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Research

Contexts and consequences of dog bite incidents

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ABSTRACT

Dog bites are a contentious issue within the United Kingdom due to their effect on public health and increasing incidence. Despite multiple expert-led dog bite prevention schemes being available, there is limited evidence regarding the surrounding factors and likely causes of a dog bite (e.g., dog/human behavior). An online convenience sample questionnaire was distributed through social media between December 2015 and February 2016 targeting self-identified dog bite victims within the United Kingdom. A total of 484 responses were received. Victims were aged between 1 and 77 years when bitten. Most dogs (66.1%) were known to the victim. The most common context of a dog bite is related to interacting or attempting to interact with the dog (e.g., stroking, playing, handling, and restraining); however, in many cases, the dog approached the victim (50%). In 27% of cases, the dog was known to have bitten someone previously. If the upper extremities were bitten, it was likely the person approached the dog, whereas for the lower extremities, it was more likely the dog approached the person. Most injuries did not require medical treatment (62.3%), and there was no follow-on consequence for the dog involved (59.9%). Bites to an owner from their own dog were more likely to be seen as “accidental” and “unintentional” than bites from a less familiar dog. This study found contexts in which dog bites occur vary widely, and thus, a number of different prevention measures are required, including addressing repeat biters.

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Introduction

Dog bites have been noted to be increasing in the United Kingdom (HSCIC, 2015) and pose a public health concern as they can result in serious injury to a person or even death. In addition, there may be negative implications for the animal involved (e.g., relinquishment, seizure, euthanasia) (Salman et al., 2000; Diesel et al., 2008; Casey et al., 2014). Previous investigations into the frequency and causes of dog bites have been mainly through hospital/clinical data (e.g., Mannion et al., 2015), newspaper reports (e.g., Winkler, 1977; Kikuchi and Oxley, 2017), or telephone interviews (e.g. Sacks et al., 1996; Guy et al., 2001). Among these sources, much information on dog bites has been gathered, which mainly focuses on factors such as injury caused (most commonly

facial and upper extremities), age of the victim, breed of the dog, and familiarity of dog to the victim (generally known to the victim) (Reisner et al., 2011; Rezac et al., 2015; Golinko et al., 2016). Although these areas are important, there are other key areas that have not been fully addressed in literature but are important to improve our understanding of dog bites: these include the surrounding contexts and circumstances of a bite and consequences for the dog involved.

The factors surrounding dog bites (such as the victim's or dog's behavior preceding a bite) are noted to be complex and tend to not be reported in scientific literature based on clinical and hospital data (Westgarth & Watkins, 2015). Recently, Rezac et al. (2015) investigated behavior before dog bites to the face of victims. Most (76%) victims were reported to be bending over the dog and 80% occurred at the owner's home/property. Similarly, Reisner et al. (2011) interviewed 203 children aged ≤ 17 years who attended a hospital in the United States because of facial injuries as a result of a dog bite and most commonly reported bites as a result of positive intended interactions (e.g., hugging), as opposed to negative intended interactions (e.g., hurting) by the child. Although these

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studies are useful, hospital data are likely to overrepresent more severe cases or younger victims (Lakestani et al., 2014). However, the reporting of dog bites and relevant information within emergency departments may not always be recorded, even when specific training is provided, or may be poorly documented because of time constraints and/or because there is no initial direct impact on a victim's treatment (Bernardo et al., 2002; Mannion and Graham, 2016). Therefore, information about dog bites gathered through hospital data is only part of the picture. To effectively understand dog bites and their causes, research into human-dog interaction before, during, and after a wide range of bites is essential (Westgarth & Watkins, 2015).

Potential causal mechanisms for bites, and thus likely effective prevention mechanisms, will only be elucidated by detailed investigation of factors and contexts surrounding dog bite incidents. Thus, the aim of this study was to investigate the type of contexts in which dog bite incidents occur, and surrounding factors, from a group of self-identified dog bite victims, including bites that did not receive medical treatment.

