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Research Article

Risk Factors for Dog Bites to People in São Paulo, Brazil

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Abstract

Millions of people are bitten by dogs each year in Brazil and worldwide. Dog and cat bites have been studied in many countries, both from the standpoint of rabies control and animal behavior, but not always assesses risk factors. This survey aimed to evaluate the characteristics of biting dogs that would allow establishing risk factors for aggression by this specie in the municipality of Araçatuba, SP, Brasil, by using a logarithmic equation. This case-control study was conducted with an analysis involving 85 questionnaires regarding non-biting dogs and 99 related to biting dogs. Statistical analysis included the chi-square test for categorical variables and t test for numerical variables, followed by Binary Logistic Regression, settling then the odds ratio (OR) for certain variables. The chances of bites by male dogs were three times more likely than for females, and intact dogs were 4.28 times more likely to have bitten than neutered dogs. Logistic regression analysis confirmed that each child present in a household increased by 1.70 times the chance of dog bites. The presence of adults, in contrast, was considered a protective factor, since each adult present in the household decreased by 35% the chances of attacks by dogs. Results and examples presented in this paper could contribute to the integration of prevention programs and responsible ownership, with the aim to guide and illustrate parents and children on the consequences of ownership and living with a dog.

INTRODUCTION

Dog and cat bites is a problem that has been studied worldwide, both from the standpoint of rabies control and animal behavior [1-5]. In the United States, dogs bite about 4.5 million people each year and on average, one in five cases require medical treatment due to injuries, mostly children [6,7]

About 40% of households in São Paulo City, Brazil, has at least one dog, and the human:dog ratio was 4.34:1 [8]. A research developed in 41 of the 606 municipalities in São Paulo State found that the human: dog ratio was 4:1, confirming high contact between humans and animals [9]. In Araçatuba, São Paulo, Brazil, this ratio was between 4.93:1 and 5.93:1 during 1994 to 2004 [10].

Because of the high number and large contact with dogs, only in 2002, the official number of people bitten by dogs in Brazil reached 424,092, of which 237,731 require treatment for rabies, resulting in expenses of around R$ 17 million [11].

Most of the information got in studies related to dog attacks refers to bitten person, reporting that the victims were especially children, usually between zero and 15 years old [3,12-15] and male [3,12,15]. Adults are often bitten in the legs or arms, unlike children who have a higher incidence of bites in the head and neck [13,15]. On the other hand many researches, have analyzed the characteristics of the attacking animal [3,16-19].

In a previous study conducted in the region of Araçatuba, Brazil, one could observe that dogs made up 67% of animals with a history of having bitten someone with owned dogs causing 80% of those bites, within their own homes [20].

The goal of this survey was to evaluate the characteristics of biting dogs, which would allow us to establish risk factors for aggression by this species and check if it is possible joint the role of these variables over the probability of occurrence of bites using a logarithmic equation.

MATERIAL AND METHODS

Study area

The municipality of Araçatuba is located in the northwest of São Paulo State, Brazil. The estimated population in 2009 was of 182,204 inhabitants [21] and canine rabies occurred in epidemic form in the county from 1993 to 1997 with 21.3% of positivity for dog rabies and one human case [22].

Experimental design and data collection

The survey conducted was a case-control study with two

studied populations. Owners of biting dogs whose victims sought medical care in the public health system of Araçatuba, SP, between January and December 2009 composed the "cases" group. To this end, we consulted information from the Information System for Notifiable Diseases (SINAN), obtained from the Epidemiological Surveillance Service of the municipality, through the W64 form – Anti-rabies Treatment. We used a structured questionnaire administered by four interviewers. In each case where the owner was not from the same home as the victims, three attempts were made to contact the dog's owner at the address provided by the victim, if known. As "control" group, surveillance questionnaire was applied to users of the Veterinary Hospital of the Faculty of Veterinary Medicine, from the Univ. Estadual Paulista. - UNESP, located in Araçatuba. Owners of dog that had been never bitten anyone, family or stranger, were screened to compose this group. As a bias control, only one dog per household was accepted, and the minimum age required for inclusion in the survey was six months. In addition, we provided a paring in the animal's gender, allowing a maximum difference of 10% between the groups. The Ethics Committee of the School of Dentistry of Araçatuba-SP (Case FOA-01065/09) approved the research project. Animal owners signed a consent form and received all the information about the research objectives, agreeing to participate.

