



Contents lists available at ScienceDirect

## The Veterinary Journal

journal homepage: [www.elsevier.com/locate/tvj](http://www.elsevier.com/locate/tvj)

# Dog bites in The Netherlands: A study of victims, injuries, circumstances and aggressors to support evaluation of breed specific legislation

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## ARTICLE INFO

Article history:  
Accepted 2 October 2009

Keywords:  
Breed specific legislation  
Dog bite  
Dangerous dogs  
Attack record  
Bite risk index

## ABSTRACT

As part of an evaluation of Dutch breed specific legislation, data were collected from dog bite victims (1078) and dog owners (6139) using Internet surveys. The incidence rate of dog bites and details of incidents (victims, injuries, circumstances and aggressors) are reported and the justification for using breed specific measurements to deal with dog bites are considered. For aggressors, attack records for breed groups and popular breeds were established by calculating breed risk indices using a reference population. Several breeds and breed groups were over- and under-represented in the biting population and there was a mismatch between risk indices and the then-current legislation. Mitigation strategies should not be based on attack records (since this would lead to the rejection of a significant proportion of the canine population) but on the circumstances of the incidents. Preventative measures must focus on a better understanding of how to handle dogs.

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## Introduction

Dog bites are of serious concern to public health and safety. By the age of 12, more than half of the children in the USA are reported to have been bitten by a dog (Spiegel, 2000), and Belgium has an annual frequency of 22 bites per 1000 children (De Keuster et al., 2006). Furthermore, 15.6% of dogs in a Canadian veterinary caseload have shown lifetime bite behaviour (Guy et al., 2001).

The incidence of dog bites forms a pyramidal shape, with an estimated 670 hospitalisations, 16,000 Emergency Department (ED) visits, 21,000 other medical visits, and 187,000 non-medically treated bites for each US dog bite-related fatality (DBRF) (Weiss et al., 1998). In the USA, rates of 7.1 fatal bites per 100 million population per year have been cited (Langley, 2009; Sacks et al., 1996) and 15.8 per 1000 people for all bites (Gilchrist et al., 2008). In The Netherlands such comparative estimates have not been made, but several registers provide an insight into the incidence of fatal and non-fatal dog bite injuries, but with no information on bites that were not medically treated. If the data from these registers in 2009 are presented in the same way as Weiss et al. (1998), it appears that for each Dutch DBRF there are approximately 150 hospitalisations, 5000 ED visits and 36,000 visits to a family

practice (FP).<sup>1,2</sup> In the years between 1997 and 2006, the annual average incidence of DBRF in The Netherlands was approximately 9.1 per 100 million of population.<sup>3</sup> Children appear over-represented in the upper parts of the dog bite pyramid for both DBRFs and non-fatal medically attended bites (Castrodale, 2007; Gilchrist et al., 2008; Horisberger et al., 2004; Langley, 2009; Ozanne-Smith et al., 2001; Rosado et al., 2009; Sacks et al., 1996), but children and adults are equally represented in the lower part of the pyramid, namely, the non-medically attended bite incidents (Gilchrist et al., 2008).

Legislation is frequently used in an attempt to reduce injuries and deaths from dog bites through breed specific legislation (BSL) or non-breed specific legislation (nBSL). BSL typically prohibits the breeding and ownership of certain breeds or types of dogs categorised as 'dangerous' or 'aggressive' and nBSL includes

<sup>1</sup> Information on hospitalisations and ED visits from the Dutch Foundation Consument en Veiligheid (Department for Consumer and Safety; see: [www.veiligheid.nl](http://www.veiligheid.nl)). Data on hospitalisations from all Dutch hospitals as recorded in the database Landelijk Medische Registratie (National Medical Registration). Data on ED visits from a selection of hospitals in The Netherlands as recorded in the database Letsel Informatie Systeem (Injury Information System).

<sup>2</sup> Information on FP visits from The Netherlands Institute for Health Services Research (NIVEL; see: [www.nivel.nl](http://www.nivel.nl)) and the Centre for Quality of Care Research WOK (see: [www.wokresearch.nl](http://www.wokresearch.nl)). Data on FP visits from a network of practices gathered in the Landelijke Informatie Netwerk Huisartsenzorg (National Information Network Family Practice Care; see: [www.lin.nl](http://www.lin.nl)).

