



# A survey on the number of dog-induced injuries inflicted by pure-breed and mixed-breed dogs in Italy

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**Abstract:** In this survey we collected information on the number of biting events inflicted by dogs on other animals or people, recorded by local health authorities (LHAs) in Italy after an official complaint over a one-year period. The aim was to evaluate the possible differences between mixed and purebred dogs and between trained dogs and untrained dogs, and potentially highlight the most aggressive breeds. A questionnaire was developed and emailed at the beginning of 2019 to 87 LHAs located in north-central Italy asking them to report biting episodes due to dog attacks occurred in one year. The questionnaire included questions about the subject attacked and the breed of the aggressor dog with the reasons for the aggression. Only six questionnaires were received and processed. The results revealed 1169 cases of aggression in one year reported in the total of the six LHAs ( $194.8 \pm 115.33$  as average value), especially against humans (96.9%). Among these attacks, 52.6% were against strangers and 29.8% were against a family member (owner or another family member).

There were no differences in the number of attacks by pure-breed (53.6%) or mixed-breed dogs (46.6%). The German Shepherd, which is often used for protection and as a guard dog, was the breed with the highest number of biting cases reported (19.0%). However, this is essentially due to its prevalence in Italy, with over 12,000 dogs registered in the ENCI every year but also why this popular breed has been used by people as a guard dog. Of the 377 cases of registered bites, 343 (91.0%) of the dogs had not undergone any training, thus indicating that owner education programmes are fundamental tools to reduce risk factors and prevent aggression.

**Key Words:** dog; breed; aggression; training; questionnaire; genetics.

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## Introduction

The problem of undesirable behavior (Giulioti et al., 2020) but above all of aggressive behavior due to certain dog breeds is a common problem which has been extensively analyzed in Italy (Mariti et al., 2015; Morosetti et al., 2010; Notari et al., 2020) as well as the United States (Kogan et al., 2019), UK (Casey et al., 2013), and the Slovak Republic (Matos et al., 2015), France (Sarcey et al., 2017). It is one of the most frequent reasons for relinquishing the responsibility of dogs to shelters (Gazzano et al., 2015) and even leads to the euthanasia of the dog (Salman et al., 2008), thus creating welfare problems for particularly aggressive.

Dog bites injuries are a significant public health problem around the world (Ozcan and Ozturk, 2019; Ruefenacht, 2002) involving other animals (generally dogs or cats), humans (strangers or family members) and many are sustained by children (Chen et al., 2016; Jakeman et al., 2020). These injuries can be complex, both physically (Mitchell et al., 2003; McBean et al., 2007) and psychologically (Ji et al., 2010), and in rare cases, fatal (Ciampolini et al., 2017; Sarenbo & Svensson, 2021).

The definition of dangerous dogs has been discussed several times, in terms of whether the risk depends on a certain type of breed (Brice et al., 2018) or if it is linked to the way they are trained. The tendency to aggressiveness is not believed to depend on a specific breed, but it is an effect of environmental factors, the dog's size, training history, living conditions and genetic factors (Haupt et al., 2007), since aggressive behaviour has been suggested to be heritable (MacLean et al., 2019; Mikkola et al., 2021).

Mikkola et al. (2021) reported that the probability of aggressive behaviour increases with age, and thus, older dogs were more likely to be aggressive than young dogs. Some studies have also reported that different substance groups such as hormones, enzymes and neurotransmitters are involved in the modulation of aggressive behavior ((Nelson and Chiavegatto 2001; Proskura et al, 2013). In addition, the involvement of some genes has been highlighted in the aggressive behaviour/impulsivity in dogs, such as DRD4 (Dopamine D4 Receptor) gene intron II VNTR (Nara et al., 2005; Hejjas et al., 2009; Proskura et al., 2013; Wan et al., 2013) and tyrosine hydroxylase (TH) intron 4 repeat (Wan et al., 2013). A genome-wide association study (GWAS) highlighted candidate genes for behaviour traits that were previously linked to behaviour in humans (Friedrich et al., 2019).

In this survey we collected information over a one-year period on the number of biting events by dogs against other animals or people, recorded by the LHA following a complaint by a citizen. The aim was to evaluate the possible differences between mixed and purebred dogs and between trained dogs and untrained dogs and to potentially highlight the most aggressive breeds.

## Material and methods

A questionnaire was developed and emailed at the beginning of 2019 to 87 local health authorities (LHAs) located in north-central Italy asking them to report biting episodes due to dog attacks occurred in one year. The questionnaire consisted of 14 questions divided into three sections. It contained information on the LHA (region and number) and included questions on the total number of bitten subjects (humans or animals) in a year, with a description of the bitten person (owner, family member, stranger) or bitten animal (dog, cat or other) and the type of dog (pure breed dogs or mixed dogs). In the case of pure breed dogs, the breed involved was specified. Breed identifications of the dogs were stated by their owners and are reported in this study according to the ENCI classification (ENCI, 2022). The participants also had to specify whether the dogs involved had been trained, or not and the possible causes for the aggression. Descriptive statistics were obtained using Excel.