Questionnaire design

The questionnaire design was based on Guy et al.[3], composed by the following items: general information about the household (I), information about the animal (II), the animal's behavior during the first two months of creation (III), the general behavior of the animal (IV), the animal's behavior over the past two months (V), dog-specific behavior regarding aggressiveness (VI) and information about the victim and the occurrence (VII), with a total of 98 questions and some sub-items. For classification purposes, people between zero and 12 years old were considered children, young people aging 13 to 17 and adults over 18 years old.

Statistical analysis

All information obtained for both groups were stored in Office Access 2003 ® database (Microsoft Corporation, Redmont, WA, USA). We considered the answer "do not know" as null field. For inclusion in the logistic regression model, each independent variable had been previously checked for its significance. Numerical variables were assessed by Student's t-test for independent samples, whereas for categorical variables the chi-square test was performed, considering the significance level of $P \leq 0.10$. Significant variables were taken as "predictors" of dog bites and were included in the logistic regression model using the *forward stepwise (Wald)* method, to test the presence of significant interactions between them ($P < 0.05$). The general fit of the models to the data was determined with Hosmer-Lemeshow goodness-of-fit chi-quare [23]. Other adjustment measures used were the value of the likelihood (-2 log), and the Cox & Snell and Nagelkerke R^2 coefficients. For all analyses, we used the SPSS 19 (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA). A logarithmic equation of Odds ratios was elaborated by using the results obtained in the multiple models, with the possibility of calculating different "P" values, according to specific situations [24]. The Odds ratio for the significant variables in the binary logistic regression model was established as a determinant of the risk factors for the occurrence of dog bites. The variables of the classes VI and VII mentioned above did not enter this analysis because they addressed only dogs belonging to the group of "cases", for other studies purposes.

RESULTS

Two hundred and three forms of biting dogs available in 2009 resulted in 183 interviews with victims of dog bites, conducted between August 2009 and February 2010. In 48.7% (99/203) of cases, it was possible to contact the biting dog's owner, making up the group of "cases". Owners that were impossible to contact made up 41.4% (84/203) of occasions, because it was a stray dog (n = 32), forgot the address (n = 14), denial to inform the location of the dog owner (n = 9) or after three unsuccessful attempts to visit the address provided by the victim (n = 29). In 20 records (9.9%) no additional information was obtained compared to that which was already on the original form. That was due to the refusal to participate in the study (n = 6) or the impossibility to contact the victim, because an incorrect address (n = 6), move in residence (n = 2), the victim's death for other reasons (n = 2) or after failure of several attempts to contact (n = 4), resulting in the removal from this analysis.

The interviews for the control group resulted in 105 questionnaires completed between February and September 2010. After the match between the number of males and females, 85 animals (81%) comprised the control group (non-biting dogs), 48.2% (41/85) males and 51.8% (44/85) females.

In the first stage of analysis, we evaluated the association between each of the 107 variables (numeric and categorical) with the dependent binary variable "biter" – univariate analysis. Sixteen of the 36 independent variables considered significant ($P<0.1$) were intentionally used for the binary logistic regression – multivariate statistical analysis, besides the dependent variable (Table 1). In this model, of a total of 184 questionnaires adding biting (99/203) and non-biting dogs (85/105), three (1.6%) were eliminated from analysis by the presence of non-responses, with a final number of 83 questionnaires from non-biters dogs and 98 from biters dogs.

Each variable used in the model corresponded to a new step, resulting in nine variables in the end of test. The value of the likelihood (-2 log) was 141.8. Since the Cox & Snell and Nagelkerke R^2 corresponded, respectively, 0.45 and 0.60, the latter indicates that 60% of cases of aggression could be explained by these seven variables. The Hosmer-Lemeshow test resulted in a 0.18 P-value. On a grading scale, the model was able to predict 80.1% of cases, with a cutoff equal to 0.5.

The correlated variables resulting from multivariate analysis (Table 2), defined risk and protective factors with the values of odds ratio and only the variable number of adults in the household and meek behavior were negative.