<sup>3</sup> Information on DBRF in The Netherlands provided by the Dutch national statistics agency, CBS (Statistics Netherlands), which manages the database that registers the causes of death for all residents.

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regulations to promote responsible dog-ownership (Rosado et al., 2007). The classification of breeds or types as 'dangerous' is generally based on attack record or aggressive potential (Collier, 2006).

For several reasons BSL has been increasingly criticised and deemed inappropriate and ineffective (AVMA, 2001; Collier, 2006; Horisberger et al., 2004; Klaassen et al., 1996; Kuhne and Struwe, 2006; Ledger et al., 2005). Firstly, obtaining a reliable attack record is complicated due to scarce data on the reference population, incomplete breed registration, incorrect breed-identification, the number of non-purebred dogs and the narrow scope of relevant studies (AVMA, 2001; Collier, 2006). Moreover, BSL is rarely based on such records (Mills and Levine, 2006; Rosado et al., 2007). Secondly, the view that aggressive potential is linked to dog breed is a point of serious concern as a dog's tendency to bite or show aggressive behaviour depends on more than just genetics, and other factors such as heredity, experience, socialisation and training, health, and victim behaviour all play a role (AVMA, 2001). As such, it has been advocated that aggressive potential should be evaluated for dogs individually (Collier, 2006).

This paper presents the first part of a study that evaluated Dutch BSL, as requested by the Dutch government. BSL was enacted to reduce the incidence of dog bites, especially fatal attacks and serious attacks requiring medical care. As far as we know, this is the first scientific evaluation initiated by a government to evaluate BSL. The work was part of a larger series of studies that contributed to the abolition of BSL in The Netherlands.

To establish the necessary perspective, we made an inventory of the details of bite incidents and of the canine population in The Netherlands. We surveyed subscribers to a representative on-line panel of people who had been bitten by a dog in the preceding 24 months, including incidents that were not presented in public health records (Beck and Jones, 1985; De Keuster et al., 2006).

## Materials and methods

### Surveys

Three retrospective cross-sectional surveys were conducted each using a representative database of 200,000 persons, managed by the Dutch research agency TNS NIPO.<sup>4</sup> Surveys were conducted using computer-assisted self interviewing (CASI) in which respondents participated using their own personal computer, received a notification e-mail after which they completed the questionnaire at a self chosen moment and returned it via the Internet or a direct modem connection (Bronner et al., 2003). The database permits submission of surveys at household-level (one family-member responds on behalf of the others), or respondent-level (where a specific family-member is addressed).

The first survey was conducted in November 2007 at household-level and included 40,355 households (reaching 141,058 people). For each positive response to the question 'Have you or has family member [x,y,...,n] been bitten at least once by a dog in the last 24 months?' we allocated the specified person as a case. Cases were limited to one per person. In total, 1420 people were classified as cases.

The second, respondent-level survey was conducted in the same month and reached 1220 of the initial 1420 cases (the remaining 200 cases could not be reached by e-mail). When the individual was younger than 14 years of age, a parent or guardian was asked to answer on behalf of the child. Information on the most recent incident was collected including victim details, victim–aggressor relationship, circumstances of the incident and breed accountable (throughout this study the term *breed* refers both to purebred dogs and look-alikes). To facilitate breed-identification, each respondent received a poster by mail, showing photographs of the 50 most popular breeds in The Netherlands (based on registrations in 2005 in the Dutch dog pedigree register) and a selection of seven other breeds that were known or suspected to be the objective of BSL in other European countries. Photographs were shown in alphabetical order, based on the breed name.

The third survey, conducted in February 2008 at household-level, included 10,014 households registered as dog owners. Information on breeds and registration status for all dogs in the household was collected.

### Data management

Survey questions were closed-ended, although some had the open-ended option of 'other'. Prior to statistical analysis, responses in the category 'other' were examined and assigned to the other answer categories for that question or, if a response did not fit any of the given categories or if the response was unclear, to the category 'I don't know' (which was later renamed 'unknown'). After this, categories were pooled into new mutually exclusive categories. For eight variables, responses were pooled into two categories. These are (with the categories set between parentheses): age group (adult/child), aggressor–victim relationship (non-owner/owner), location of incident (non-public areas/public areas), aggressor–victim interaction (interaction/no interaction<sup>5</sup>), behaviour of the dog (intentional bite/unintentional bite<sup>6</sup>), severity of injuries (no or minor injuries/severe injuries<sup>7</sup>), injury site (extremities/head or torso), medical treatment (medical treatment/no medical treatment).

