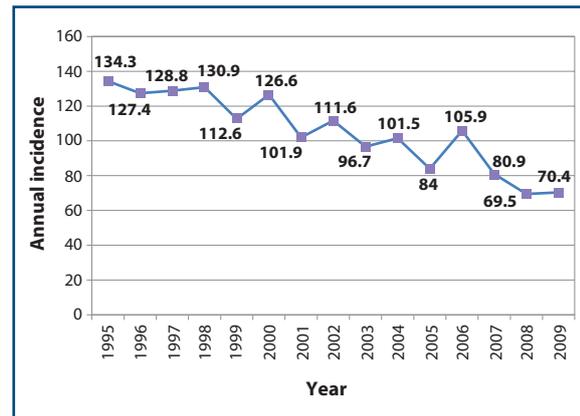


Figure 5. Annual incidence of dog lesions (per 100,000 inhs.) in the Health District of Bolzano (1995 – 2009).

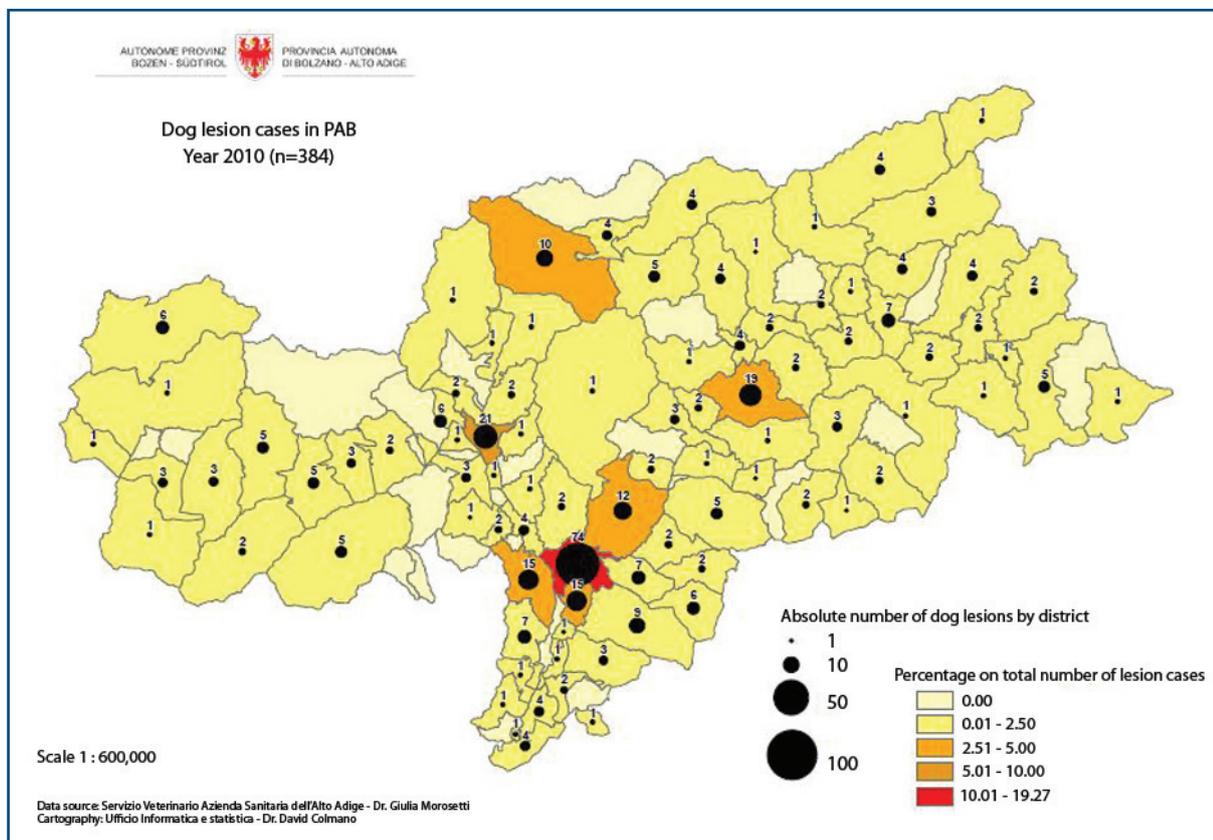


Figure 6. Geographic distribution of cases.

