RESEARCH

Spanish dangerous animals act: Effect on the epidemiology of dog bites

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Abstract The effectiveness and suitability of legislation regarding the issue of dangerous dogs, especially those targeting so-called "dangerous breeds" (DB), have been the object of a lot of criticism. However, the shortage of scientific studies in this field makes an objective assessment of the impact of current legislation difficult. In the present study, dog bite-related incidents from Aragón (Spain) were analyzed for a 10-year periods (1995 to 2004). With the aim of assessing the impact of the Spanish Dangerous Animals Act on the epidemiology of dog bites, data from the non-legislated (1995 to 1999) and the legislated period (2000 to 2004) were compared in 2 different areas (low- and high-populated areas). According to the results, the population density did exert a significant effect on the incidence of dog bites, whereas the legislation in force did not. Popular breeds such as the German shepherd and crossbreed dogs accounted for the great majority of the incidents during the 2 periods of study. Specifically, the German shepherd proved to be over-represented significantly among the canine population. Dogs in the dangerous breeds list, on the other hand, were involved in a small proportion of the incidents both before and after the introduction of legislation. The present results suggest that the implementation of the Spanish legislation exerted little impact on the epidemiology of dog bites. Besides the scarce effectiveness, the results suggest that the criteria to regulate only so-called DB were unsuitable and unjustified. It is hoped that this study will be helpful in the elaboration of future regulation measures in this matter.
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Introduction

Dogs are considered one of the favorite pets in modern industrialized societies. Despite the important psychologic, physical, and social benefits derived from living with a dog (McNicholas and Collis, 2000; Wells, 2007), the ability to

occasionally bite people has made these animals become the focus of a public health and security challenge (Overall and Love, 2001; Palacio et al., 2005; Morgan and Palmer, 2007). In addition, a great number of dogs that show aggressive behavior are abandoned or euthanized, which poses problems in the field of animal welfare (Hunthausen, 1997; Mikkelsen and Lund, 2000).

Canine aggression directed toward people has given rise to an enormous interest both in the media and in the scientific literature during the last 2 decades. Moreover, the problem has pervaded political spheres and several countries in

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Europe, North America, and Australia have regulated dog ownership with the aim of reducing the number of people injured by dog bites and prevent new episodes (Butcher et al., 2002; Ledger et al., 2005; Collier, 2006).

Two kinds of legislation have been developed in this regard. The first type of legislation is Breed Specific Legislation (BSL), which is based on a series of regulations, including banning measures, applied to the so-called "dangerous breeds" (DB). It is thought that the elaboration of DB lists has been influenced to a large extent by biases in the media and the subsequent social alarm in response to fatal dog attacks. The second type of legislation, non-Breed Specific Legislation (nBSL), includes different regulation measures to promote responsible dog ownership regardless of the animal breed.

Most countries apply BSL as a first response, and complement it with characteristic nBSL measures (De Meester, 2004). According to the literature, BSL has not been proven effective in decreasing the number of people injured by dog bites (Ledger et al., 2005; Collier, 2006; Kuhne and Struwe, 2006) nor in preventing fatal dog attacks (Sacks et al., 2000). However, it is difficult to assess the effect of a particular type of legislation reliably due to the scarce scientific studies and data in this field. With this purpose, studies over long periods of time both before and after the introduction of the legislation should be carried out (De Meester, 2004). To our knowledge, only the study by Klaassen et al. (1996) has been carried out in this way, but it is important to note that a relatively brief period of time (3 months) was assessed. This study showed that the implementation of the Dangerous Dogs Act 1991 in the UK had limited effect on the rate of patients treated for dog bites in 1 urban Accident and Emergency department.

According to several studies based on data from both hospitals and public health departments, the so-called DB contribute to only a few of the dog bite-related incidents (Kahn et al., 2003; León, 2006). This finding contradicts the belief that these breeds are more dangerous and discredits DB lists. There are, however, no published data that show the effectiveness of nBSL over BSL (De Meester, 2004). This shows the necessity of carrying out more comparative scientific studies in this field.

