






Retrospective analysis of dog bites in Southern Italy

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ABSTRACT: Dog bite is one of the major public health problems involving people worldwide. Although, several studies have investigated this phenomenon in different countries, little information about the incidence of dog bite episodes in Italy is available. We analysed data about dog biting events between 2010 and 2019 provided by the CRIUV, the Regional Reference Centre for Veterinary Urban Hygiene in the largest city of Southern Italy, namely, Naples. We observed severe and profound inconsistencies in the data collection that reveal structural and significant weaknesses of the current data collection system. Given the multifactorial nature of dog bite, we highlight the need to improve the gathering of all the information related to the factors affecting the occurrence of biting episodes for an accurate assessment of the biting phenomenon.

Key words: dog bite, canine aggression, human-dog relationship, public health.

Análise retrospectiva de mordidas de cães no sul da Itália

RESUMO: A mordida de cães é um dos maiores problemas de saúde pública que envolve pessoas em todo o mundo. Embora vários estudos tenham investigado esse fenômeno em diferentes países, poucas informações sobre a incidência de episódios de mordidas por cães na Itália estão disponíveis. Analisamos dados sobre eventos de mordidas de cães entre 2010 e 2019 fornecidos pelo CRIUV, Centro de Referência Regional para Higiene Veterinária Urbana na maior cidade do sul da Itália, Nápoles. Observamos inconsistências graves e profundas na coleta de dados que revelam fragilidades estruturais e significativas do sistema de coleta de dados atual. Dada a natureza multifatorial da mordida canina, destaca-se a necessidade de melhorar a coleta de todas as informações relacionadas aos fatores que afetam a ocorrência de episódios de mordida para uma avaliação precisa deste fenômeno.

Palavras-chave: mordida de cachorro, agressão canina, relação homem-cão, saúde pública.

INTRODUCTION

Canine aggression is the most common complaint in veterinary behaviour referral practice (BAMBERGER & HOUP, 2006; FATJO et al., 2006). Familiar humans and family members are the most common targets of dog bites (GUY & BRADY, 2001; ROSADO et al., 2009; BARRIOS et al., 2021). They severely compromise dog welfare since it generally causes abandonments, relocation to shelter and euthanasia (OVERALL, 2013; D'ANGELO et al., 2020; POWELL et al., 2020).

Conversely, they have consequences on human health that includes physical injuries, transmission of zoonoses and psychological trauma

(CASEY et al., 2014). In recent years, a growing body of literature investigated the factors that influence the expression of dog bite behaviour (LOCKWOOD, 2016). The most analyzed parameters were related to the personal data of both victims and dogs, which includes their sex, age, breed for dogs, and the severity of lesions. Dog bite episodes involving children and infants were more frequently denounced and it is probably due to higher severity of the lesions, which are generally directed to the face and neck (OZANNE-SMITH et al., 2001; POLO et al., 2015; OWCZARCZAK-GARSTECKA et al., 2018). Seventy two percent of the children know the biting dogs (REISNER et al., 2011). This finding suggested that; although, humans and dogs are capable of

recognizing the other species' communicative signals and emotions (MOLNÁR et al., 2010; SINISCALCHI et al., 2016; FARAGO et al., 2017; SINISCALCHI et al., 2018a,b; SINISCALCHI et al., 2021), misunderstandings can occur and this may lead to inappropriate reaction of the dog, particularly toward children, whose ability to correctly identify dog emotions could be less mature (OVERALL & LOVE, 2001).

Among the dog bite episodes registered, it has been reported a higher number of men than women (RODRIGUES et al., 2013; POLO et al., 2015). Bite incidents usually occur within the house when humans initiate an interaction with the dog, whereas the incidents occurring outdoors generally involve unfamiliar dogs in a non-interactive context (OZANNE-SMITH et al., 2001; REISNER et al., 2011; POLO et al., 2015). Concerning the dog features, several studies have reported that male, large dogs of specific breeds, including Rottweiler, German shepherd, Terriers (and Pit bulls), Siberian Husky, are more frequently involved in the denounced biting episodes (OVERALL & LOVE, 2001; GARVEY et al., 2015; O'BRIEN et al., 2015). However, the need to consider the prevalence of dog breeds, age, sex, and reproductive status, in relation to the demographic population for which dog bites is investigated emerged from the recent literature (GUY et al., 2001; REESE & VERTALKA, 2020). Moreover, the investigation of the "breed" effect poses important issues considering that the breed identification by victims, official authorities and even specialists working in the animal field is notoriously faulty (REESE & VERTALKA, 2020). Previous studies investigated the context of the biting episodes, which includes inappropriate physical contacts, resource guarding, social agonistic and play interactions, pain-discomfort conditions, a state of emotional tension-fear-anxiety of the animal (OVERALL & LOVE, 2001; REISNER et al., 2007; CASEY et al., 2014; POLO et al., 2015; OWCZARCZAK-GARSTECKA et al., 2018; BARRIOS et al., 2021). It was also found also that owner attitude, attachment style and personality traits are related to dog bites (GOBBO & ZUPAN, 2020; POWELL et al., 2020). Specifically, owners with higher neuroticism scores were associated with dogs' aggressive behaviour towards humans. Moreover, owners with lower scores for anxious attachment were associated to dogs that expressed aggressive behaviour towards strangers, whereas owners with higher scores for avoidant attachment had dogs that expressed aggressive behaviour toward them (GOBBO & ZUPAN, 2020). The owner personality