Type of breeds involved

In 328 cases the breed of the dog involved was reported. The dogs that bit were grouped according

to the categorisations of dog breeds established by the ENCI (Italian Kennel Club), with the addition of the group of mongrels (including unknown breeds) and that of pit bulls.

Table XI. Relationship between attacking dog and injured person.

Relationship with dog	Number of cases	%	Lower lim 95% C.I.	Upper lim 95% C.I.
Owner	24	9.9%	6.5%	14.4%
Regular contacts	77	31.8%	26.0%	38.1%
Unknown	141	58.3%	51.8%	64.5%
Total	242	100.0%		

Numerically the cases caused by mongrels (39.9%) and sheepdogs (27.7%) were more frequent (Figure 7). However, when the number of bite cases are compared with the number of dogs of the same breed recorded in the provincial dog register, the breeds with the highest rate of risk are found to be the dachshunds and once again the sheepdogs, followed by the pit bulls (Figure 8).

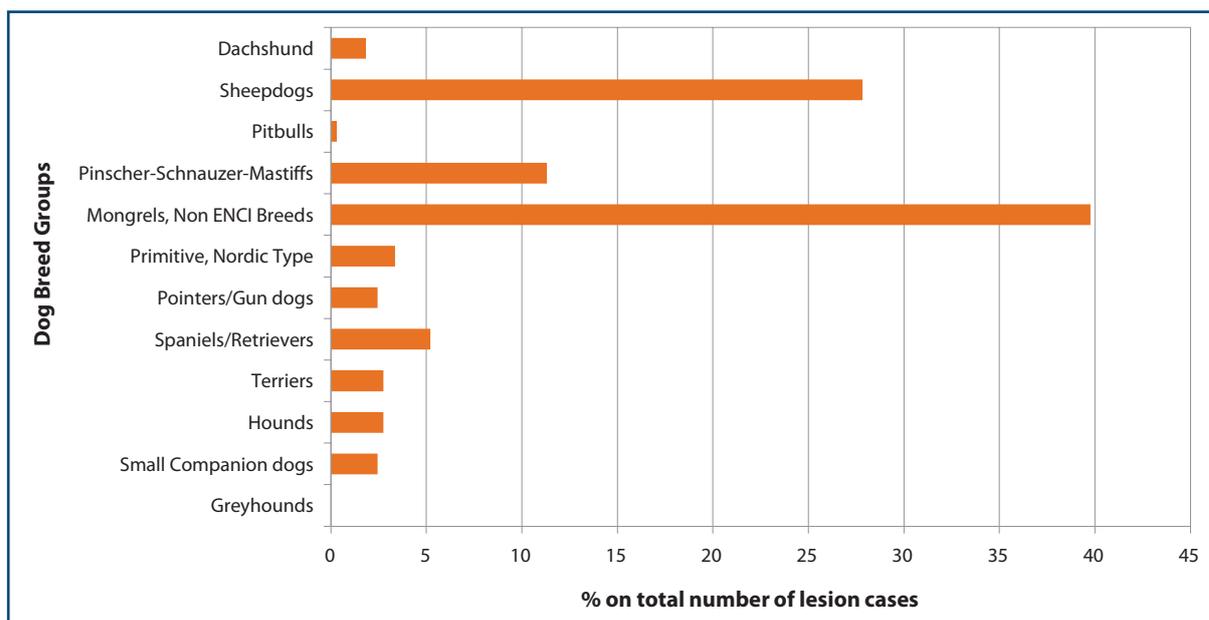


Figure 7. Relative frequency of lesion cases according to dog breed group.