Table 1: Variables used in binary logistic regression model to determine risk and protection factors to canine aggression, referring to Araçatuba, SP, Brazil.

Independent variable	*n*	P-value
Number of adults in the household	184	0.01 [a]
Number of children in the household	184	0.002 [a]
Number of dogs in the household	184	0.056 [a]
Medium size dog (yes)	184	0.006 [b]
Dog's gender (male)	184	0.017 [b]
Dog's neuter status (intact)	184	0.01 [b]
Meek dog (yes)	184	0.001 [b]
Number of situations that can result in aggressive response	184	<0.0001 [a]
Acquisition of the dog for protection of the home (yes)	184	<0.0001 [b]
Dog received as a gift (yes)	184	<0.0001 [b]
Dog trained (yes)	184	0.063 [b]
Dog socialization with children (yes)	182	0.014 [b]
Dog locked up over seven hours / day (yes)	184	0.081 [b]
Dog chained at any time of day (yes)	184	0.076 [b]
Food protection (yes)	183	<0.002[b]
Aggressive response if disturbed while resting (yes)	184	<0.006[b]

[a]t test. [b]χ^2 test.

Table 2: Multiple regression model of risk and protective factors related to dog bites [a] referring to Araçatuba, SP, Brazil.

Variable	Coefficient	Probability	Odds ratio	95% CI [b]
Intercept	-0.97		0.381	
Number of adults in the household	-0.42	0.027	0.66	0.46-0.95
Number of children in the household	0.72	0.016	2.05	1.14-3.69
Dog's gender (male)	1.02	0.019	2.77	1.18-6.48
Dog's neuter status (intact)	1.76	0.035	5.81	1.13-29.77
Dog received as a gift (yes)	1.58	0.001	4.85	1.99-11.81
Acquisition of the dog for protection of the home (yes)	2.10	0.006	8.12	1.83-36.14
Number of situations that can result in aggressive response	0.22	0.011	1.25	1.05-1.47
Medium size dog (yes)	0.88	0.05	2.42	0.99-5.86
Meek behavior (yes)	-2.68	<0.0001	0.07	0.02-0.26

[a]Hosmer-Lemeshow goodness-of-fit, $\chi^2 = 11.44$, Degrees of freedom = 8, p = 0.18.
[b]95% Confidence Interval.

The resulting logistic regression equation was:

Logit (P) = log (P/1-P) = -0.97 -0.42*N.Adults + 0.72*N. Children + 1.02*Sex (male) +1.76*D.Neuter Status (intact) + 1.58*Gift + 2.10*Protection + 0.22*N.Aggr.Answ. + Size (medium)*0.88 –Meek Dog*2.68

N. Adults = Number of adults in the household
N. Children = Number of children in the household
Sex (male) = Male dogs
D.Neuter Status (Intact) = Dog's Neuter Status (Intact)
Gift = Dog received as a gift
Protection = Acquisition of the dog for protection of the home (yes)
N.Aggr.Answ = Number of situations that can result in aggressive response
Size (medium) = Medium size dogs
Meek Dog = docile, submissive dog

DISCUSSION

The control group from the Veterinary Hospital of UNESP, was a representative population with around 12% of the total urban canine population of the studied area, belonging to people of all social classes of the city. Previous report using this same the case group of aggressive dogs showed that over 70% of the biter dogs were male and most of them (71%) received as a gift. The victims who were children were predominantly male, while the elderly victims were predominantly female. Most children were bitten on the head/neck, while adults were bitten on the hands/feet and lower limbs. Situations involving aggression were related to dogs having escaped from their home (18.7%) or roaming free on the streets (17.0%) [25].