affects also the likelihood of decreased aggressive behaviour of dogs: owner conscientious was, indeed, negatively associated with the likelihood of decreased stranger-directed aggression (POWELL et al., 2020).

Although several studies highlighted the importance of considering the dog living conditions, information regarding the development of the animals (their origin, age of adoption, socialization, etc.) and their management, the human-dog relationship, the dog personality traits and the behaviour of both the individuals preceding the aggression (CASEY et al., 2014; LOCKWOOD, 2016; FARHOODY et al., 2018; GOBBO & ZUPAN, 2020), is still a matter on ongoing research.

In Italy, dog bite episodes are assessed by Official Veterinarian with the purpose of preventing Rabies. The collection of the data has not the purpose of investigating the factors involving in the expression of such behaviour but the bite phenomenon is approached in the framework of the prevention of human diseases.

This study used the database of dog bites in order to investigate the dog- and victim-related risks factors for dog bites in Southern Italy, specifically in Naples. We discussed the findings with reference to the existing literature, and evaluate the efficacy of the method used to collect the data for reliable information regarding dog bite phenomenon.

MATERIALS AND METHODS

Data collection

This study used data about dog biting events that occurred between 2010 and 2019 in the largest city of Southern Italy, i.e. Naples. Data were provided by CRIUV, the Regional Reference Centre for Veterinary Urban Hygiene. It is a Naples-based local health company dedicated to collecting dog-related records that can support National Plan on Rabies Control within the region. The territory of the ASL Napoli 1 Centro extends for 128 Km² and includes the metropolitan city of Naples and the island of Capri. The total human population is 1,005,792 inhabitants. The population density referred to the municipality of Naples is; therefore, approximately 8,500 inhabitants per Km² (REGION, 2021). CRIUV records were available in digital and paper formats.

The data about the bite events were collected by Official Veterinarians by completing a standard scheme, with the purpose of preventing Rabies. It includes: the owner personal data; the place where the event occurred (day, address and city

district); the victim personal data; the dog sex, age, breed, size (classified according to BARRIOS et al., 2021); general notes about the event.

The numbers of dog registered in the Dog Registry for each year were provided by the ORSA (National Observatory for Food Safety) of the Campania Region. These data were used to evaluate the incidence of dog bites according to the characteristics of the registered general dog population.

Analysed parameters

Although, the standard scheme of the CRIUV considered all the above-mentioned parameters, we reported several missing information and inconsistencies in the different report of each analysed year. The official standard scheme changed during the years and information regarding the context of the aggression, as well as the anamnestic data regarding dogs' living conditions and management were incomplete, inaccurate or even missing. Therefore, the final parameters that we could consider for a reliable observation of the denounced episodes of dog bites were: dog sex, breed (pure breed vs. cross breed, according to the evaluation of the Official Veterinarian who reported the event) and size (small, medium, large) and the victim sex.

Statistical analysis

The statistical analysis was performed with GraphPad (version 9.0; La Jolla, CA). The difference in the pure breed vs. cross breed and in the sex of the dog involved in the reported biting episodes were analysed by using the chi-square test. Differences between the sizes of the biting dogs were tested by one-way ANOVA, whereas the differences in the victims' sex were assessed by the t-test. Results were considered statistically significant for $P < 0.05$.

RESULTS

The analysed population consisted of 73441 dogs registered in the Dog Registry from 2010 to 2019. It included 37842 males (51.5%) and 35599 females (48.5%) belonging to pure breeds ($N = 46854$, 63.8%) and cross breeds ($N = 26587$, 36.2%). The dog bite events recorded in the analysed period were 806 that involved 1.1% of the dogs of the entire registered population. Each dog was reported to be involved in a single bite episode.

