Incidence and characteristics of hospitalizations after dog's bite injuries in Sicily (Italy) between 2012-2015

Daniela Alberghina[1*], Antonino Virga[2], Sergio Pio Buffa[2] and Michele Panzera[1]

[1] *Department of Veterinary Sciences, Polo Universitario dell'Annunziata, 98168, Messina, Italy,*
[2] *Epidemiological Observatory and Health Department of Sicilian Region, Piazza Ottavio Ziino 24, 90145 Palermo, Italy.*

[*] *Corresponding author at: Department of Veterinary Sciences, Polo Universitario dell'Annunziata, 98168, Messina, Italy. Tel.: +39 0903503749, e-mail: dalberghina@unime.it.*

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Summary
There have been several studies focusing on dog's bite injuries and their epidemiology. To our knowledge, the incidence and characteristics of hospitalization after a dog's bite injury have not been examined quantitatively in Italy. The aim of this study was to identify the incidence and characteristics of dog's bite hospitalizations throughout Sicily (Italy) between 2012-2015. Data for statistical analysis were acquired through the Epidemiological Observatory and Health Department of Sicilian Region (Italy). One hundred and forty records with E-code 906.0 (dog's bites) were extracted from 214 cases of hospitalization due to lesions caused by animals. The age group most frequently injured by dogs was children between 0 and 9 years old. The distribution of bite incidences among males and females was similar in children between 0 and 15 years and in elderly adults between 60-84 years old; whereas it was statistically different in adults between 16-59 years, 66% males and 34% being female ($Z = 2.60$, $P < 0.01$). The head, face, and neck region constituted the most common location of lesions in children (76%), the hands were the most common location of lesions for adults (38%), while the arms were the most common location for the elderly (43%). Two photoperiods were considered, short: October-March, and long: April-September. During the long photoperiod, 69% of injuries occurred in children ($P < 0.05$). The identification of the incidence and characteristics of hospitalization could be useful for proposing specific preventive approaches to dog's bites injuries.

Indagine sui ricoveri ospedalieri in Sicilia provocati da morsicature di cani nel quadriennio 2012-2015

Parole chiave
Morsicature canine,
Ospedalizzazioni,
Lesioni,
Sicilia,
Sanità Pubblica Veterinaria.

Riassunto
Sono numerose le indagini in letteratura sulle lesioni da morsicature di cani e sulla loro epidemiologia, tuttavia non risultano in Italia valutazioni di nostra conoscenza sui ricoveri ospedalieri provocati da morsicature di cani. Scopo dello studio è stato quello di riportare l'incidenza e le caratteristiche dei ricoveri ospedalieri in Sicilia determinati da morsicature di cani nel quadriennio 2012-2015. L'indagine è stata condotta sui dati del Dipartimento per le Attività Sanitarie e dell'Osservatorio Epidemiologico della Regione Sicilia. Da 214 casi di ospedalizzazione per lesioni causate da animali, ne sono stati estrapolati centoquaranta registrati col codice E906.0 (altro traumatismo causato da animale: morso di cane). I bambini di età compresa tra 0 e 9 anni sono risultati significativamente più esposti al rischio di ospedalizzazione rispetto ai soggetti di età superiore. La distribuzione delle incidenze tra maschi e femmine è risultata molto simile nei soggetti di età compresa tra 0 e 15 anni e tra i 60 e gli 84 anni col 53% dei maschi e il 47% delle femmine. Nei pazienti adulti (16-59 anni) è stata rilevata una significativa predominanza dei soggetti maschi (66%) rispetto alle femmine (34%) ($Z = 2.60$, $P < 0.01$). Nei bambini di età compresa tra 0 e 15 anni, le regioni della testa, della faccia e del collo sono risultate le più soggette a lesioni (76%), le mani negli adulti (38%) e le braccia negli anziani (43%). Relativamente all'eventuale stagionalità delle aggressioni, i dati sono stati valutati considerando due fotoperiodi: ottobre-marzo (corto fotoperiodo) e aprile-settembre (lungo fotoperiodo). Nel lungo fotoperiodo la percentuale negli adulti e negli anziani è stata quasi uguale a quella registrata nel corto fotoperiodo, diverso il trend nel gruppo dei bambini: il 69% ($P<0.05$) è stato aggredito tra aprile e settembre. L'identificazione delle caratteristiche e delle incidenze può essere utile per proporre specifiche misure preventive volte a contrastare o mitigare il manifestarsi delle aggressioni canine.