The risk analysis obtained here corroborates those results,

once the chances of bites by male dogs were almost three times (OR = 2.77) more likely than for females, and intact dogs were 5.81 times more likely to have bitten than neutered dogs. Besides that, in this model, medium size dogs could increase the risk of bites in 2.42 times (Table 2). As observed in USA male dogs were 6.2 times more likely to have bitten than females and intact dogs 2.6 times more likely than neutered dogs [18]. Moreover, in a research in Canada, female dog bites were 2.98 times more likely with male dogs as reference and 0.83 times less likely by neutered dogs than for intact dogs [3]. According to Messam et al., [18] in USA and Jamaica, all categories, showed higher relative risks for being biters when compared to spayed females. For intact males, for example, the risk was 2.56 times higher, and for intact females 3.22 times higher [19]. That difference between such results might be related to different populations used in different studies or because bites provoked by male dogs may be more serious, resulting in higher rate of medical care search [3].

However, such studies [3,19] approached customers from veterinary clinics, seeking both biting and non-biting dogs, while in the present study we address cases related to the seeking of medical care by the victim. When the studied population was similar to the one of our study [18] similar results were observed regarding sex and neuter status of the biting dogs.

An interesting effect observed after logistic regression analysis, was the demographics of households. Each child present in a household increased by two times (OR = 2.05) the chance of dog bites. The presence of adults, in contrast, was considered a protective factor, since each adult present in the household decreased by 34% the chances of attacks by dogs (OR = 0.66). Similar studies have shown that adolescents and children in households are related to an increased chance of bites [3,18,19]

By approaching the total number of situations that would result in aggressive response, with a maximum of twelve conditions set out in the utilized questionnaire (as food, toy, territories, or owner protection; facing, screaming, touching, grooming, or beating the dog, and variations), we concluded that each added situation in which the dogs reacted aggressively increased in 1.25 times the odds of occurrence of aggression (OR = 1.25). Similar correlation was also observed by Guy et al.[3], between aggressiveness in general (P<0.005) and the occurrence of dog bites.

In our survey dogs received as a gift increased 4.85 times the chance of occurrence of bites (OR = 4.85). Likewise, acquisition for protection of the home increased the odds by 8.12 times (OR = 8.12). In addition to the number of adults in the household, the meek behavior was also considered as a protective factor, strongly reducing the risk of bites (OR = 0.07). This variable 'meek behavior' was established after asking owners a grade (from 0 to 10) to the aggressiveness of their dogs. These responses were divided in two groups, containing meek dogs (grades 0 to 5) and aggressive dogs (grades 6 to 10).

The resulting equation allowed us to calculate the probability of bites according to the seven output variables in the logistic model [23]. Two examples can illustrate hypothetical conditions:

- Case 1 - a family consisting of a mother with two children between five and 12 years old, which received as a gift a medium size male dog, neutered, with a meek behavior, presents a logit (P) equal to 0.86, for which the probability P of occurrence of a bite is equal to 0.70 (70.3%). Adding one more child at the household, the probability P would reach 83%.

- Case 2 - a family consisting of a couple with two sons between 20 and 25 years old, who buys an intact female dog, large size, in search of company, which does not respond aggressively to any situation, presents a log it (P) equals -0.87, resulting in the probability of occurrence of aggression P=0.29, i.e. 29.5% probability of occurrence of aggression.

The main factors considered of risk for dog bites towards people were the dog's gender (male) and neuter status (intact), number of children at the residence, receiving the dog as a gift, acquisition for protection of home and total number of situations that result in aggressive response. The number of adults in the household and a meek behavior of dogs might be favorable to the non-occurrence of bites. It was possible to consider the role of these variables on the occurrence of aggression by dogs in different situations, revealing its relationship with the family structure and other factors. The breed can also be important, but as in this study were related more than 30 different breeds, with a small number of dogs each one, the use of this variable could be considered as a possible bias, leading to skew the final results.

Results and examples presented in this paper could contribute to the integration of prevention programs and responsible ownership, with the aim to guide and illustrate parents and children on the consequences of ownership and living with a dog. We can conclude that keep female or neutered dogs is safer, but there are others points to be considered. As example, we can imply that receiving a puppy as a gift sometimes can be more dangerous than beneficial, so families need to be prepared to keep and deal with the dog. Beyond that, we can conclude that large dogs are not the most common biters; despite being a weakness of this study does not evaluate the severity of these injuries. This way they can evaluate the home and family conditions before getting a dog, and if they already have one, they would be leaded to find better interaction ways with their dogs in the home environment and consider the risk that their pet can entail not only for family but also neighbors, relatives and strangers.

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