Breeds acknowledged by the Fédération Cynologique Internationale (FCI) were given a unique code. Variations (such as, for example, long-haired and short-haired) were regarded as the same breed. Breeds that are not acknowledged by the FCI and dogs of mixed breeds or mongrels were denoted 'mixed breed/mongrel'. Subsequently, breeds were classified according to their breed group.

### Establishing a bite risk index

A bite risk index (BRI) was determined for all breed groups and for a selection of popular breeds, as described by Schalamon et al. (2006). The selection was based on the distribution of breeds in the canine population that was found in the third survey and included the top 90% of breeds. The selection included 53 breeds (including mixed breed/mongrel) and excluded 132 breeds with <18 dogs each. We assessed BRI for all bites, intentional and unintentional, with BRI defined as:

$$\frac{\text{The fraction of breed}_x \text{ within the biting population}}{\text{The fraction of breed}_x \text{ within the canine population}}$$

### Statistics

Data were analysed using Statistical Package for the Social Sciences (SPSS) 16.0 and Microsoft Office Excel 2003 for Windows. Data on the eight variables on victims, injuries and circumstances were organised in cross-tabulations and association between variables was tested with Pearson's Chi square test. Data on breeds were presented in contingency tables with the variables breed (breed<sub>x</sub> or non-breed<sub>x</sub>) and population (biting population or canine population). To test for statistical significance of differences between the two fractions, we used Fisher's Exact test for breeds and Pearson's Chi square test (without Yates' correction) for breed groups. Responses in the category 'unknown' were considered as missing data in statistical analyses. Tests were two tailed, and significance was accepted if  $P < 0.05$ .

## Results

In the second survey, 1078 responses could be included in our analyses and nine were dropped because the respondents had indicated that no dog bite incident had occurred. This reflected a response rate of 89% (Table 1). An annual incidence of dog bites of 8.30 (95% CI 7.69–8.91) per 1000 population was found. Men were over-represented ( $P < 0.05$ ) and no difference existed between incidence for people up to 18 years of age and those who were 18 and older.

<sup>5</sup> The aggressor–victim interaction denotes the presumed trigger of the incident (i.e. the behaviour of the victim prior to the incident). An incident was classified as 'aggressor–victim interaction' when the victim indicated activities that implied interaction with the dog (e.g. petting or playing with the animal, interfering with the dog while it was eating or sleeping, stepping on it or pulling its ears or tail). An incident was classified 'no aggressor–victim interaction' when the victim indicated activities that implied no interaction with the dog (e.g. 'I met the dog with its owner', 'I met the dog without its owner', 'I was jogging or riding a bicycle', 'I did not interfere with the dog').

<sup>6</sup> Intentional bites are those bites where the victim thought that the dog bit intentionally, either with or without giving warning signs (barking, growling and/or showing of the teeth), whereas unintentional bites are those bites where the victim believed the dog bit during play or by accident.

<sup>7</sup> Victims indicated the severity of injuries themselves. Injuries were classified as 'no injuries' when the individual reported damaged clothing, bruising of the skin (black spots), or teeth marks on the skin without breaking it. Injuries were classified as 'minor injuries' when the victim reported breaking of the skin with superficial wounds. 'Severe injuries' were those where the victim reported breaking of the skin with deep wounds or tissue loss.

<sup>4</sup> See: [www.tns-nipo.com](http://www.tns-nipo.com).