Introduction

Human injuries due to dog's bites are a complex public health problem that has received much attention due to the recognition of the huge impact that these injuries have on medical and public health costs (Overall and Love 2001). Canine aggression also poses a problem in terms of animal welfare, since biting can lead to rehoming, relinquishment to an animal shelter or euthanasia (Huntausen 1997). Data on dog's bites come mainly from studies in public health departments (Ostanello *et al.* 2005, Rosado *et al.* 2009) and most of the scientific literature has analysed data related to the victims. The frequency of bites reported to any authority is just the tip of the iceberg and the occurrence of dogs' bites could be very common. In the USA, it was estimated that approximately only between 17% and 18% of dogs' bite related injuries receive medical attention, and that approximately between 1% and 2% of bite injuries require the hospitalization of the victim (Overall and Love 2001).

In Italy, the incidence of injuries caused by dogs' bites have been reported for the municipalities of Bologna and Florence (Ostanello *et al.* 2005, Mariti *et al.* 2015) and for the Autonomous province of Sud Tyrol (Morosetti *et al.* 2013). Given the lack of knowledge on the incidence of dogs' bite injuries in the Autonomous Region of Sicily (ARS), a questionnaire about dogs' bites in humans was administered in 2013 to 400 dog-owners. Based on the responses to this questionnaire, 6.5% of dog-owners reported that their dogs have bitten a family member. However, none of these incidences has been reported to authorities (unpublished data). Reportedly, over the last several years, serious dogs' bites requiring hospital admission have increased (Westgarth and Watkins 2015, Rhea *et al.* 2012), but there is little information pertaining the hospitalization of dogs' bite injuries (DBIH) in Europe (Villalbi *et al.* 2010, Súilleabháin 2015). For administrative purposes, hospitals report the external cause of injury (E-codes and ICD-9, International Classification of Diseases, 9th Revision) and the use of dog bite E-code E906.0 enhances dog bite surveillance (Rhea *et al.* 2012). The aim of this study was to identify incidence and some characteristics of DBIH in the ARS between 2012-2015, in order to progress towards better and more practical measures to improve public safety.

Materials and methods

Data for this study are based on residents living in Sicily, Italy. Sicily is situated in Southern Italy and comprises of 9 provinces (Palermo, Catania, Messina, Agrigento, Trapani, Siracusa, Ragusa, Caltanissetta, and Enna); in the study period the population counted about 5,000,000 residents. The total area of Sicily is 25,711 Km^2, while the ARS (which includes smaller surrounding islands) has an area of 27,708 Km^2.

Hospitalization records that were reported by the Public Health Department of Sicilian Region with E-code 906.0 (dog bite) were obtained from 27 public hospitals that are part of the Surveillance System. Only records transcribed between the 1st of January 2012 and the 31st of December of 2015 have been used for this study. Data collected from each record included information about patient age, sex, residence, location of principal lesions, date of admission to the hospital, and number of days hospitalized. Children patients were defined as patients equal to or younger than 15 years of age. Adult patients were defined as patients between 16 and 59 years. Elderly patients were defined as patients equal to or older than 60 years of age. Date of admission was used to consider 2 photoperiods of DBIH, namely Short photoperiod (SP) (= October-March) and Long photoperiod (LP) (= April-September). The statistical report of DBIH refers to the years 2012-2015 and is a part of a series of activities started by the Department of Veterinary Sciences of Messina and the Epidemiological Observatory and Health Department of Sicilian Region.

Statistical analysis

The data were summarised using descriptive statistics [means and standard deviations (SD) or number and percentage]. A Poisson regression general linear model (GLM) analysis was used to model count data and contingency tables. A Z-Test was used to compare the frequency of injuries between males and females and a Kruskal-Wallis ANOVA was used to analyse interval and ordinal variables. Results were considered to be statistically significant at $P < 0.05$. This report is a summary of the results of analyses.

Results

Between 2012 and 2015, a total of 140 records of lesion with a dog-bite E-code (E 906.0) (65%) were extracted from 214 cases of hospitalization for lesion caused by animals (E 906) in the hospital districts of ARS. This represents approximately 35 hospitalizations per year. There were non-fatalities secondary to dogs' bite during the studied period. Data were examined according to the victim's residence and province within the ARS (Table I). DBIH involved 129 (92%) residents and 11 (8%) non-residents. Almost 1/3 of the victims (33%) were residents of the province of Catania. The highest incidence (number of DBIH *4 years per 100,000 inhabitants) was found in the province of

Table I. *Distribution of dog bite injurie hospitalizations (DBIH) in Sicily between 2012-2015 according to residence.*

Public Hospital Districts	Number of residents	% resident DBIH	Resident population by Province (mean value from 2012 to 2015)	Incidence*4yrs/100,000 residents
Palermo (3)	13	10%	1.259.520	1.03
Catania (6)	43	33.3%	1.096.945	3.92
Messina (2)	25	19%	647.762	3.86
Agrigento (3)	10	8%	444.799	2.25
Trapani (3)	10	8%	433.115	2.31
Siracusa (3)	15	11.6%	402.330	3.73
Ragusa (2)	2	1.6%	313.787	0.64
Caltanissetta (4)	4	3.1%	273.530	1.46
Enna (1)	7	5.4%	172.359	4.06
Total	129	100%	5.044.207	2.56

In brackets number of hospitals involved.