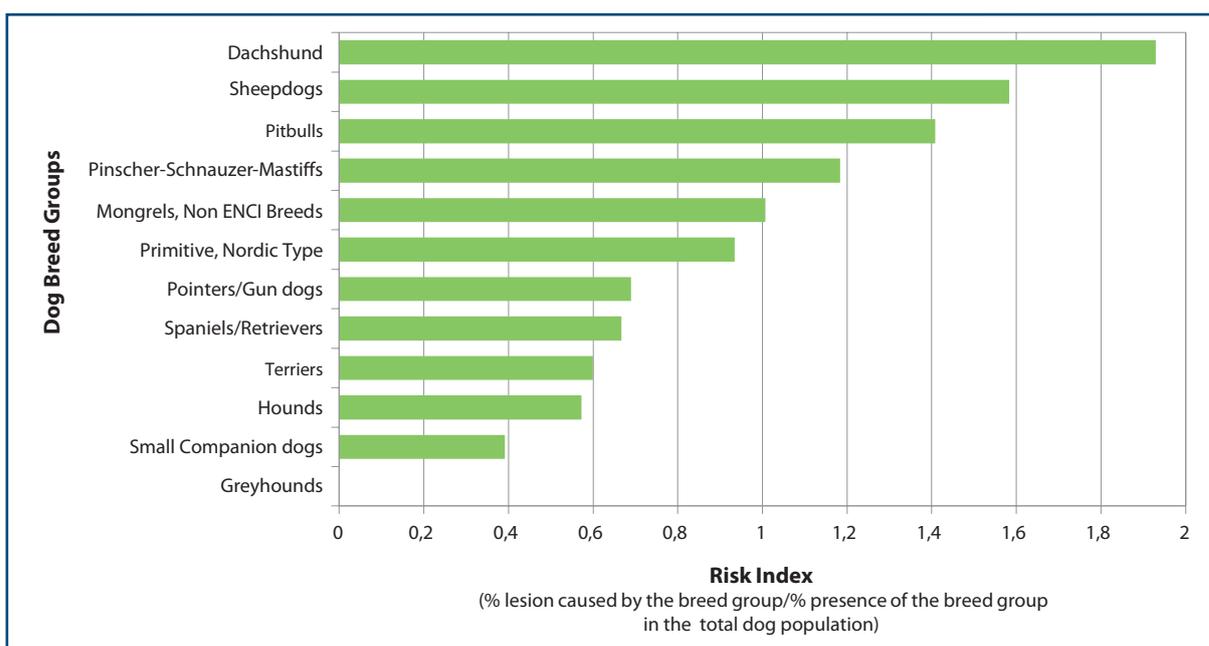


Figure 8. Lesion risk index of the different dog breed groups.

Context

The context was described in 320 out of 390 cases (82.1%). More than half of the cases in which a dog injured a person (54.6%) happened in public places or outside homes, in 39.6% of cases in the owner's home and in 5.8% in that of the person bitten (95% C.I. 49.2%-59.9%; 34.4%-45.0%; 3.7%-8.9% respectively).

In most of the episodes the dog bit for reasons of self-defence and there were frequent cases in which the dog slightly injured the person who was playing with it or attacked a person walking or running past the dog. There were also cases of people being injured when intervening to separate two dogs fighting each other or who in some way irritated the dog during grooming, medication or by touching it in painful or sensitive places.

Relationship between the dog and the injured person

Tables XI and XII show the contexts in which the lesion to the person occurred, taking into account the type of relationship between the victim and the dog. A **known** person was more frequently injured, and

Table XII. Context of attack when injured person was **well-known** to the dog.

Context	Frequency of cases	%	Lower lim 95% C.I.	Upper lim 95% C.I.
Food	9	9.0%	4.2%	16.4%
Other	4	4.0%	1.1%	9.9%
Defence	16	16.0%	9.4%	24.7%
Disturbance	19	19.0%	11.8%	28.1%
Play	29	29.0%	20.4%	38.9%
Dog fight	17	17.0%	10.2%	25.8%
Movement	6	6.0%	2.2%	12.6%
Total	100	100.0%		

Table XIII. Context of attack when injured person was **not known** to the dog.

Context	Frequency of cases	%	Lower lim 95% C.I.	Upper lim 95% C.I.
Food	4	2.9%	0.8%	7.2%
Other	8	5.8%	2.5%	11.0%
Defence	46	33.1%	25.4%	41.6%
Disturbance	25	18.0%	12.0%	25.4%
Play	14	10.1%	5.6%	16.3%
Dog fight	16	11.5%	6.7%	18.0%
Movement	26	18.7%	12.6%	26.2%
Total	139	100.0%		

generally slightly injured, while playing with the dog. In various cases the dog had reacted against being disturbed while being handled or had accidentally injured the person in charge of it while he/she was trying to separate it from another dog during a fight. An **unknown** person was more often injured in the context of the dog defending its territory, its owner, or the owner's home or possessions. Frequently cases were reported of an attack on persons walking or running past or in reaction to an attempt by a stranger to approach the dog.