The problems posed by dog attacks toward people in Spain (Knobel et al., 1997; Méndez et al., 2002; León-Artozqui et al., 2004) gave rise to specific legislation in 1999 (Spanish Dangerous Animals Act: Ley 50/1999). At first, the act opted for the principles of nBSL, but in 2002 (RD 287/2002), this regulation was ammended with the inclusion of a DB list.

The aim of this study was to assess, in an objective way, the effect of the Spanish Dangerous Animals Act on the epidemiology of dog bites and to discuss the effectiveness and suitability of legislation regarding the issue of dangerous dogs. The study analyzed epidemiologic data of medically-attended dog bites, comparing those belonging to the periods before (1995 to 1999) and after (2000 to 2004) the introduction of legislation. Furthermore, the effect of both the nBSL and the BSL was assessed. To this end, 2 main parameters were used: first, the incidence of dog bite-related incidents in 2 different areas, namely areas of low and high population density; second, the relative proportion of involved breeds. In addition, a breed-related risk factor analysis was carried out.

Materials and methods

Materials

Dog bite-related incidents reported between 1995 and 2004 to the Public Health Department of Aragón (Spain) were collected using the Rabies Control and Prevention Programme. According to this program, the health staff from the Public Health centre where the victim is attended (i.e., primary care center, emergency department, etc.) fills out a record with information related to the incident and then reports it to the Public Health department. Subsequently, the dog is subjected to an observation period carried out by official veterinarians. Records, archives were obtained and information related to the number of cases and the dog's breed was gathered for the present study.

The region of Aragón (area = 47,719.2 Km^2) is situated in the northeast of Spain and it comprises 3 provinces, each of them with a provincial capital. The most important of the latter represents also the region's capital and is located in the center of the region.

Human population data were extracted from the 2001 official census of Aragón. The total population was 1,204,215 inhabitants; of these, 53.6% lived in the region's capital and its outskirts. To avoid bias, data on the number of cases were divided into 2 strata: (1) low-populated area (average density: 12.2 inhabitants per Km^2), made up of towns and villages; and (2) high-populated area (average density: 337.6 inhabitants per Km^2), made up of the region's capital and its outskirts. Only post-1997 data were available in the high-populated area.

Canine population data were obtained from the 2004 municipal census of the 3 main urban areas (provincial capitals). In this regard dogs were registered by a tax code linked to the rabies vaccination that remains mandatory once a year in this region. The registered population totalled 15,493 dogs, of which 644 (4.2%) belonged to the so-called DB and their crosses. According to Spanish legislation (RD 287/2002), the DB list includes the pit bull terrier, Staffordshire bull terrier, American Staffordshire terrier, rottweiler, Argentine Dogo, Brazilian fila, Tosa Inu, and Akita Inu breeds.

Both crossbreed dogs (generic term to name mongrels and mixed dogs) as shepherd-type dogs (non-purebred dogs that people describes as shepherd-like animals according to morphologic or functional aspects) were considered as separate breeds. In addition, particular crosses within the crossbreed group were dealt with independently, namely: German

shepherd crosses, mastiff crosses, and DB crosses. These subdivisions were considered relevant in the light of their frequent involvement in bite incidents according to literature and other features such as body traits and original function.

For the purposes of simplifying results, only data of the 32 most popular breeds (accounting for the 90% of all registered dogs) were presented, thereby excluding breeds with a registered population lower than 85 individuals; with the exception of shepherd-type dogs (65 individuals). Among these 32 breeds, the 6 most popular ones (cross-breeds, cocker spaniel, German shepherd, Yorkshire terrier, poodle, Siberian husky) together with the DB group (DB and their crosses) accounted for 65% of all registered dogs.

Lastly, regional records for the number of dogs vaccinated annually against rabies were used as a proxy for the evolution of canine population in Aragón. Because rabies vaccination in this region is mandatory, it was expected that the vaccinated canine population highly mirrored the total canine population.