Enna (4.06), whereas the province of Ragusa had the lowest incidence (0.64).

Characteristics of injured subjects

Patients ranged in age from 1 to 84 years (34.8 mean ± 6.6 SD). As shown in Table II, injury rates were highest among children aged 0-9 (n = 37), all other age classes have a significantly lower number of cases. The age and sex of patients are reported in Table III. The distribution of bite incidences among males and females was very similar in children and in elderly, with 53% being males and 47% being female. The distribution of bite incidences among males and females was significantly different in adults, with 66% being males and 34% being female ($z = 2.60$ $P < 0.01$).

Distribution of lesions, length and period of hospitalization

In children, 76% of bite lesions were located on the neck, face, and head, 11% were located on the lower extremity, 7% were on the arms, 4 % were on the hands, and 2% were on the trunk. In adults, 20% of bite lesions were distributed between the neck, face, and head, 31% were on the upper extremity, 38% were on the hands, 9% were on the lower extremity and 2% were on the trunk. In the elderly group, 17% of lesions were on either the neck, face and/or head, 43% were found on the upper extremity, 33% were on the hands, and 7% were on the lower extremity (Table IV).

The length of hospitalization also increased with age groups with hospitalization lengths being 3.91 ± 2.64 days for children, 4.35 ± 3.33 days for adults, and 7.00 ± 7.83 days for the elderly. The distribution of bite incidences during LP and SP was very similar in adults and in elderly, with 53-54% occurring during LP and 47-48% during SP. The distribution of bite incidences among photoperiods was significantly different in children, with 69% of bite incidences occurring during LP and 31% during SP ($P < 0.05$).

Table II. *Number of hospitalization cases in Sicily between 2012-2015 per age class.* Statistical risk comparison was calculated using Poisson regression based on the 0-9 years age class.

Age classe (years)	Number of cases	β	p-value
0-9	37	3.6109179	-
10-19	14	-0.9718606	0.00195
20-29	13	-1.0459686	0.00118
30-39	17	-0.7777046	0.00795
40-49	16	-0.8383292	0.00508
50-59	14	-0.9718606	0.00195
60-69	18	-0.7205462	0.01216
70 -84	12	-1.1260113	0.00070

Discussion

In this study, the incidence and characteristics of hospitalizations after dog's bites related injuries

Table III. *Distribution of dog bite injuries hospitalizations (DBIH) in Sicily between 2012-2015 according to age and sex of patients.*

	Children (n = 45)	Adults (n = 65)	Elderly (n = 30)
Age group (years)	0-15	16-59	60-85
Mean age ± S.D.	6.40 ± 3.34	38.40 ± 12.90	69.57 ± 6.59
Percentage	32%	47%	21%
Male number (%)	24 (53%)	43 (66%)**	16 (53%)
Female number (%)	21 (47%)	22 (34%)	14 (47%)

**Asterisks denote statistical differences with respect to adult females ($z = 2.60$, $P < 0.01$).

Table IV. *Characteristics of dog bite injuries according to injured body part, length and period of hospitalization days (long photoperiod LP* vs *short photoperiod SP) in Sicily between 2012-2015.* Significance was calculated by Poisson regression. The variables, children's age group lesions to the neck, face and head, and the Short photoperiod of hospitalization were fixed as the reference categories for statistical analysis.

	Children (n = 45)	Adults (n = 65)	Elderly (n = 30)
Injured body Part			
Neck, face, and head	34 (76%)	13 (20%)[a]	5 (17%)[c]
Arm	3 (7%)[c]	20 (31%)[c]	13 (43%)[c]
Hand	2 (4%)[c]	25 (38%)[c]	10 (33%)[c]
Trunk	1 (2%)[c]	1 (2%)	0
Lower extremity	5 (11%)[c]	6 (9%)	2 (7%)
Number of hospitalization days (mean ± SD)	3.91 ± 2.64	4.35 ± 3.33	7.00 ± 7.83
Period of hospitalization			
April-September (LP)	31 (69%)[a]	35 (54%)	16 (53%)
October-March (SP)	14 (31%)	30 (46%)	14 (47%)

Letters denote a statistical difference with respect to the reference level [a]$P < 0.05$ [c]$P < 0.001$.

in the ARS were described. The incidence of hospitalizations over 4 years was different among provinces. Of the overall hospitalizations, 33% were from people residing in the Catania province area. A demographic study with a focus on population density and total dog population is needed for assessing differences in hospitalization incidences among provinces.