Method

A questionnaire was designed to elicit information regarding dog bite incidents. The questions were developed based on the authors' experience and review of relevant literature. The final questionnaire was reviewed by 2 dog behavior experts, and a pilot study involving 10 participants was conducted before the final study.

The questionnaire comprised 5 main sections, collecting data on (1) the number of times the respondent had been bitten previously and information about the most recent dog bite (information about the dog [age, size, sex, breed, neutering status, relationship to dog]), victims location, victim behavior and dog behavior just before the bite; (2) the injury incurred and treatment received (location of bite, severity of bite, treatment received, and type of treatment); (3) the victims perception of blame for the bite; (4) the victims definition of a dog bite and views of predefined statements incorporating Dunbar's dog bite scale (APDT, n.d.); and (5) demographic information of the victim and dog (victims age, gender, education, employment sector/status, and dog ownership experience). This study reports on sections 1, 2, 3, and 5. The questionnaire consisted of 40 questions (both open and closed ended) and was completed online using the Qualtrics survey software (www.qualtrics.com).

The questionnaire was available online between December 2015 and February 2016. A link to the questionnaire was distributed through social media (Facebook and Twitter) and a University of Liverpool press release. Information provided via social media outlined the aim of the study and inclusion criteria (e.g., the respondent had to have been previously bitten by a dog, be 18 years of age or over, and live within the United Kingdom to complete the survey).

Data analysis

Once all responses were received, data were exported into SPSS 17.0 for Windows (SPSS Inc., Chicago, IL) for analysis. Descriptive data were summarized as percentages. Qualitative data gathered from open-ended questions regarding the bite context were inductively coded into emerging themes; qualitative data analysis was managed using NVivo 11 software (qualitative data analysis software; QSR International Pty Ltd., version 10, 2012). Chi-square tests were used to test for association between categorical variables, with associations presented using odds ratios (ORs) and confidence intervals (CIs); for example, the anatomic location of a

bite and age of the victim, whether treatment was sought, if the dog approached the victim or vice versa.

Results

In total, 636 responses were received, but 152 were removed for various reasons (e.g., lived outside the United Kingdom, answered less than 25% of questions). This gave a total response of 484 self-reporting dog bite victims who were aged over 18 years and lived in the United Kingdom or Ireland. As this study used a convenience sample, the results should not be interpreted as a reliable reflection of actual prevalence.

Demographics

Most respondents were female (84.8%), aged between 25 and 54 years (70.5%), and lived in England (88.9%). Most (53.6%) had at least an undergraduate degree and were in full-time paid employment (see Table 1).

Dog ownership

Currently, 82.6% (285/345) of respondents owned a dog and most (87.7%; 364/415) had owned dogs at some point in their lifetime. Of those that had ever owned a dog, 39.8% (145/364) stated they had owned dogs all their life, 23.4% (85) more than 15 years, 21.1% (77) between 6 and 15 years, 9.1% (33) stated that they had owned a dog between 0 and 5 years, and 6.6% (24) stated only as a child.

Dog bites

Just under half of the respondents (49%; 237/484) had been previously bitten on only 1 occasion; 22.9% (111) were bitten twice, 12.2% (59) 3 times, and 15.9% (77) were bitten 4 or more times. Respondents were asked to provide further details about the most recent bite, which ranged in year from 1957 to 2016. There were 74.6% (361/484) of most recent bites from over 12 months ago and 23.4% from the last 12 months. When describing this recent bite incident, most (86.0%; 416/484) victims stated that they were only bitten once, with the remaining 14.0% (68/484) being bitten more than once during this single incident.

The average age of the victim when bitten was 29.8 years (range: 1–77 years). Respondents who stated the month the bite occurred showed that bites were most common over summer months (June [13.4%; 31/231], July [15.6%; 36/231]) and the least common months being February (4.8%), March (2.2%), and April (4.8%).