Statistical analysis

First, the annual incidence of dog bite-related incidents during the non-legislated period (1995 to 1999) and the legislated one (2000 to 2004) was calculated in the low and the high-populated area. Incidence was expressed as the number of bite incidents per 100,000 inhabitants. In addition, an univariate analysis of variance (weighted general linear model) was used to examine simultaneously the effect of legislation (L) and population density (D) on the incidence of dog bites. A first test was carried out by establishing 2 main periods of time within each area of study: non-legislated period and legislated period. A second test included a subdivision of the latter, considering a nBSL period (2000 to 2001) and a BSL period (2003 to 2004). Because 2002 was considered as a transition period (introduction of BSL), this year was excluded from the second test. The interaction between explanatory variables was also included (L × D).

Second, the relative proportion of the biting individuals within the breeds was studied during the 2 5-year periods. These proportions were compared with reference information from the canine census to detect disparities between both sets of data. To complete the assessment of breed dangerousness, a breed-related risk factor analysis was carried out. The study was designed as a retrospective case-control type, where "cases" were the animals of a given breed that caused bites and "controls" were the rest of registered animals of that breed. Odds ratio (OR) and its confidence interval (CI) were used to test the association between the variables "breed" and "bite incident." The factor "breed" was considered positively associated with "bite incident" when OR was greater than 1, and negatively when OR was less than 1. In addition, the χ^2 test was used to determine the statistical significance between the association. Because the canine

census was just available for the last period of study in the main urban areas, only data from 2000 to 2004 in these areas were used for the analysis.

Calculations were carried out using the statistical program SPSS 13.0. for Windows (SPSS, Inc., Chicago, IL). Estimation of OR and CI was carried out using the epidemiologic program Win Episcope 2.0. (Thrusfield et al., 2001). P less than 0.05 was considered significant.

Results

A total of 4,186 dog bite-related incidents were registered during the course of the period of study, 1,877 during the first 5-year period (1995 to 1999) and 2,309 during the second one (2000 to 2004). Breed information was available in 48.7% (n = 915) of collected cases during the first period and in 52.1% (n = 1203) during the second one.

Annual incidences from 1995 to 2004 together with the evolution of canine population during this period are represented in Figure 1. The following incidence mean values (SE) were obtained during the non-legislated and legislated period, respectively: (1) low-populated area, 71.8 (3.8) and 73.0 (3.3); and (2) high-populated area, 18.6 (3.9) and 9.3 (3.0) (bite incidents per 100,000 inhabitants). Univariate analyses of variance showed a significant effect of the population density (D) on the incidence of dog bites regardless of the periods. A non-significant effect of legislation (L) in general (first test), and of nBSL or BSL in particular (second test) was observed. In addition, a non-significant interaction was detected between both variables (L × D) Table 1 shows the results from the second test.

The distribution of bites according to the breed is summarized in Table 2. The same 7 breeds (German shepherd and its crosses, crossbreeds, shepherd-type dogs, mastiff, Siberian husky, cocker spaniel, and Belgian shepherd) accounted for greater than 70% of the bite incidents across the 2 periods of study, although German shepherd and crossbreeds stood out among the rest of biting breeds. When considering a "shepherd group" made of German shepherd and its crosses, Belgian shepherds and shepherd-type dogs, they were involved in 38.3% and 34.7% of the incidents during the first and the second period, respectively. No DB were included among the 7 most bite-causing breeds, although rottweilers bit in similar proportion to Belgian shepherds. Figure 2 shows the involvement of the 7 most popular breeds (mastiff and shepherd-type dogs have also been represented because of the importance of the aforementioned results) in biting episodes during both 5-year periods. From the most biting breeds group, only crossbreeds and cocker spaniel did seem under-represented with respect to their relative presence in the reference canine population.