**Table 1**  
Details of 1078 dog bite incidents in The Netherlands.

Details of incidents	n (%) <sup>a</sup>
<b>Gender</b>	
Male	558 (52)
Female	520 (48)
<b>Age</b>	
Adult (≥16 years)	854 (79)
Child (<16 years)	224 (21)
<b>Dog in household</b>	
Yes	545 (51)
No	533 (49)
<b>Aggressor–victim relationship</b>	
Non-owner	772 (72)
• Familiar with owner	• 431
• Not familiar with owner	• 341
Owner	304 (28)
<b>Location of incident</b>	
Non-public areas	665 (62)
• On dog's territory	• 556
• Not on dog's territory	• 109
Public areas	407 (38)
<b>Aggressor–victim interaction</b>	
Interaction	590 (60)
No interaction	389 (40)
<b>Behaviour of the dog</b>	
Intentional bite	702 (69)
Unintentional bite	312 (31)
<b>Severity of injuries</b>	
No injuries	339 (32)
Minor injuries	517 (48)
Severe injuries	220 (20)
<b>Injury site</b>	
Upper extremities	627 (58)
Lower extremities	313 (29)
Head	90 (8)
Torso	46 (4)
<b>Medical treatment of injuries</b>	
No medical treatment	665 (62)
• No treatment necessary	• 337
• Home treatment	• 328
Medical treatment	408 (38)
• Family practice	• 316
• Emergency Department or polyclinic	• 90
• Hospital	• 2

<sup>a</sup> Only valid responses are used for analysis, therefore totals may not add up to 1078.

Of the 1078 respondents, 52% were male and 79% were adults (≥16 years; mean 35.8 years, range 1–80 years). Most victims (82%) were bitten once, while 12% were bitten twice and 6% more than two times. Half of the respondents (51%) had a dog in their household. Approximately one-third of victims (28%) had been bitten by their own dogs and the majority (62%) of incidents took place in non-public areas. When asked for the presumed trigger of the incident (i.e. the behaviour of the victim prior to the incident), 60% indicated activities that implied they had interaction with the dog (e.g. petting or playing with the animal, interfering with the dog while it was eating or sleeping, stepping on it or pulling its ears or tail). When asked for the behaviour of the dog, most respondents thought the dog attacked them intentionally, either with (20%) or without (49%) warning signs (barking, growling and/or showing of the teeth). These incidents were classified as 'intentional bites'. 'Unintentional bites' were defined as those incidents where respondents thought the dog bit during play or by accident, and accounted for 31% of the cases.

Most of the incidents resulted in no (32%) or minor (48%) punctures of the skin, whilst 20% resulted in severe punctures (deep

wounds or tissue loss). Most victims were bitten in the upper (58%) or lower (29%) extremities, while bites to the head (8%) and torso (4%) occurred less frequently. In 62% of the cases, the bite was not medically treated.

Almost every respondent (92%) specified the aggressor's breed while looking at the identification poster. In total, 86 different breeds of dogs were identified, 764 dogs of a specific breed, 212 dogs of the group mixed breed/mongrel, and 102 dogs were of unknown breed. When asked how certain the respondents were about their answer on this question, 77% indicated they were 'very certain' and 19% indicated they were 'certain'.

Association between eight variables (age group, aggressor–victim relationship, location of incident, aggressor–victim interaction, behaviour of the dog, severity of injuries, injury site and medical treatment) was examined more closely. Four variables, age group, aggressor–victim relationship, location of incident and behaviour of the dog, were tested for association among themselves and with the remaining variables.

#### Differences between adults and children

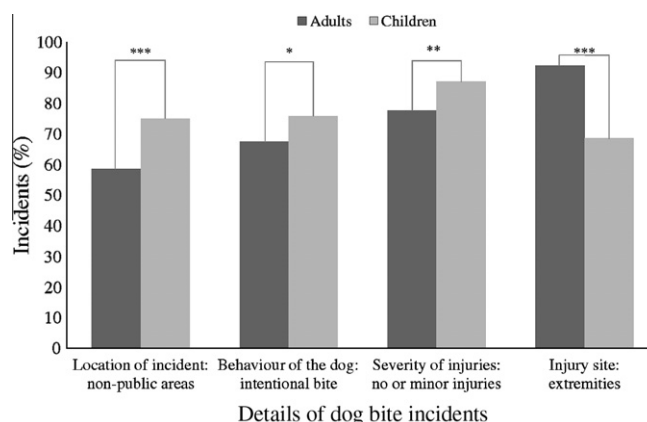
Cross tabulation of the variable age group with the seven other variables revealed that the variables aggressor–victim relationship, aggressor–victim interaction and, medical treatment were not related to age group. The other four variables did show a significant association with the variable age group (Fig. 1).