Context of lesions to minors

With minors (<18) there is a greater probability of the bite being associated with the context of playing than there is with adults (OR = 3,2; χ^2 MH 9.5; P = 0.002; 95% C.I. 1.5-6.2).

With regard to lesions to minors (<18), in children under the age of 14 there is an *odds ratio* (OR) of a lesion occurring after an **interaction begun by the child** rather than the dog of 3.5 times higher than there is with older young people (P [Fischer exact] = 0.01; 95% C.I. 1.3-9.3).

Agreement between the declarations of the victims and the dog managers

In 212 episodes out of 320 the context was reported by both the person bitten and the dog manager. Generally speaking, quite good agreement can be observed on the basis of the interpretation of Landis and Koch (19) between the context described by the two persons involved (Landis and Koch: Agreement = 62.26%, Expected Agreement = 16.74%, Kappa = 0.5468; SD = 0.0301, Z = 18.19, P = 0.0000) (Figure 9).

If the various contexts reported are examined in detail, the greatest agreement between the two was in the cases of fighting between dogs

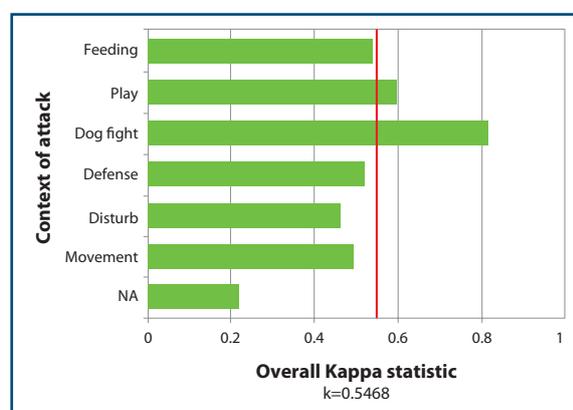


Figure 9. Agreement between injured person and dog owner on context of attack.

(Kappa = 0.816) and in the case in which the dog played (Kappa = 0.568) or was receiving food (Kappa = 0.603). Little agreement is found in other contexts, in which the injured person reported a certain type of interaction (for example, handling, stroking) with the dog, while the dog owner gave a different interpretation of what happened.

Veterinary aspects

Veterinary assessment of the dog responsible for biting

The dog remained unknown/unascertainable by the veterinary officer in 105 of the 390 cases (26.9%), (Figure 10).

For 231 cases, the veterinary officer's assessment was available with the distribution shown in Table XIII. 73 (31.6%) of the episodes could be attributed to poor management of the dog by its owner.

Anti-rabies vaccination

The dog's vaccination status was known in 64.1% of the lesion cases (n= 250). In 16 of these cases (6.4%) the dogs did not have a valid vaccination or had not been vaccinated.

Discussion

This survey refers to the whole of 2010 and is part of a series of activities started by the Veterinary Service of the APB to better understand the phenomenon of lesions from animals, in particular from dogs, at

a local level. The main aim was to prepare strategies for the prevention of damage to persons and to produce recommendations for better management of animals kept as companion pets in the context of the possible risk of transmission of rabies, whose presence among wild animals had re-emerged in the province since the end of 2009.

With regard to the completeness of the data collected, it is possible that cases of less severe lesions treated at home or by the general practitioner, less used to notifying the veterinary authorities according to fixed procedures, have escaped inclusion. There were also some cases involving non-resident persons or animals in which it was not possible to follow up the animal. It also seems plausible that minor cases involving one's own dog or one belonging to friends or relations do not get reported to the Health Service. Also according to Fedele *et al.* (14) not all cases of visits for medical treatment of dog lesions are reported and very slight lesions are treated at home; according to Kahn *et al.* (18) and Schalamon *et al.* (27), fewer than 50% of dog bites are reported.

On the other hand, a factor contributing to the completeness of the reports in this survey may have been the reappearance of wild animal rabies in the province since 2009 and the campaign launched between 2009-2010 to inform the population about the severity of the disease and the measures for vaccination and control. These may have induced persons with animal lesions to seek medical treatment, even in minor cases.