During the period 2000 to 2004 (legislated period), a total of 401 dog bite-related incidents were recorded in the main urban areas. Breed information was available in 228 (56.9%) of the cases, of which 12 (5.3%) belonged to the
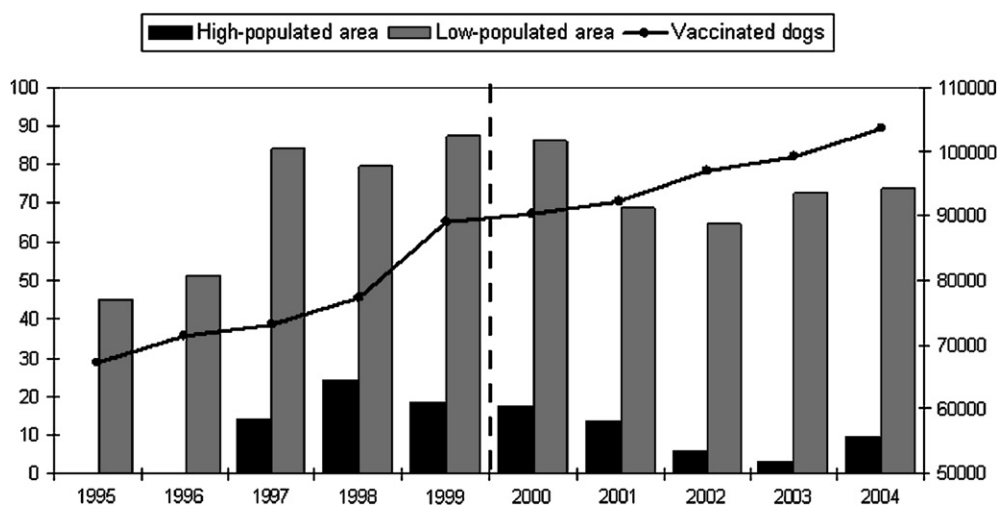
Figure 1   Annual incidences of dog-bite related incidents (per 100,000 inhabitants) (left scale) and evolution of canine population within the study area according to the number of vaccinated dogs against rabies (right scale) across the period of study. The broken line shows the division between the non-legislated and the legislated period. Only post-1997 data were available in the high-populated area.

DB group. The results of the breed related-risk factor analysis are shown in Table 3. Only in the case of the German shepherd was the breed associated positively with causing an incident. Instead, crossbreeds and cocker spaniel seemed significantly under-represented when compared with registered dogs. Furthermore, belonging to the DB group was not significantly associated with causing a bite.

Discussion

In the present study, the impact of the Spanish Dangerous Animals Act (50/1999, R.D. 287/2002) on the epidemiology of dog bite-related incidents was assessed. It is important to note that this study deals only with medically-attended dog bites.

According to the results, the implementation of nBSL measures and the subsequent DB list did not exert a significant effect on the incidence of dog bites during the non-legislated period. Because this finding was observed both in the region's capital area (high-populated area) as in

the rest of the territory (low-populated area), the results suggest that introduction of the act was unsuccessful in the attempt to reduce the number of people injured by dog bites.

Despite this finding, some aspects should be considered when interpreting the results. On one hand, it is likely that a rise in canine population occurred during the last period, thus increasing the probability of being bitten by a dog (Berzon et al., 1972). According to the records rabies-vaccinated dogs in Aragón (Figure 1) a striking rise in the number of dogs did indeed occur just before enacting the law. On the other hand, it is also likely that a greater tendency to notify bite incidents existed as a result of the growing public awareness after introduction of legislation (Berzon et al., 1972). By contrast, this is difficult to estimate, especially in small towns and villages.

These results are similar to those found by Klaassen et al. (1996), who carried out a comparative prospective study in 1 Accident and Emergency department before the implementation of the Dangerous Dogs Act in 1991 in the UK and again 2 years later. In this case, 2 3-month periods of time were compared showing little impact of legislation on the rate of bite injury patients after legislation.