Children were bitten in non-public areas more often (75%;  $P < 0.001$ ) than adults (59%). They were bitten intentionally more often (76%;  $P < 0.05$ ) than adults (68%), and they had no or minor injuries more often (87%;  $P < 0.01$ ) than adults (78%). Adults reported 'extremities' as the site of injury (92%) more often ( $P < 0.001$ ) than children (69%).

#### Differences between incidents involving the aggressor dog's owner and incidents involving someone other than the owner

Cross tabulation of the variable aggressor–victim relation with the seven other variables revealed that the variables age group and injury site were not related to aggressor–victim relation. The other five variables did show a significant association with the variable aggressor–victim relationship (Fig. 2).

Incidents where the dog bit its owner occurred in non-public areas more often (86%;  $P < 0.001$ ) than incidents where the dog bit someone who was not its owner (53%). For these type of incidents it was reported more often ( $P < 0.001$ ) that there was interaction between the aggressor and the victim (90%), compared to incidents where the victim was not the dog owner (48%). For inci-



**Fig. 1.** Differences between adults and children. \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

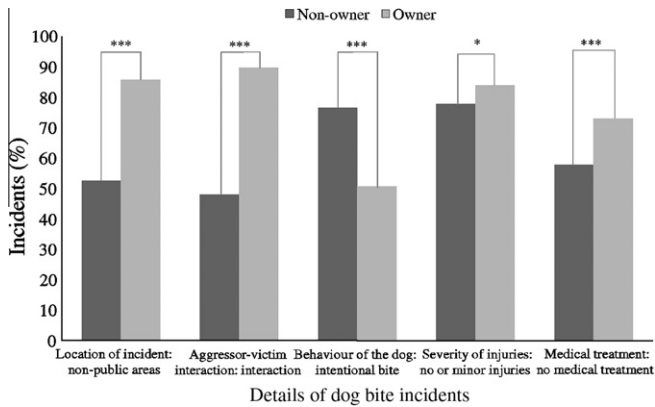


Fig. 2. Differences between incidents involving the aggressor dog's owner and incidents involving someone other than the owner. \* $P < 0.05$ ; \*\*\* $P < 0.001$ .

dents involving non-owners it was reported more often ( $P < 0.001$ ) that the dog bit intentionally (77%), compared to incidents with owners (51%). Furthermore, incidents involving the dog owner resulted in no or minor injuries (84%) more often ( $P < 0.05$ ), than incidents involving someone other than the dog owner (78%). Finally, for incidents with owners it was reported more often ( $P < 0.001$ ) that medical treatment was not sought for (73%), than for incidents with non-owners (58%). Thus, medical treatment is needed more often in the incidents with someone other than the aggressor's dog owner.

#### Differences between incidents in non-public areas and incidents in public areas

The variable location of the incident appeared to be related to all the seven other variables (Fig. 3). The association between location of the incident and age group and aggressor–victim relationship has been explained previously, but 89% of incidents in public areas involved non-owners, compared to 61% of incidents in non-public areas.

For incidents in non-public areas aggressor–victim interaction was reported more often (74%;  $P < 0.001$ ) compared to incidents in public areas (39%). These incidents also resulted more frequently in no or minor injuries (82%;  $P < 0.05$ ) and in the absence of the need for medical treatment (67%;  $P < 0.001$ ) compared to incidents in public areas (76% and 54%, respectively). In addition, for incidents in public areas intentional bites were reported more often (76%;  $P < 0.001$ ) as well as bites to the extremities (92%;

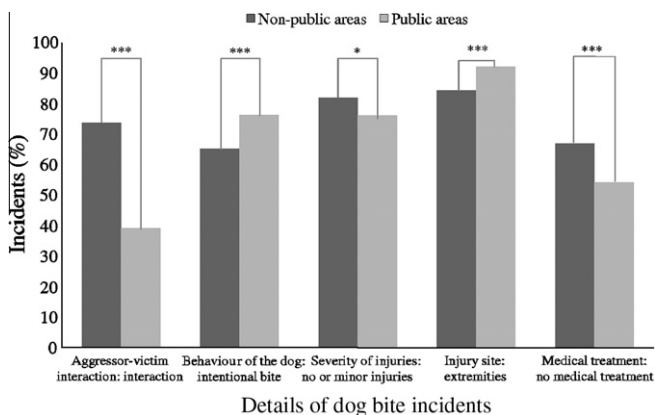


Fig. 3. Differences between incidents that took place in non-public areas and incidents that took place in public areas. \* $P < 0.05$ ; \*\*\* $P < 0.001$ .