## Results and discussion

### *Information on the LHA*

Only six questionnaires were received and processed however the data received from the LHAs refer to different years due to the availability of data. In particular, five LHAs reported data relating to 2015 and one LHA reported data relating to 2018. Twelve LHSs replied but were unable to provide the data due to too long processing times, insufficient data, privacy issues, insufficient staff, or failure to obtain authorization requests. The other 70 did not respond.

### *Information on the victims*

The results revealed 1169 cases of aggression with bitings (Table 1) reported in one year in the six LHAs ( $194.8 \pm 115.33$  as average value), especially received by people (1133 cases equal to 96.9%). Among these attacks (Table 2), 52.6% of the biting events were received by strangers and 29.8% by family members (owner or another member of the family). Aggressive behaviour toward people is quite common in pet dogs although the reported cases differ depending on the study approaches and study populations (Mikkola et al. 2021). Duffy et al. (2008) highlighted that there are breeds with the highest number of aggressive behaviour directed toward both humans (for example Chihuahuas, Dachshunds and Jack Russell Terriers mostly attack both strangers

and owners) and dogs, while other breeds attack specific targets e.g. Australian Cattle Dogs attack strangers and American Cocker Spaniels and Beagles attack owners. Akitas and Pit Bull Terriers prefer to attack unfamiliar dogs (dog-on-dog attack).

On the other hand, the least aggressive dogs toward both humans and dogs were Golden Retrievers, Labrador Retrievers, Bernese Mountain Dogs, Brittany Spaniels, Greyhounds and Whippets (Duffy et al., 2008). The two retriever breeds showed the lowest probability of aggressive behaviour, also in other studies (Hsu et al., 2010; Mikkola et al., 2021).

**Table 1.** Number of victims (humans and animals).

LHS	Humans n°	Dogs n°	Cats n°	Total n° per LHS
1	147	11	0	158
2	99	4	1	104
3	265	13	0	278
4	390	0	0	390
5	102	0	1	103
6	130	6	0	136
Total	<b>1133</b>	34	2	1169

**Table 2.** Numbers of human victim (187 data not known).

LHS	Owner	Family member	Known by the dog	Strangers	Total (%)
1	29	16	28	74	147
2	-	36	-	63	99
3	31	46	33	117	227
4	24	-	77	141	242
5	22	42	22	15	101
6	16	20	6	88	130
Total	122	160	166	498	<b>946 (83.5%)</b>

### *Information on the dogs*

Out of a total of 972 cases (Table 3), in which the breed was known, 451 biting episodes (46.4%) were caused by mixed-breed dogs, thus there were no differences in the number of attacks due to pure-breeds (53.6%) or mixed-breed dogs. The percentage of mixed-breed biting dogs found in our survey is higher than the percentage reported by Mariti et al. (2015) in a report referring to dog bites occurring in Florence from September 2002 to August 2005.

**Table 3.** Biting dog data.

USL	Recognized dogs n° (% per LHA)	Pure Breeds	Mixed Breeds
1	140 (88.6%)	69	71
2	99 (95.2%)	58	41
3	254 (91.4%)	135	119
4	322 (82.6%)	191	131
5	80 (77.7%)	37	43
6	77 (56.6%)	31	46
Total	972 on 1169 (83.1%)	521 (53.6%)	451 (46.4%)

Concerning pure breeds (Table 4), the three most represented were: German Shepherd (19.0%), Maremma Sheepdog (7.0%) and Rottweiler (5.0%). In our opinion, the large percentage of German Shepherd dogs is due not only to the high prevalence of this dog breed in Italy and thus it is likely a location-dependent finding, as there are over 12,000 dogs registered with ENCI every year (Table 5). In addition, German Shepherds are a popular breed as guard dogs, and therefore strong selection has encouraged aggressive behavior towards strangers (Flint et al., 2017). German Shepherds, and other herding breeds, might be more likely to act aggressively due to differences in how they are raised and trained, as well as the types of people who choose to own this breed (Flint et al., 2017).

The percentage of biting dogs of the Abruzzese Maremma Shepherd breed is high, whose annual registration with ENCI is about 1000 dogs per year.

Mariti et al. (2015) reported the same main biting breeds as those found in our survey, but they also mentioned the American Pitt Bull Terrier.

In our survey, only 1 out of 521 cases of aggression reported was by the American Pitt Bull Terrier, which is notoriously considered to be the one of the most aggressive breeds (Brice et al., 2018). This confirms the finding by an Australian study conducted by Collier (2006) that this is not a uniquely dangerous breed, and that aggression does not depend on the breed but on how the individual dogs are raised. In Collier's research (2006), most of the bites reported in three years of data collection (1997-2000) were attributed to the German shepherd dog and Rottweiler, thus confirming the results highlighted in our survey. Notari et al (2020) analyzed questionnaires completed by veterinarians in northern Italy and found no significant association between the severity of bites and one or more specific breeds.

However, as reported by Mariti et al. (2015), the only way to estimate the proportion of biting dogs within each breed is to compare the data collected in an area with the true composition of the canine population in the same area. This is because the same breed can be considered the most aggressive or the least aggressive in different contexts: for example, the Maremma Sheepdog is on the current list and in the paper by Mariti et al. (2015) but not in other studies, as this breed is not common outside of Italy.