Furthermore, the present results show that there were significant differences in the incidence of dog bites depending on the area of study, namely low-populated (71.8 and 73.0 per 100,000 inhabitants) and high-populated area (18.6 and 9.3 per 100,000 inhabitants). It is important to note that these differences already exited before enacting the law. A study conducted in another Spanish region (Valencia) found very similar results, showing an incidence of 71.5 bites (per 100,000 inhabitants) in the total region and of 19.8 bites (per 100,000 inhabitants) in the region's capital area (León, 2006). These findings are in agreement with a recent survey that found that respondents from rural areas were 3 times more likely to have been bitten by dogs

Table 1   Weighted least square means (SE) from dog bite-related incidents in relation to legislation in force and population density

	Low-populated area* $\bar{x}$ (SE)	High-populated area* $\bar{x}$ (SE)	P value		
			L	D	L × D
nL	71.8 (3.9)	18.6 (3.9)			
nBSL	77.3 (5.3)	14.8 (4.8)	NS	<0.001	NS
BSL	73.1 (5.2)	6.0 (4.8)			

BSL, Breed Specific Legislation (2003-2004); D, population density; L, legislation in force; nBSL, non-Breed Specific Legislation (2000-2001); nL, non-Legislation (1995-1999).
  *Expressed as the number of bite incidents per 100,000 inhabitants.

Table 2 Bites distribution (%) according to the dog breed during both 5-y periods

Breed	1995-1999	2000-2004
Alaskan malamute	2.2	0.7
A. Staffordshire t.*	0.0	0.2
Belgian shepherd	2.3	2.4
Boxer	1.4	0.4
Braco	1.5	0.7
Bulldog	0.0	0.3
Cocker spaniel	2.6	4.7
Crossbreeds	19.1	21.4
Dachshund	0.2	0.4
Epagneul Breton	0.7	0.9
Fox terrier	1.6	1.2
German shepherd	23.6	20.0
German shepherd crosses	6.1	4.5
Golden retriever	0.1	0.2
Gos d'atura	0.7	0.7
Labrador retriever	0.3	0.7
Mastiff	8.0	5.6
Mastiff crosses	1.5	1.2
Pekingese	1.7	1.6
Pit bull terrier*	0.4	0.6
Pointer	0.7	0.6
Poodle	2.0	1.9
Rottweiler*	2.0	2.2
Sabueso	0.4	0.7
Samoyed	0.4	0.2
Schnauzer	0.4	0.8
Shih Tzu	0.0	0.1
Shepherd-type dogs	6.3	7.8
Siberian husky	3.8	3.7
Setter	0.2	0.7
West Highland w.t.	0.1	0.3
Yorkshire terrier	1.3	1.3
Other non-DB	8.1	10.6
Other DB	0.0	0.5
Total (%)	100	100

DB, dangerous breeds.
  *Breeds belonging to the DB group.

in their lifetime experience than city dwellers (Wake et al., 2006).

The differences in the incidence values depending on the population density might be accounted for by physical environment-related factors. Thus, it is likely that most dog owners might not allow their pets to roam freely and unattended in densely populated areas with few open spaces and heavy traffic (e.g., a major city). By contrast, people living in an area characterized by 1-family homes and much open space (e.g., small towns and villages) might allow dogs to roam unleashed because of the considerably less hazardous situation (Harris et al., 1974). In addition, psychologic and cultural factors might also influence the incidence of dog bites in each particular area (Beck and Jones, 1985).

Considering this, it could be hypothesized that the physical environment by itself might indirectly raise people's consciousness in densely populated areas promoting a more responsible dog-ownership. Moreover, it is likely that compliance with the regulation measures in these already sensitized populations may turned out to be easier than in areas of low population. In fact, in the present study the incidence of dog bites in the region's capital area underwent a downward trend during the legislated period. It is possible that a significant decrease might be observed by including further years in the study. Even so, the situation in this area before the implementation of the law did not seem to be critical compared to the situation in the rest of the territory or in other reviewed studies in Spain and abroad (Knobel et al., 1997; Thompson, 1997; Borud and Friedman, 2000; León, 2006).

According to the data on bite-causing dogs, the present results suggest that no great changes in the distribution of involved breeds occurred since legislation was first introduced. Thus, German shepherd together with crossbreed dogs, 2 of the most popular breeds, accounted for the vast majority of the total bite incidents during both 5-year periods. It is suggested that the breed of the dogs most often involved in bite incidents covaries with the popularity of the breed (Overall and Love, 2001). Other popular breeds such as cocker spaniel or Siberian husky but also less popular ones such as mastiff, shepherd-type dogs, or Belgian shepherd constituted the rest of the main biting breeds. Furthermore, the shepherd group was involved in a third of the incidents across the 2 periods of study. On the other hand, the distribution of only certain breeds (German shepherd, mastiff, shepherd-type dogs) according to their involvement in bite incidents during each 5-year period was disproportionate to the distribution in the reference canine population (Figure 2).