In this study, the victims most frequently injured were children between the age of 0 and 9, which is in agreement with previous studies of Central and Northern Italy (Ostanello *et al.* 2005, Morosetti *et al.* 2013) as well as studies run worldwide (Feldman *et al.* 2004, Touré *et al.* 2005, Schalamon *et al.* 2006, Rosado *et al.* 2009, Dhand *et al.* 2011, Chiam *et al.* 2014). Children may be more prone to dog's bites because of miscommunication in body language between dog and child (Beck and Jones 1985). The lack of education in the child on how to approach a dog may lead to anger in the animal (Chiam *et al.* 2014). The most effective intervention strategies could be videos illustrating how to interact with dogs (Shen *et al.* 2016). It is often better to educate the parents and paediatricians rather than children directly (Duperrex *et al.* 2009). Child psychologists, teachers, and veterinarians are ideal partners in promoting health, safety, and well-being for both member species of the family (Love and Overall 2001, Meints and De Keuster 2009). Children-dog interactions should always be supervised, and dog-owners should become more aware of the natural tendency of pets to bite when they are scared or intimidated (Beck and Jones 1985).

Unlike adults and the elderly, in which only 20% and 17% lesions were found on the face, head, and neck; 76 % of bites in children are distributed in this area, a finding that has been previously reported in other studies (Gandhi *et al.* 1999, Schalamon *et al.* 2006, Morgan and Palmer 2007, Horswell and Chahine 2011, Golinko *et al.* 2017). This finding could be explained by the height of a 3-5 years old child, which could be the same of a standing medium-large dog (Reisner *et al.* 2011). It is also possible that these areas are the most affected parts in children because of the way they are interacting with a dog. At this age, a child could be behaving in a way that is perceived as a challenge to a dog, even if the dog is not normally aggressive (Overall and Love 2001).

While previous studies have found an association between gender and patients injured by dogs, with more males than females as injured patients (Ostanello *et al.* 2005, Tenzi *et al.* 2011, Morosetti *et al.* 2013, Mariti *et al.* 2015), we only found this to be true for the adult group. In children, other authors have reported contradictory results regarding the gender factor, with some finding males having more injuries than females (De Kauster *et al.* 2006, Dhand *et al.* 2001, Chiam *et al.* 2014), others reported the opposite effect (Touré *et al.* 2015) or injuries distributed equally between genders (Lang and Glassen 2005, Shalamon *et al.* 2006, Chen *et al.* 2016). These inconsistent results suggest that the association may only be true for adults but not children.

The results indicate that, for children, most of the injuries occurred during the LP, whereas the number of injuries in adults and the elderly sustained did not significantly differ between photoperiods. Other authors, however, have reported that the frequency of lesions peaks in the summer for all ages (Ostanello *et al.* 2005, Fedele *et al.* 2008, Shelton 2010, Morosetti *et al.* 2013). In a previous study focusing on children, it has been reported that children were more likely to be bitten during the summer between 4 pm and 8 pm (Lang and Glassen 2005). The peak of dogs' bites in the LP could be due to the fact that children play outside during warmer months, and so there are more chances to encounter dogs (Raghavan 2008). Another possible explanation could be that different networks of aggressive behaviour operate under different environmental conditions where certain aggressive behaviours are influenced by the modulation of the photoperiod. This possibility has been reported for rodents under experimental conditions (Trainor *et al.* 2010). The influence of photoperiod length on aggression towards people, in particular, children, should be investigated in more depth.

Our results suggest that the distribution of lesions and the number of days hospitalized are different in elderly people compared to children and adults.

The different hospitalization length could be due to various types of existing medical conditions that elderly people have and which either prolongs their recovery from an additional injury or makes them unable to care for themselves at home when injured (Pfortmueller *et al.* 2013). Further studies are clearly warranted to determine the mechanism of dog attacks on humans in different age groups. These studies will help determine whether dogs' bites are associated with human characteristics and the extent to which these characteristics foster aggression.

A limit of this report is that it did not collect and analyse the circumstances of the dogs' bites, e.g. familiarity or not between the victim and dog. This limited the interpretation of some findings. Less serious injuries not requiring hospitalization were also not included. Another source of error is that residence of the patients is not necessary the city of lesion. Additionally, this is a regional study and our data may not be generalizable to the whole nation.

Regardless of these limitations, however, this is the first study to quantify DBIH in Italy. Further studies are needed to analyse more detailed data. Based on the information gathered from this current study, we suggest the establishment of preventive measures for dog bites. Educational programs about responsible dog-ownership and training is recommended as a first step to preventing future dogs' bites. Furthermore, the results of this study stress the importance of supervised children-dog interactions and the development of educational intervention programs for preschool and elementary school-aged children. The enhancement of collaboration between human and veterinary healthcare professionals and animal behaviour practitioners could also reduce the risk of dog bites.

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