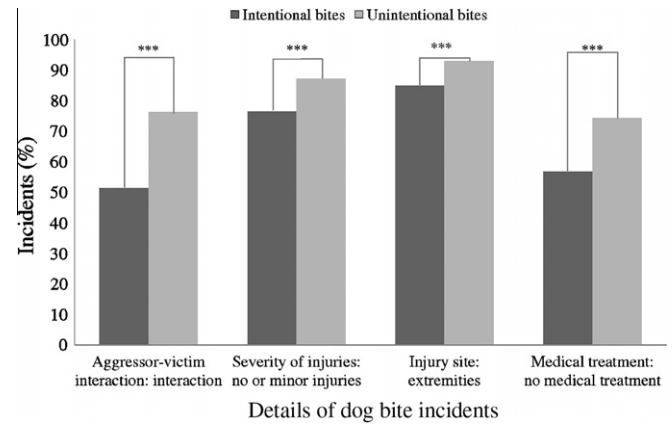


Fig. 4. Differences between intentional and unintentional bites. \*\*\* $P < 0.001$ .

$P < 0.001$ ) compared to incidents in non-public areas (65% and 84%, respectively).

#### Differences between intentional and unintentional bites

The variable behaviour of the dog was related to all seven other variables (Fig. 4). The association between behaviour of the dog and age group, aggressor–victim relationship and location of the incident has been discussed above. For unintentional bites, aggressor–victim interaction was reported more often (76%;  $P < 0.001$ ), than for intentional bites (51%). Unintentional bites resulted in no or minor injuries (87%), or bites to the extremities (93%) with no requirement for medical treatment (74%) more frequently ( $P < 0.001$ ) than intentional bites (76%, 85% and 57%, respectively).

#### Bite risk indices

The response rate for the third survey was 77%. It appeared that not all households that were registered as dog owners in the database were in fact owners at the time of the survey. Of the 7682 households that responded, 6139 actually owned one or more dogs. In these 6139 households, a total of 7926 dogs were recorded, reflecting an average of 1.29 dogs per household. For 72% of the dogs, the owners indicated a specific breed and 184 different breeds were mentioned. The rest of the dogs were classified as mixed breed/mongrel.

Table 2 displays BRIs for breeds and breed groups. When considering all bites, three breed groups and six breeds had BRIs significantly higher than 1, while two breed groups, six breeds and the group of mixed breed/mongrel had a BRI significantly lower than 1. When focussing on intentional bites, the pattern was the same, except for significance levels and the absence of the Yorkshire terrier on the low BRI-list. For unintentional bites, more differences emerged and two breed groups and two breeds were eliminated from the high BRI-list, while two new breeds appeared (Dutch Schapendoes and Shar Pei). Also, one breed group and three breeds were eliminated from the low BRI-list.

#### Discussion

As Table 3 shows, about 136,000 dog bite incidents occur annually in the Netherlands (8.3 per 1000 population), resulting in 40,000 individuals who are treated at FPs, 11,000 at EDs or polyclinics and 300 who are hospitalised. To compare these findings with those of Weiss et al. (1998) for the US, we estimated that for each Dutch DBRF, there would be 180 hospitalisations, 8000



**Table 2**

Bite risk indices (BRI) of dog breeds and breed groups for all bites, intentional bites only and for unintentional bites only. The table displays only BRIs significantly higher or lower than 1.