Recent results from prospective and retrospective studies in hospitals or in public health departments (Kahn et al., 2003; León, 2006; Schalamon et al., 2006) agreed that the German Shepherd was the breed involved most frequently. It is worth mentioning that some large, dark-colored dogs might be classified incorrectly as German shepherds (Mathews and Lattal, 1994) causing an over-reporting of this breed. Despite the misinterpretation, this finding might suggest that German shepherd-like dogs are frequent biting animals. The shepherd group (Horisberger, 2002) and the crossbreed dogs (Avner and Baker, 1991; Gracia et al., 1992) were among the most bite-causing animals in other studies.

Data on DB, on the other hand, denote that these animals were involved in a small proportion (<4%) of the incidents during both 5-year periods. This finding had been observed previously in studies from hospitals and public health departments (Kahn et al., 2003; León, 2006). Moreover, a behavior test showed no significant differences in the frequency of inadequate aggressive behaviors between the legislated breeds and a comparison group of golden retrievers (aggression assessed by the scaling system of the
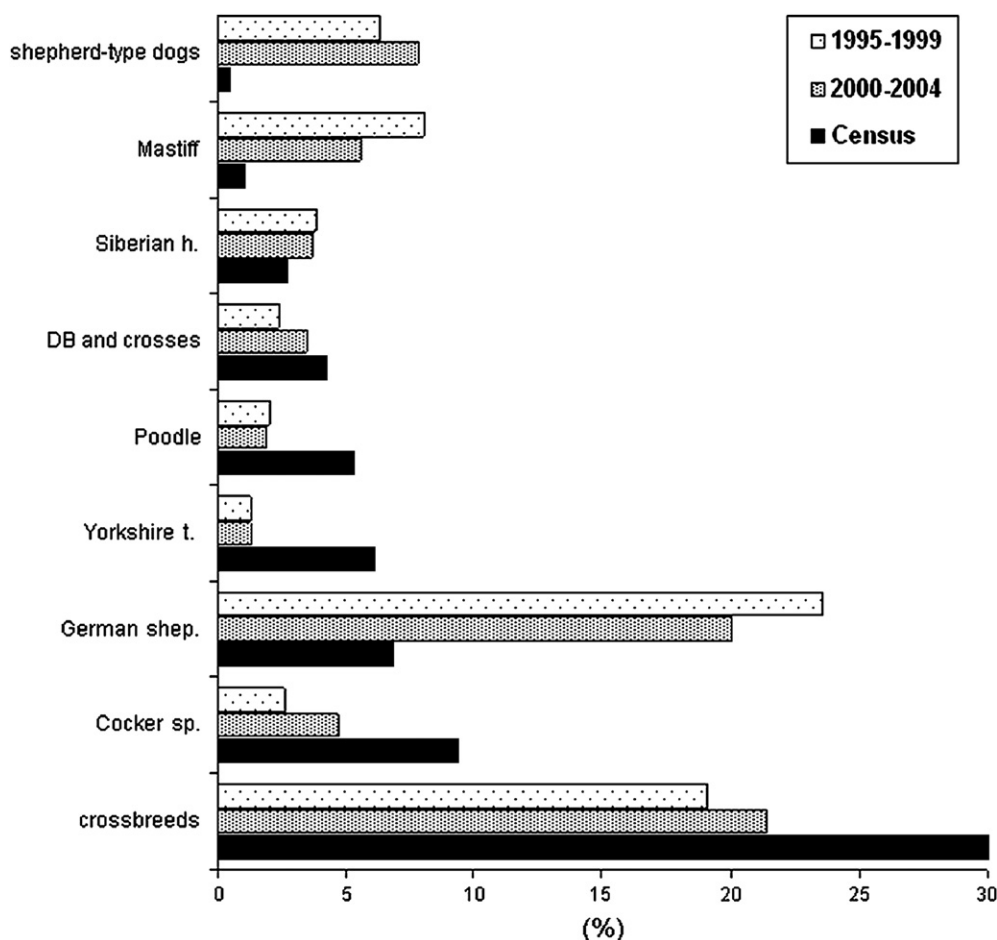
Figure 2   Breeds distribution (%) according to their involvement in bite incidents during the periods 1995 to 1999 and 2000 to 2004 and to their representation in a canine population (census reference). The 7 most popular breeds (sorted by decreasing popularity) along with mastiff and shepherd-type dogs.