Impact on the Health Service agencies

Apart from a small number of serious cases, lesions caused by animals rarely make hospital admission necessary (27). In the APB the rate of hospitalisation was less than in other studies. Shelton (28) found a hospitalisation rate after a visit to the HED in Florida (USA) of 4.7%, while in this survey admission was only necessary for 1.74% of patients who visited the Health Service because of lesions caused by animals. Naturally the differences may also be due to the different possibilities for access to treatment in the two territories studied.

Moreover, if only the cases concerning dogs are considered, frequency of admission is even rarer (1.3%). Although biting is one of the normal forms of a dog's behaviour, lesions are not always caused by a bite. In most episodes, people visited the Health Service for scratches or bruises (1, 6, 10, 23, 26, 27, 31) and this was observed also in this study. In various cases the dog had simply played with the person in a rather unrestrained way without biting, causing haematomas or superficial grazes.

It was not possible to analyse the type or severity of the lesions/traumas because of the sporadic

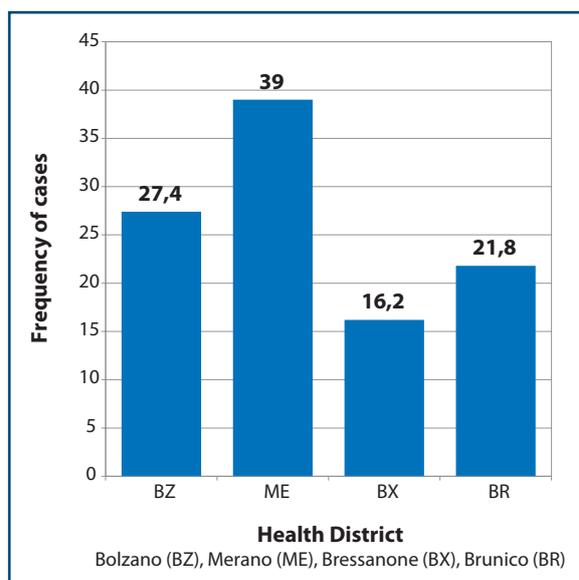


Figure 10. Proportion of cases where attacking dog remained unknown or untraceable in each health district.

compilation of the medical diagnoses on the report form. However, in the few serious cases that occurred for which documentation was complete, the patient needed long, complex treatment: in the 5 cases of dog attacks with severe consequences, average hospitalisation was 28 days.

The cost of medical treatment due to dog bites should not be underestimated. In addition to the danger associated with rabies, these traumas are frequently a source of infection (9). Furthermore, in a great number of cases, as well as treatment, the patient was given a prophylaxis against rabies and tetanus.

The indirect costs connected to these kinds of incident must also be considered. They concern time off work, or off school in the case of minors (on average eight days). The costs deriving from psychological trauma caused by reaction to the dog cannot be estimated.

Proportion of animal lesions in visits to hospital emergency departments

From the data collected, it emerges that between 0.15 and 0.3% of visits to the HEDs of Bolzano, Merano, Bressanone and Brunico were for lesions caused by animals. Similar data for visits to HEDs was noted by Ostanello *et al.* (22) in the city of Bologna (0.21%) and by Matter (20) for the pediatric hospital in Lucerne (0.36%).

The hospital of Bolzano receives the largest number of cases of lesions from animals, which in percentage terms make up 0.25% of the total number of visits to the HED.

As also observed in Piedmont by Fedele *et al.* (14), most cases were reported to the veterinary authorities of the HEDs and only a small proportion of the visits concerned general practitioners or the Public Health and Hygiene Services, although, as mentioned above, it is possible that not all the visits to the services of the province were reported.

In comparison with other causes of visits due to accidents to the Public Health Service, animal lesions are among the least frequent reasons when compared to other types of accident (e.g. sports accidents, domestic accidents). Unfortunately detailed information of this type is lacking for the District of Bolzano, to which almost half the reported cases belong.

Incidence of lesions

The population of the APB is 503,399 inhabitants (ASTAT 2010). At the beginning of 2010, in the APB 32,236 dogs were registered in the dog registry (2010 Annual Report of the Veterinary Service of the Public

Health Service, unpublished). This corresponds to a man/dog ratio of 15.6:1.