Dog information

Of the dogs involved, 66.1% (320/484) were known to the victim; of those known, 34.7% (111/320) stated it was their own dog, 35.3% (113/320) stated it belonged to a close family member or a friend, and 30% (96/320) stated they were acquainted with it (e.g., seen on a dog walk).

Where dog-related factors were known, most dogs were reportedly male (68.2%; 253/371), aged between 2 and 10 years (76.6%; 328/428), and were medium (34.1%; 165/484), or large (35.7%; 173/484), in size. Regarding neutering status, 36.4% (176/484) of dogs were reportedly neutered (see Table 2 for full details).

Most respondents (73.4%; 353/481) stated they knew the breed of the dog involved. Of these, 95.8% (338/353) provided a breed name. Eighty-two different dog breeds were stated with the most common being the German shepherd/Alsatian (49/338), border

Table 1
Respondent demographics for online survey of 484 dog bite victims

Demographic	%	n
Gender		
Male	15.2	63
Female	84.8	351
Total	100.0	414
Missing		70
Current age		
18-24	10.9	45
25-34	21.3	88
35-44	24.4	101
45-54	24.9	103
55-64	15.2	63
65-74	2.7	11
75 or over	0.7	3
Total	100.0	414
Missing		70
Location		
England	88.9	368
Wales	3.4	14
Scotland	5.1	21
Northern Ireland	1.2	5
Republic of Ireland/Eire	0.7	3
Other ("the UK")	0.7	3
Total	100.0	414
Missing		70
Region within England		
North East	6.0	22
North West	27.5	101
East Midlands	9.0	33
West Midlands	6.8	25
South East	22.1	81
South West	15.0	55
Yorkshire and the Humber	5.2	19
East Anglia	7.6	28
Other	0.8	3
Total	100.0	367
Qualification level		
University higher degree (e.g., MSc, PhD)	21.0	87
First-degree-level qualification (including foundation degrees, graduate, membership of a professional Institute, PGCE)	32.6	135
Diploma in higher education	8.9	37
Teaching qualification (excluding PGCE)	1.2	5
Nursing or other medical qualification not yet mentioned	4.1	17
A level	10.9	45
International baccalaureate	0.2	1
AS level	1.0	4
Higher grade/advanced higher (Scotland)	1.0	4
Certificate of sixth year studies	0.7	3
GCSE/O level	12.3	51
CSE	1.0	4
Standard/ordinary (O) grade/lower (Scotland)	0.2	1
Other school (inc. School leaving exam certificate or matriculation)	2.7	11
None of the above	2.2	9
Total	100.0	414
Missing		70
Employment status		
Yes, work for wage, payment or profit	74.6	309
Yes, unpaid work	6.3	26
Retired	9.4	39
Home duties	5.3	22
No, I do not have a job	4.3	18
Total	100.0	414
Missing		70
Current dog ownership		
None	17.4	60
One	30.4	105
Two	29.3	101
Three	10.4	36
Four	5.8	20
Five	2.0	7
Six	1.7	6
Seven	0.9	3
More than seven	2.0	7
Total	100	345
Missing		139

collie (29/338), and Jack Russell (29/338). A further 12.1% (58/481) were known crossbreeds and 6.2% (30/481) were unknown crossbreeds. And 8.3% (40/481) stated that they did not know the breed involved.

For just over half of the dogs (51%; 243/480), it was known whether they had previously attended some form of behavioral training; of these, almost two-thirds had attended such training (60.5%; 147/243).

For 61.9% (296/479) of dogs, it was known whether the dog had a history of aggression. Of these over half (57.4%; 170/296) had a history of aggression, either toward both people and dogs (38.2%; 65/170), dog only (42.4%; 72/170), or people only (19.4%; 33/170). About one-quarter (26.5%; 127/479) of dogs had bitten someone on a previous occasion compared to 24% (115/479) who had not and 49.5% (237/479) it was unknown.