	All bites		Intentional bites only		Unintentional bites only	
	Number of incidents ( <i>n</i> = 1078)	BRI all bites	Number of incidents ( <i>n</i> = 702)	BRI intentional bites	Number of incidents ( <i>n</i> = 312)	BRI unintentional bites
<i>Breed groups</i>						
Sheepdogs and Cattle dogs	196	1.6***	132	1.6***	53	1.5**
Pinscher and Schnauzer, Molossoid breeds, Swiss Mountain and Cattle dogs	115	1.3**	76	1.3*	32	–
Terriers	196	1.3**	126	1.2*	55	–
Retrievers, flushing dogs, water dogs	88	0.5***	45	0.4***	37	–
Companion and toy dogs	55	0.5***	38	0.5***	14	0.4***
Mixed breed/mongrel	212	0.7***	149	0.7***	56	0.6***
<i>Breeds</i>						
Belgian Shepherd dog	58	2.1***	29	1.6*	20	2.5***
Bouvier des Flandres	19	1.8*	16	2.3**	3	–
Doberman	12	3.2**	10	4.0***	2	–
Dutch Schapendoes	6	–	3	–	2	2.5*
German Shepherd dog	75	2.9***	58	3.5***	16	2.2**
Jack Russell terrier	114	1.5***	71	1.4**	36	1.6**
Rottweiler	40	3.9***	30	4.5***	7	2.3*
Shar Pei	5	–	1	–	4	4.4*
Cavalier King Charles Spaniel	5	0.3**	2	0.2**	2	–
Golden Retriever	32	0.6**	21	0.6*	10	–
Labrador Retriever	32	0.5***	10	0.2***	20	–
Maltese	15	0.4***	10	0.4***	4	0.3*
Yorkshire Terrier	9	0.5*	7	–	0	0*

\*  $P < 0.05$ .

\*\*  $P < 0.01$ .

\*\*\*  $P < 0.001$ .

ED visits, 29,000 other medical visits and 60,000 dog bite incidents that did not require medical attention. These figures are of the same order of magnitude as those found by Weiss et al. (1998) and those reported in Dutch medical registers. However, some minor differences were seen, which could be the result of a different structure of medical care in the two countries. The total incidence of dog bites found in our study was lower than that reported for the USA, possibly as a result of the lower penetration of dogs in Dutch households; the USA has 37.2% dog-owning households (AVMA, 2007), whilst in the Netherlands 21% of households owns a dog (TNS NIPO, personal communication).

The literature suggests that the majority of children are bitten at home by dogs familiar to them and after interaction with their aggressor (De Keuster et al., 2006; Horisberger et al., 2004). The current study supports this finding. Furthermore, several studies have found that children are more prone to severe dog bites, particularly since they are bitten around the head-area more often (Brogan et al., 1995; Lang and Klassen, 2005; Rosado et al., 2009). Our study also revealed that children received bites to the

head-area more often than adults (31% versus 8%), but we did not find an over-reporting of severe injuries (i.e. those injuries where the victim reported skin breaks with deep wounds or tissue loss) among children.

Mitigation strategies addressing children should focus on teaching the young how to behave around dogs so that their behaviour does not trigger a dog bite. Since the majority of child victims bitten at home were unsupervised at the time of the incident (De Keuster et al., 2006) strategies should also include the parents. It should be emphasised that leaving a child unattended with a dog poses a serious risk for a child. Dog bites to children cannot be prevented by measures at the public security level, but should target children and their parents directly. Several successful educational interventions for the prevention of dog bites in children have been reported in the literature (Chapman et al., 2000; Jalongo, 2008; Meints and De Keuster, 2009; Spiegel, 2000; Wilson et al., 2003).

Dog owners were not the biggest group in our sample (they comprised almost one-third of the victims) but it was striking that more than half (51%) of the respondents owned a dog. This is more than twice the national average (21% of households are reported to own a dog in the Netherlands; TNS NIPO, personal communication) and suggests that people that own a dog are at higher risk of being bitten, as reported by others (Horisberger et al., 2004; Kahn et al., 2003; Rosado et al., 2009). In our study, the group of victims that were bitten by their own dogs reported more incidents in non-public areas after interaction with their aggressor and where the dog bit unintentionally. This is not surprising since dog owners are more often around their dogs playing with them and will inevitably be at a greater risk of being bitten either intentionally or unintentionally during this interaction. The consequences of these incidents appear to be less serious than incidents with non-owners, since respondents reported less severe injuries and less need for medical treatment. To reduce bite incidents involving dog owners and their own dogs it will be necessary to focus on interactions with the dog and understanding 'dog language'.

**Table 3**

Estimated annual incidence rate and number of incidents for different types of dog bite incidents in the Netherlands.