The incidence of lesions for 2010 was 78.9 per 100,000 inhabitants (urban and rural context combined), slightly higher than that found by Ostanello *et al.* (22) in the urban context of Bologna, which was 58.4 per 100,000 inhabitants, with a man/dog ratio of 19:1, but much lower than that observed by Matter (19) in Switzerland in 1996, in urban and rural areas, of 192.5 per 100,000 inhabitants, with a man/dog ratio of 16:1, similar to the APB. The incidence of lesions caused by cats in this survey was also much lower than that found in Switzerland by Matter (19) of 9.9 as opposed to 77.7 per 100,000 inhabitants.

Risk factors

There are limitations in the design of the study on account of the lack of checks to establish the association between bites and various factors. However, for some variables a more detailed analysis was possible and some results were found to be in line with the findings of other studies.

Age and sex of the injured person

With regard to the age of the person injured by a dog, the victims most frequently involved are children under the age of 10. This datum is confirmed in various studies (14, 19, 27). According to Ostanello *et al.* (22), the age group most affected, that is, children between the ages of 0 and 9, is also the one at greatest risk from bites to the face.

In the APB, in severe cases of lesions caused by dogs and in injuries caused by cats, those most frequently involved are elderly patients. Many authors agree on the fact that the victims who suffer severe injuries are most often children and women, above all elderly women (1, 6, 10, 23, 26, 30).

The average age of those injured by a dog is lower than that of those injured by a cat both in this study (39 vs. 49 years of age [ANOVA, $P=0.001$]) and in that of Ostanello *et al.* (22). These authors report that the age group with the highest incidence of dog lesions was ages 20-29, while for cat lesions it was 60-69. Shelton (28) noted that injuries caused by cats were considerably more frequent in adult women and minors under the age of 20.

It is possible that the source of data influences the datum for the relative age of the victim. In fact, it is likely that children are taken to the doctor in all cases while adults are more inclined to treat themselves at home in minor cases.

In this survey, keeping in mind the confounding effect of age, there seems to be an association between the sex of the person and the animal

responsible for biting: compared to the female sex, men appear at greater risk from lesions caused by dogs, while women are at greater risk from lesions caused by cats. This observation is in line with the findings of Ostanello *et al.* (22), who describe clear differences among the victims of lesions caused by animals: a greater number of male patients are injured by dogs, while injuries caused by cats more frequently concern women patients. Shelton (28), on the other hand, noted a generally higher frequency of lesions among women, with an incidence per 100,000 inhabitants of visits to the Public Health Service for bites of 103.6 for women compared to 85.5 for men.

These results could depend on the fact that in the APB, the cat is usually kept as a companion animal by adult women and elderly women. The control and management of dogs, on the other hand, is often delegated to male members of the family, especially in the case of dogs, which are more difficult to look after.

Seasonality

As found by other authors (14, 22, 28), the frequency of lesions peaks in summer when in the APB there is more tourism and more outdoor recreational activity, and during which dogs are probably taken out more frequently and for longer periods, with a greater chance of interacting with people and animals.

Geography

In the 7,400 km² territory of the APB, the greatest concentration of cases of lesion occurs in the large population centres (the communes of Bolzano, Appiano, Renon, Merano, Bressanone, Brunico and Vipiteno). The problem is therefore primarily one of public urban medical-veterinary health care.

The provincial capital Bolzano, a densely inhabited urban area with 104,029 inhabitants and 4,550 dogs, is the commune with the greatest frequency of lesions caused by dogs (19% of the total) and a man/dog ratio of 23:1. It is probable that in urban environments, where the probability of man-dog interactions is more frequent and the areas of cohabitation smaller, people may run a greater risk of being injured by animals than in a rural environment (22).

Typology of dog

In the APB the stray dog phenomenon is absent and we consider the data for the typology of the dog population registered in the present-day provincial electronic dog registry system to be sufficiently complete and representative of the local dog population.

There are indications that some breeds tend to be more dangerous on account of their genetic characteristics or because of the type of attack (11, 21, 29), in particular the sheepdog group (16): Alsatians, maremme sheepdogs and Belgian sheepdogs (7).

In the APB, mongrels are the most numerous type of dog, so it is not surprising that they are the dog group by far the most frequently involved in cases of lesions to persons. However, when the frequency of attacks by the various groups of dogs was compared with the size of that group in the dog register, other groups of breeds, not the mongrels, were found to be of greater importance. These certainly included some groups already considered aggressive by public opinion, such as sheep dogs and the pinscher-schnauzer-mastiff group, but also breeds not generally considered dangerous, such as dachshunds. When only the frequency and not the severity of the lesion are considered, in this survey the latter group occupies first place as an index of risk from biting.