study) (Johann, 2004). A slight increase in the number of reports involving DB was noted during the second period. Although this might be explained by a rise in the number of DB dogs, this seem to be unlikely considering the example of the marked fall in the number of registered rottweilers in Spain during the last years precisely as a consequence of the introduction of legislation (data from the Spanish FCI Official Kennel Club) (Fatjó, 2006). Instead, it might be reasonable to assume that a greater likelihood to notify incidents caused by DB and include breed information occurred after the implementation of the act, especially BSL (Sacks et al., 1989). In this regard, it has been proven that an important aspect in the evaluation of canine aggressiveness is the breed-related preconceived opinion, which would be biased by the media (Nordhaus, 2001).

The study conducted by Klaassen et al. (1996) showed similar results regarding the involvement of German shepherd and crossbreed dogs in bite incidents before and after legislation. In the case of DB, however, a higher proportion of these animals was observed during the first period (6.1%) and a substantial increase was registered during the second one (12.25%).

Considering the aforementioned results, it is important to note, however, that a breed might seem over-represented in bite rates just because there are a great number of dogs of this breed among a canine population (Wright, 1991). According to the breed-related risk factor analysis carried out in the main urban areas, only the German shepherd was significantly over-represented among the most biting breeds. Instead, belonging or not to the DB group was not associated significantly with the likelihood of causing a bite incident.

Scientific literature regarding breed-related risk factor analysis (odds ratio [OR]) is scarce. It is worth mentioning that the German shepherd, both alone and along with other shepherd dogs, was represented significantly among the most biting breeds in all reviewed studies (Gershman et al., 1994; Horisberger, 2002; León, 2006). In addition, similar results were also found in studies where the risk index (RI) (ratio between the proportion of aggressive dogs of each breed and the representation of that breed among the canine population) was calculated (Thompson, 1997; Schalamon et al., 2006). However, calculation of the RI instead of the OR analysis makes it difficult to establish comparisons among breeds to detect significant differences.

Table 3   Breed-related risk assessment[†]

	n	P value	OR	CI
Non-dangerous breeds	216	NS		
Cocker spaniel	10	*	0.441	0.238-0.819
Crossbreeds	44	**	0.590	0.429-0.812
German shepherd	51	***	4.115	3.067-5.520
Poodle	5	*	0.398	0.169-0.939
Siberian husky	10	NS		
Yorkshire terrier	3	*	0.201	0.072-0.563
Dangerous breeds	12	NS		
Rottweiler	8	NS		

CI, confidence interval; n, number of biting dogs in the main urban areas during the period 2000-2004; OR, odds ratio.

*$P < 0.05$.
**$P < 0.001$.
***$P < 0.0001$.
[†]Only breeds where valid results were obtained in the risk factor analysis are listed.

Risk factor results regarding the rest of the breeds differ from one study to another. These differences might be explained by particular characteristics of the canine population depending on the area and the period of the study (Wright, 1991; American Veterinary Medical Association, 2001). Considering this, caution should always be exercised in extrapolating results from one geographic area to another one. In addition, differences might be related to the type of study carried out. A recent study conducted in a referral practice in Spain showed that the cocker spaniel displayed the highest risk for aggression toward people, especially for owner-directed aggression (Fatjó, 2006). It is likely that data from behavioral practices and public health departments reflect the situation concerning the canine aggression issue from different perspectives.