Type of dog bite incident	Estimated annual incidence rate of dog bite incidents	Estimated annual number of dog bite incidents <sup>a</sup>
Hospital admission	1.5 per 100,000	300 <sup>b</sup>
Emergency Department and polyclinic	7.0 per 10,000	11,000 <sup>c</sup>
Family practice	2.4 per 1000	40,000 <sup>c</sup>
All bites	8.3 per 1000	136,000 <sup>c</sup>

<sup>a</sup> Extrapolated using the average population numbers of 2006 and 2007 (CBS).

<sup>b</sup> Rounded to the nearest hundred.

<sup>c</sup> Rounded to the nearest thousand.

The overwhelming majority (89%) of incidents in public areas involved non-owners and in our view it is of great importance to address and reduce these incidents. For those incidents that occur in public areas, most victims believed the dog bit intentionally and that the incident happened without a clear trigger (intentional bites were reported for 76% of incidents in public areas and 61% of victims reported no interaction when the incident was in a public area). Furthermore, the incidents appeared to be more serious in terms of injuries and the need for medical treatment. Dog bite prevention strategies teaching people to interact better with dogs are unlikely to be enough to prevent these attacks as most victims did not interact with their aggressor. On those occasions where the human did not interact with the dog that bit them, the focus should be on the owners who must be made aware that their dog can inflict damage to other people, to feel accountable for the behaviour of their pet, and to be willing to take the necessary measures to prevent it causing harm to others.

We found that 1/5 incidents resulted in severe injuries and more than 1/3 victims sought medical attention. While this can be ascribed mostly to intentional bites, unintentional bites also caused severe injuries (13%) leading to the need for medical attention (26%). Thus, unintentional bites are not only 'just play', but can cause serious damage.

A number of studies have examined attack records of dog breeds but with considerable differences in study design. Examples include investigations based on the population attributable fraction (PAF) (Szpakowski et al., 1989) or the risk ratio (Shuler et al., 2008), risk factor analysis (Messam et al., 2008) or ranking (Horisberger et al., 2004). In the present study, risk factor analysis was deemed unsuitable because of the absence of a control population. Risk ratio and PAF are both products of the biting rate, something we could not assess with our two independent data sets (biting population and canine population). We therefore presented the attack records using a BRI, i.e. 'representation ratio' (Thompson, 1997) or 'risk index' (Schalamon et al., 2006), to ensure that the likelihood that a breed would bite was presented in the light of its representation within the reference population. This enabled us to compare two datasets and statistical tests made it possible for us to compare fractions. Our methods did not allow comparisons or ranking between breeds or breed groups but we believe we have been able to obtain attack records on which we may satisfactorily base breed specific measures; the study involved a great number of biting dogs and had a broad scope (including incidents not reported elsewhere), a reference population reflecting the true distribution of dogs in The Netherlands was used, and for the popular breeds over- or under-representation in the biting population was assessed.

Our findings, like those from other groups (Horisberger et al., 2004; Overall and Love, 2001; Rosado et al., 2007), do not support the use of an attack record in developing mitigation strategies. We found that *all dogs can* bite and therefore one should always be careful when interacting with a dog, even a family dog and during play. If we were to base mitigation strategies on the attack records, this would not lead to the establishment of feasible actions to take. Removing the most common biters would also imply removing the most common breeds; for example, we found that the Jack Russell terrier was responsible for approximately 10% of bites, and 8/10 of the most popular breeds were the most common biters (including the highly polymorphic group of mixed breed/mongrel). Eliminating these breeds is neither practicable nor desirable.

## Conclusions

Attack records can be assessed using the methods described but it is important to appreciate that such records may not be suitable

as a basis for the development of mitigation strategies because this would require the removal of a large proportion of the canine population. The circumstances of the incidents must be the starting point for developing a suitable strategy. Prevention strategies need to be effective in non-public as well as in public arenas and should address both dog owners and people who do not own a dog. They also require education about ways to deal with dogs, dog behaviour and 'dog language', and be directed both at children and adults, and always emphasise that even unintentional bites can inflict damage.

## Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

## Acknowledgements

We would like to thank the 'committee of wise men' for their help in designing this study. We acknowledge the Ministry of Agriculture, Nature and Food Quality for their financial support. Many thanks also to Linda McPhee for her professional support in preparing this paper and to Bas Engel, Willem Buist, Hilde Tobi, Joanne van der Borg and Matthijs Schilder for their help in the analyses. Finally, we thank all the people that contributed to the data collection in so many ways.

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