With regard to dachshunds, it is not surprising that the high risk index of 1.8 found in this survey is similar to that found by Cattarossi & Martuzzi (7) who put the dachshund category, with a risk index of 1.47, in sixth place in their classification. In fact, as these authors note, until a few generations ago this breed, in common also with terriers, was used to hunt into their lair combative prey that the dog had to attack and possibly kill without human intervention. They are therefore dogs that, as Notari & Goodwin (21) observe, are of medium-high aggressiveness, high reactivity and so potentially more inclined to bite than other breeds.

In the APB, dachshunds are more popular and numerous than terriers. Perhaps for this reason, the terrier group, although including highly reactive breeds comparable to the dachshunds, were found to be less frequently involved in the cases of lesions reported.

These data support the correctness of the decision to abolish the regulations whose provisions included a list of so-called dangerous dogs. Although in some breeds selective breeding may have aimed to produce individual dogs with strong reactivity, sense of territory, possessiveness, tenacity of bite and a general tendency to react to stimuli with offensive-defensive attacks (20), the concept of the dangerousness of breeds will certainly continue to be the subject of extensive debate, as the variables to be taken into account are not only the genetic and behavioural characteristics of the dog but many other factors, including the individual characteristics of each dog-manager pair. As De Keuster *et al.* (12) also underlined, the tendency to bite depends not just on genetics, but also on various factors

connected to socialisation, education, physical and psychological health, the behaviour of the victim and, according to the authors of this survey, also that of the owner. Lesions from dogs must therefore always be considered in the human socio-cultural context in which they occur.

Sex and age of the dog

Other variables that must certainly be taken into consideration in assessing the risk of biting are the animal's sex and age. Beaver (3) emphasises that non-neutered male dogs are involved considerably more frequently in problems arising from aggressiveness, comprising more than half of all cases described. This is also confirmed by Gershman *et al.* (16). Moreover, the dogs involved are generally young adults (4, 5).

In this survey, male adult dogs of about four years of age are involved considerably more often in cases of lesions to persons than female dogs.

Hence the importance of paying particular attention to the socialisation and education of this category during the period of its development, in particular during puberty (6-18 months), especially in the case of large dogs and/or dogs with high levels of arousal. It is precisely during adolescence that male dogs may challenge the hierarchy within the family-pack, adopt forms of behaviour for the defence of territory, and indulge in playful activity with strong physical interaction and competition with other males (3).

Place

Another influential factor is the place in which the event occurs. Over half the events took place in public places. Various events occurred near or inside owners' homes, but not inside the victims' homes. It was noticed that dogs behave aggressively much more often in the homes of their own families, in their gardens or yards, or in the immediate neighbourhood (1, 6, 10, 23, 26, 27, 30). For De Keuster (12), a small number of cases (9%) occur in public parks; most of these incidents occur because the dog was not adequately controlled (51%) or wandered unattended near its own home (31%), whereas more than half of dog bites happened while it was accompanied on walks along streets and roads and 30% on the private property of the family where the dog lives.

This means various cases of lesion could be avoided by taking into account the territorial and defensive behaviour of the dog, making sure it cannot cross the boundaries of its owner's property, and preventing it entering areas people pass through or that give access to public places, or else by ensuring that the dog is adequately supervised in areas in which it is left off the lead.

Context

Interpretation of the context in which the dog's reaction occurred varies according to whether it is reported by the person who was the victim of the attack or the dog's manager. The dog's owner and the injured person often do not agree on how the event happened. The closest agreement is in cases of lesions due to the intervention of a person to separate two dogs fighting each other, where it is clear what happened. In many other cases that would seem to be the result of wrong or deficient interpretation of possible warning signals from the dog, descriptions often do not match: the injured person states that he/she wanted to stroke the dog while the dog's manager believes the person disturbed the dog. In particular, the signs of aggressiveness of a frightened dog may be less visible and not interpreted correctly by the owner. This is even more likely if the person is a stranger to the dog (3).

Moreover, the context of the event would seem to differ according to whether the person is familiar with or unknown to the dog. In the former case, there is a prevalence of cases of lesion during play or as a result of the dog's reaction to being handled (e.g. grooming of its coat), while in the latter case the most frequent cases of attack regard actions taken to defend its territory or attacks by an unattended dog on persons walking or running past.