Some questions could be raised regarding the risk factor analyses carried out in this study. On one hand, results were obtained for only certain breeds due to limitations related to the number of registered animals, which influenced the validity of the statistical analysis. However, we considered it important to assess the statistical validity of the "breed-bite incident association." On the other hand, other animal related risk factors (e.g., sex or age) were not considered. Further analyses of these factors in different geographic areas are needed to accurately deal with this matter.

Finally, considering the results related to incidence of dog bites together with the data on breeds, some arguments can be gathered to discuss the effectiveness and suitability of the legislation regarding the issue of the dangerous dogs, especially that based on a DB list. The present results suggest that BSL was fundamentally flawed because both the involvement of DB in biting episodes during the non-legislated period (2.4%) as the target population according to the reference urban census (4.2%) was very small.

Besides the scarce effect in reducing the incidence of dog bites, the minor involvement of DB in bite incidents

during the 2 5-year periods highlights that BSL are discriminatory and entail a problem of over-inclusiveness because they assume that all DB dogs are aggressive by nature (Lockwood, 1988; Bandow, 1996). In addition, the criteria to include only so-called "fighting breeds" according to their original use might be obsolete in light of recent findings that suggest that the breed-typical behavior today has no relationship with the function in the breeds' origin owing to recent selection pressure (Svartberg, 2006). Because other breeds such as the German shepherd proved to be much more frequently involved, targeting only DB also poses a problem of under-inclusiveness because it obviates that any dog regardless of the breed may occasionally bite (Bandow, 1996). Moreover, this might lead to a false sense of security regarding the risk of causing an incident when owning an outlawed breed (Boillat, 2003).

However, extending the number of regulated breeds in the breed-based regulations should not be the solution to deal adequately with the problem. Even though it has been proven that some breeds have a higher tendency to behave more aggressively than others, a high intra-breed variation has also been denoted (Scott and Fuller, 1965; Hart and Miller, 1985; Hart and Hart, 1985; Bradshaw et al., 1996; Bradshaw and Goodwin, 1998; Takeuchi and Mori, 2006; Svartberg, 2006). This makes breed (genetic factor) less reliable to predict aggression and denotes the importance of other causative factors such as early environment, learning, and physical and mental health (Heath, 2005). In addition, it is suggested that the domestication of the dog is an ongoing process and therefore changes in aggressiveness might be possible in few generations as selection pressure changes (Trut, 2001; Gulevich et al., 2004; Svartberg, 2006). This again shows the relatively poor power of breed in predicting aggression and underlines the temporary scope of breed-based regulations. It moreover stresses the importance of behavioral considerations in dog breeding (Svartberg, 2006), which might be neglected when breeds become very popular (Overall and Love, 2001).

In this study, the nBSL measures also proved to be ineffective in decreasing the incidence of dog bite-related incidents. However, the Spanish legislation at first was ambiguous and vague at defining the concept of "dangerous dogs" that indeed led to the inclusion of the subsequent DB list. Thus, it is likely that these early measures were not suitable enough to achieve their goal. In fact, most experts on the subject uphold nBSL (Sacks et al., 2000; Overall and Love, 2001; Ledger et al., 2005; De Keuster et al., 2006; Schalamon et al., 2006) but acknowledge the need for a coordinated approach in the investigation of dog bites to elaborate accurate and effective measures (American Veterinary Medical Association, 2001; Mills and Levine, 2006).

In conclusion, the present results suggest that the Spanish Dangerous Animals Act (50/1999, RD 287/2002) was not effective in protecting people from dog bites in a significant manner. Differences in the incidence of dog

bites between the high and the low-populated areas should be considered when carrying out awareness raising campaigns about the problem in major cities but also in towns and villages where a higher frequency of bite incidents was reported. This study shows that the main biting breeds, which were not included in the DB list, continued to be the same after the implementation of legislation whereas so-called DB accounted for a minor part of the incidents. To our knowledge, this is the first study that assesses the impact of a dangerous dogs legislation over long periods of time both before and after its implementation. We hope these results contribute to create a scientific base on the investigation of dog bites with which current regulation measures can be improved.

Acknowledgments

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