The statistical analysis revealed a significant difference in the sex of the dogs involved in the bite episodes denounced between 2010 and 2019. Specifically, among the bite episodes reported, there are

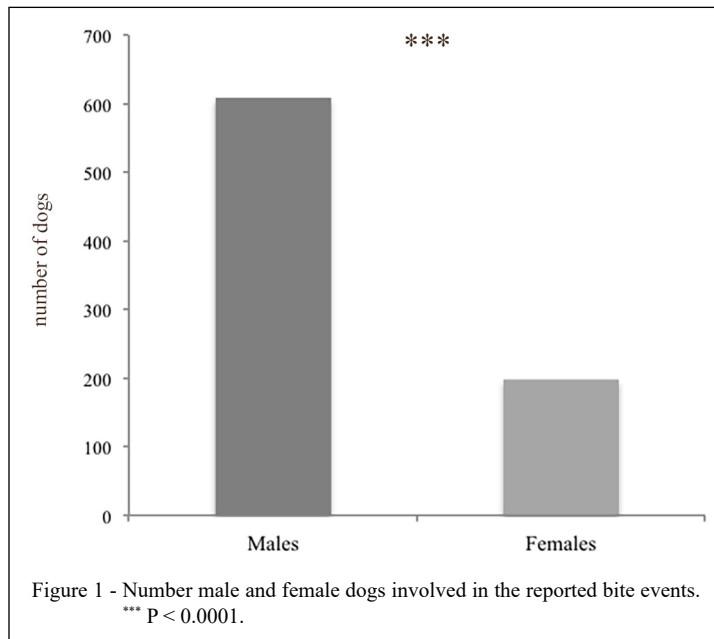
more male than female dogs (males: $N = 608$, 1,61% of the total numbers of males in the registered population; females: $N = 198$, 0.6% of the total numbers of females in the registered population; $\chi^2 = 186.5$, $P < 0.0001$; Figure 1). Moreover, the number of episodes involving cross breed dogs were significantly higher than those related to pure breed dogs (cross breed: $N = 415$, 1.6% of the total numbers of cross breed dogs in the registered population; pure breed: $N = 391$, 0.8% of the total numbers of pure breed dogs in the registered population; $\chi^2 = 82.46$, $P < 0.0001$, Figure 2) and the number of large dogs were significantly more than medium and small dogs (one-way ANOVA, $F(2,27) = 5.264$, $P = 0.0117$; Figure 3).

Regarding the victims characteristics, the statistical analysis showed no differences in the sex of the people involved in the biting episodes (males: $N = 438$; females: $N = 387$; t-test: $P > 0.05$).

DISCUSSION AND CONCLUSIONS

To the best of our knowledge, this is the first analysis of dog bite incidents of the Southern Italy. The information and parameters here considered and later analysed were collected by Official Veterinarians in the framework of the National Plan on Rabies Control in the most important city of Southern Italy, namely Naples, between 2010 to 2019. Although, a standard scheme was available for data gathering, we observed severe and profound inconsistencies and several missing information. Some data were unreliable and/or not recorded. This finding reveals structural and significant weaknesses of the current data collection system that could not provide a reliable and efficient method for evaluating all the potential factors involved in the biting event onset. The accuracy of data collection must be maximized. This constitutes the first step for an accurate assessment of the biting phenomenon.

From the available and consistent data reported in the schemes, we could consider the information related to the dog sex, breed (pure breed vs. cross breed) and size and to the sex of human victims. We found that, among the bite episodes reported, male dogs were significantly more than those involving females. Although, this finding could be in line with previous studies reporting similar observations (SHULER et al., 2008; MESSAM et al., 2018; OWCZARCZAK-GARSTECKA et al., 2018; OXLEY et al., 2018; CAFFREY et al., 2019; REESE & VERTALKA, 2020), our results reflect the higher number of males in the general population of dogs registered in the analysed period. This highlighted the importance of considering the demographic