As well as the differences connected with the dog's familiarity with the injured person, the question of the latter's age plays an important role. In various studies, and likewise in this survey, children are clearly found to be at greater risk than adults. Although for Gershman *et al.* (16) most bites seem to be inflicted on people who are strangers to the dog's family, for Schalamon *et al.* (27) most attacks by dogs on children are by dogs known to them (73%), but not living with them, caused by the child disturbing the dog. According to De Keuster (12), 86% of bites to children occur as a result of an interaction initiated by the children. Various authors have noted that children are bitten by a dog they know either during play or when the dog is disturbed (1, 6, 10, 23, 26, 27, 30).

Children and adolescents must therefore be taught to correctly interpret particular signs, postures and sounds of the animal, and to adopt safe forms of behaviour to avoid negative interactions. This should be done under the constant supervision of an adult, with the main objective of guaranteeing the wellbeing of both dog and child.

In Australia, programmes in schools teaching children how to behave safely with dogs have significantly increased the adoption of protective forms of behaviour by the children involved in

preventive activities compared to groups not targeted by such activities (30). The decision to bring a dog into the family must also be carefully considered and must not be made just to satisfy the incessant requests of the children. In any case, the potential benefits connected with the presence of a dog on the psycho-emotional development of the child must be set against its possible costs, including the risk of lesions. Schalamon *et al.* (27) suggest, for example, waiting until school age is reached before admitting a dog into the family.

Assessment of the dangerousness of dogs

In a territory where wild animal rabies is present, the observation of dogs is clearly of primary importance for keeping this pathology under surveillance. However, in future, veterinary assessment must increasingly take into account aspects that are not strictly clinical but are connected with the behavioural equilibrium of the dog and the way it is managed by the person in charge of it.

In 2010, for the first time an assessment form for use by veterinary officers was introduced in the APB. To create a data-collection tool that was simple to use in day-to-day activities, it was necessary to strike a compromise between the need to simplify the procedure as much as possible and at the same time to objectively collect information that was useful for assessing the animal responsible for biting. Although there are still many difficulties in making a satisfactory assessment of behavior and context, data seem to indicate that most lesions occur not so much because of the dog's behavioural problems but because of deficiencies in the training/management of the animal by its owner.

Conclusions

On the basis of the results obtained by this survey and in order to prevent, as far as possible, cases of lesions to people by animals, in particular dogs, the following recommendations are considered necessary:

Surveillance of the phenomenon is essential and the flow of information between doctor and veterinary officer must be improved and coordinated.

Particular attention must be given to making interactions between children and dogs safe. It seems essential for the latter to be taught by adults, themselves well-informed, to respect the space and needs of the dog and of companion animals in general.

Given how easy it is for some dog breeds, originally selected for utilitarian purposes, to succeed in becoming popular and widespread, it would seem

to be of primary importance to consult experts when choosing the breed and type of dog. This choice should be suited to the family context and to the puppy's style of life and socialisation.

Many lesions occur because of the owner's poor management of the dog or because the dog is kept in conditions that cause it frustration or even make it feel unwell. It is necessary to study ways of informing/educating that enable owners to manage their dogs correctly.

It would also seem important to inform the public about illegal practices and the risks of buying puppies from unscrupulous sellers. These animals can develop behavioural pathologies, often serious ones, deriving from adoption too early and from insufficient intra- and interspecific socialisation in their period of development.

It is necessary to underline the importance of promoting high quality dog breeding, with a suitable choice of breeding partners, not only from a physical-morphological point of view, but also from one of balance of character.

In addition, the need must be stressed for adequate training for health care workers and those working in the dog training sector, and for opportunities for the exchange of experiences acquired in this field, with an integrated multidisciplinary approach to guarantee the flow of information, suitable treatment with prophylactic human and animal vaccination in the case of lesions, and the adoption of techniques for the assessment of dog behaviour.

In organising the presence of staff for accident and HEDs and for veterinary controls on animals responsible for bites, the seasonal nature of the phenomenon, typically associated with summer, should be kept in mind.

In areas in which wild animal rabies is present, it is necessary to stress the importance of raising awareness among the population about going to the doctor and of ensuring the active availability of anti-rabies and anti-tetanus vaccinations.

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