**Table 4.** Main breeds involved (% in 521 events).

Breed	%
German Shepherd	0.19
Maremma Sheepdog	0.07
Rottweiler	0.05
American Staffordshire Terrier	0.04
Pinscher	0,04
Cane Corso	0.03
Jack Russell Terrier	0.03
English Setter	0.03
Boxer	0.03
Dobermann	0.03
English Cocker Spaniel	0.02
German Dachshund	0.02
Border Collie	0.02
Dogo Argentino	0.02
Belgian Shepherd Dog	0.02
Chihuahua	0.02
Siberian Husky	0.02
Other Breeds	0.34

**Table 5.** Number of dogs registered with the ENCI between 2014-2018 for the 10 breeds that recorded the highest number of aggressive incidents. with bites.

Breed	2014	2015	2016	2017	2018
German Shepherd	16425	14705	16563	14681	11941
Maremma Sheepdog	909	1037	1171	1173	1129
Rottweiler	3791	4202	4335	4032	3753
Am. Staff. Terrier	4170	4610	5063	4881	4332
Pinscher	27	28	45	44	54
Cane Corso	3879	4076	4237	3901	3157
Jack Russell Terrier	5743	5356	5422	5057	4562
English Setter	13118	13920	14051	14626	13039
Boxer	3716	3768	3635	3080	2909
Dobermann	1948	1752	1466	1403	1299

As regards the training of the biting dogs, only three of the six LHAs were able to provide this type of information: out of 377 cases of registered bites, 343 (91.0%) of the dogs had not done any training activities. Out of 71 mixed-breed dogs reported by LHA "1", only two had undergone previous training (2.8% of the mixed-breeds where the owner reported training).

Regarding the causes of aggression, no information is available related to humans, but only data relating to attacks on animals, almost all of which occurred because they were being walked on leads and were approached by dogs off the lead.

## Conclusions

Our survey confirmed previous studies that found that it would be inappropriate to make assumptions about an individual animal's risk of aggression towards people based on the animal's particular characteristics and that there are no differences between purebred or mixed breed dogs. As in previous studies, we found that aggressiveness is not related to a specific breed, although certainly dogs who are predisposed to defence and other disciplines-based biting, seem to be predisposed to aggression. However greater education of the owners and improvements in breeding practices could alleviate aggressive behaviour toward people or animals. Dog training has been found to increase obedience and decrease behaviour problems in dogs (Arhant et al., 2010). A dog's aggression can thus be managed by the owner of the dog by channelling its energies into particular activities, favouring those that recall the use for which the dogs were originally bred.

Genetic studies, and in particular molecular genetics, have highlighted genes associated with aggression/impulsivity and it is important to extend this research because the prevalence of variants of these genes differs across breeds, and the functional role of specific variants is unclear. Clearly genetics and dog training can together reduce and prevent dog-dependent aggression with positive repercussions for public health and on the animals, leading to fewer cases of abandonment or euthanasia.

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## Un'indagine sul numero di lesioni causate dai cani in Italia da cani di razza pura e mista

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### Sintesi

In questa indagine abbiamo raccolto informazioni sul numero di morsicature inflitte dai cani ad altri animali o persone, registrate dalle autorità sanitarie locali (ASL) in Italia dopo una segnalazione ufficiale per un periodo di un anno. Lo scopo era quello di valutare le possibili differenze tra cani meticci e di razza e tra cani addestrati e cani non addestrati, ed evidenziare le razze potenzialmente più aggressive.

All'inizio del 2019 è stato sviluppato un questionario inviato via email a 87 ASL del centro-nord Italia chiedendo loro di segnalare episodi di morsicature dovute ad attacchi di cani avvenuti in un anno. Il questionario includeva domande sul soggetto aggredito e sulla razza del cane aggressore con le ragioni dell'aggressione. Sono stati ricevuti ed elaborati solo sei questionari. I risultati hanno rivelato 1169 casi di aggressione in un anno segnalati nel totale dei sei LHA ( $194,8 \pm 115,33$  come valore medio), soprattutto nei confronti dell'uomo (96,9%). Tra questi attacchi, il 52,6% era contro estranei e il 29,8% contro un familiare (proprietario o altro membro della famiglia).

Non ci sono state differenze nel numero di attacchi da parte di cani di razza pura (53,6%) o di razza mista (46,6%). Il pastore tedesco, spesso utilizzato come cane da protezione e da guardia, è stata la razza con il maggior numero di morsi segnalati (19,0%). Ciò è dovuto essenzialmente alla sua prevalenza in Italia, con oltre 12.000 cani iscritti all'ENCI ogni anno, ma anche al motivo per cui questa popolare razza è stata utilizzata dalle persone come cane da guardia. Dei 377 casi di morsi registrati, segnalati da tre ASL, 343 (91,0%) erano stati inferti da cani che non avevano seguito alcun programma di addestramento, indicando così che i programmi di educazione siano strumenti fondamentali per ridurre i fattori di rischio e prevenire l'aggressività.