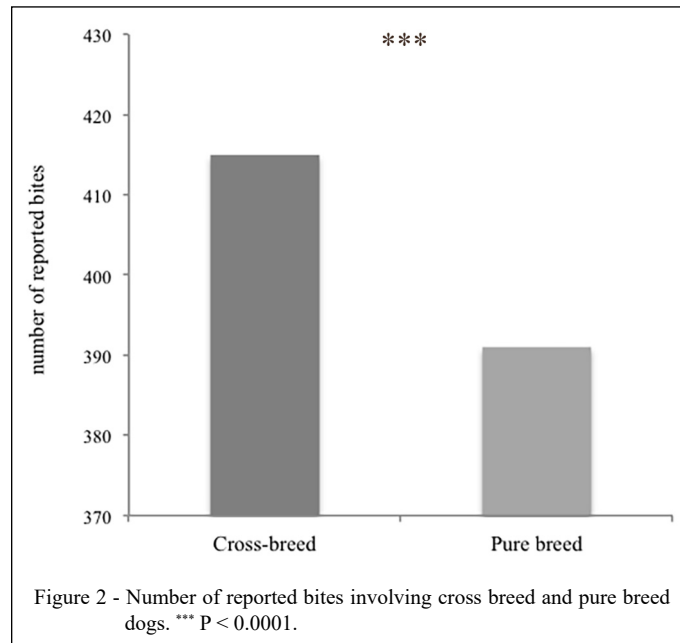


characteristics of the population investigated in the analysis of the outcome, considering their features for a proper interpretation of the study findings.

We also observed that biting episodes involving large dogs were significantly more than those related to medium and small dogs. This was expected since large dogs are more likely to cause injuries and/or severe damages to humans than small and medium dogs, resulting in a higher number of denounced biting events (REESE & VERTALKA, 2020). Physical factors related to the size, including physical strength, muscle mass, jaw structure and the tenacity of the purchase (OVERALL & LOVE, 2001), influence the severity of the wounds produced by dogs and they often require medical interventions. This causes the automatic and compulsory inclusion of the episode in the data system of the Rabies Control Plan. Nevertheless, this data needs to be related to the context in which the biting episode occurs to draw reasonable conclusions about the influence of the size to the likelihood of a dog to bite. Given the above mentioned physical features, we cannot rule out the possibility that the biting event could have also occur during positive interactions with humans, including a particularly physical play or during the offer of a piece of food, in which lesions are only accidentally caused by dogs. The higher number of denounced biting episodes involving large dogs can also be related to the fact that owners tolerate the aggression

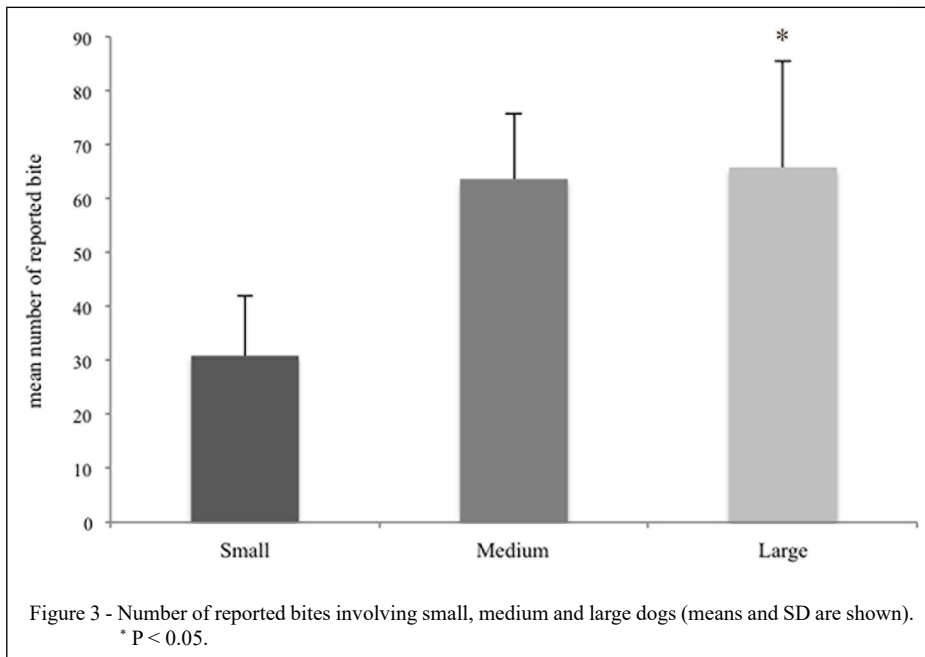
of small dogs for longer (ARHANT et al., 2016) since they cause less severe injuries and that bites by small dogs may be perceived even as comical (OWCZARCZAK-GARSTECKA et al., 2018). This may cause an underestimation of the involvement of small and medium dogs in biting events; and consequently, it negatively affects the evaluation of the potential factors contributing to dog bite phenomenon. Moreover, this result may reflect the prevalence of the large dogs in the investigated population but this data was not available for our analysis.

Finally, among the bite episodes reported, we found that biting incidents involving cross breed dogs were significantly more than those related to pure breed dogs. This difference does not reflect the demographic characteristics of the population analysed since the percentage of pure breed dogs was considerably higher than cross breed dogs between 2010 and 2019. However, when investigating the “breed” effect on the biting events, it is necessary to relate the data to the capacity of the human to identify dog breeds. Generally, information about the breed is provided by the victims, public safety officials and animal specialists, whose ability of estimate dog breed is notoriously poor (ILIPOLOU et al., 2019; WEBSTER & FARNWORTH, 2019; REESE & VERTALKA, 2020). Breed identification is mainly based on dogs’ phenotype rather than on official



certificates reporting that an individual belonged to a process of genetic selection. The analysis of this parameter is further complicated when its prevalence is related to the general distribution of pure breed/cross breed dogs in the population investigated. Differences in the breed evaluation between the different organism involved in the data collection (Rabies Control Plan and Demographic Offices for the registration of dogs) may further affect the reliability of the provided information. It is necessary therefore to set up standard and more rigorous criteria for the breed assessment and registration for a reliable evaluation of the influence of genetic on the dog bite phenomenon. According to our results, different scenarios can be proposed. It is possible that the owners of purebred dogs, who generally spend a considerable amount of money to purchase them, are more worried about the legal and economic consequences of denouncing the biting episode, which might include the payment of damages, the removal of the dog from the house and a compulsory rehabilitation process. On the contrary, the owners of cross breed dogs, who generally adopt them from kennels, may be less worried about the removal of the animal from their house (or the place where the dog lives) to return to the kennel. This may explain the differences in the reported biting incidents by the owners, if the event occurs within the place where the dog lives.

An alternative hypothesis could be that the owners of pure breed dogs are more educated on how to correctly interact with the dog and about its physiological and ethological needs. Since they invest an amount of money for purchase their dog, they could also promote an adequate development of their pets by attending educational programs carried out by dog behaviour specialists. Consequently, it could be less likely that during the interaction with the owners biting events occur. Conversely, it could be possible that the higher involvement of cross breed dogs in the denounced episodes reflects the lack of appropriate development and adequate living conditions before being adopted. Bite behaviour can be an expression of a stressful condition (HANDELMAN, 2012; SINISCALCHI et al., 2018c) deriving from previous experiences and inadequate living conditions (in kennel or related to previous abandonments) (CASEY et al., 2014; POLO et al., 2015; GOBBO & ZUPAN, 2020). Therefore, these factors and the origin of dogs should be investigated. Moreover, since this data is related to a specific territory, it is possible that the management conditions of the local kennels may have an influence on the phenomenon. It could be interesting; therefore, to evaluate the link between the origin of the dog (which kennel, its management, the length of stay etc.) and the occurrence of the biting incidents in order to highlight potential factors affecting the outcome of the biting events.



Overall, our hypotheses on the findings of this study provide evidence about the need of considering each parameter not as an independent factor but it must be related to all the other data collected considering the multifactorial nature of dog bite. Therefore, the genetic, demographic, developmental, environmental and social factors must be considered in order to have a comprehensive overview on the biting phenomenon (LOCKWOOD, 2016; D'INGEO et al., 2021). The analysis should also include information regarding the dog living conditions, the human-dog relationship, the owner attitudes, the detailed description of the context in which the event occurred (place, dynamic of the event, human and dog behaviour preceding the bite) and, most importantly, the personality traits of the dog involved in the incidents, which must be evaluated by a veterinarian behaviour specialist (CASEY et al., 2014; OWCZARCZAK-GARSTECKA et al., 2018; GOBBO & ZUPAN, 2020; REESE & VERTALKA, 2020). All these parameters should be included in a standard scheme that needs to be adopted for the data collection at a National level in order to gather reliable information about the biting phenomenon. This constitutes the basis for future directions aiming to reduce the occurrence of biting episodes in our society.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

Conceptualization: D.d., S.d., F.N. and A.Q.. Data acquisition: G.P., I.M. and V.C. Design of methodology and data analysis: D.d., S.d., F.N. and A.Q. D.d., S.d., F.N. and A.Q. prepared the draft of the manuscript. All authors critically revised the manuscript and approved of the final version.

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