The most common behavior of the dog before the bite, as identified by the respondents using predefined options, was excited/active (29.1%; 125/430). This was followed by aggressive (21.4%; 91/430), relaxed (15.8%; 68/430), scared/fearful/tense/stressed (15.8%; 61/430), happy (8.1%; 35/430), sleeping/resting (6.0%; 26/430), and "other" (e.g., jealousy; inquisitive) (9.8%; 42/430). And 8.4% (36/430) could not see the dog before the bite and 10.7% (46/430) reported that they could not remember or did not know the dog's behavior before the bite.

Intention, situation, and context

Most (67.5%; 286/424) respondents felt that the dog intended to bite them, whereas 32.5% (138/424) stated the bite was accidental. Victims of bites from their own dog were more likely to state it was an accident, whereas if they knew the dog through a friend or family member, or did not know the dog, they were more likely to state the dog intentionally bit them (OR = 5.1, 95% CI = 3.1-8.3, $P < 0.0001$).

Most victims (59.5%) stated that they were with another person when the dog bite occurred. This compares to 23.8% who stated they were totally alone and 16.7% who stated they were alone but with their own dog. In 45.5% of incidents, the victim approached the dog, and in 49.5% of incidents, the dog approached the victim. The highest proportion of bites (40.5%; 163/402) occurred on private land (e.g., private property; Table 3).

A wide variety of situations were noted with the most common being the victim involved with some form of direct interaction with the dog. In particular, stroking or attempting to stroke the dog was the most commonly reported. Playing with the dog or handling/lifting/restraining the dog were also key bite contexts (Tables 4 and 5).

Bite body location, injury, and treatment

Just under half (49.9%) of respondents stated the bite resulted in some form of puncture to the skin, with 43% making contact with clothing or skin but causing no puncture wound (Table 6).

Regarding the location of the bite, 410 victims provided a location, of which 356 were bitten once and 54 were bitten more than once. Of those that were bitten multiple times, 33 were bitten in the same location, 19 in 2 different body regions, and 2 victims in 3 different body regions. The most common region was the upper extremities (hands, wrists, lower and upper arms: 256/410; 62.4%); lower extremities (feet, ankles, lower and upper legs: 119/410; 29.0%); torso (chest, stomach, waist [bottom and genitals], back [upper/lower]: 30/410; 7.3%); and the head/neck (28/410; 6.8%).

Age was associated with risk of being bitten on the head/neck ($P < 0.001$) or upper extremities ($P < 0.001$). Of the 28 individuals

Table 2
Dog-related factors as reported by respondents

Dog demographics	%	n
Sex		
Male	52.4	253
Female	24.4	118
Unknown	23.2	112
Total	100	483
Missing		1
Age		
Puppy (under 6 months)	0.4	2
Young dog (6 months to <2 years)	14.2	68
Adult (2 to 10 years)	68.6	328
Old dog (>10 years)	4.6	22
Unknown	12.1	58
Total	100	478
Missing		6
Size		
Toy (e.g., pug, Chihuahua)	4.5	22
Small (e.g., terrier)	23.8	115
Medium (e.g., collie, spaniel)	34.1	165
Large (e.g., Labrador, GSD)	35.7	173
Giant (deerhound, Great Dane)	1.9	9
Total	100	484
Neutering status		
Yes	36.4	176
No	20.9	101
Unknown	42.8	207
Total	100	484

bitten on the head/neck, 22 (78.6%) were aged under 19 years, of which 15 were aged between 0 and 9 years. Bites that occurred to children aged under 19 years were more likely (81.5%; 22/27) to be on the head/neck compared to those aged over 19 years (OR = 12.6; 95% CI = 4.6–34.2; $P < 0.001$). Compared to people under 19 years, more people ≥ 19 years (77.6%; 194/250) were bitten on the upper extremities (OR = 2.7; 95% CI = 1.7–4.3; $P < 0.001$), with the highest (25.2%) age group bitten was those aged 20–29 years. People bitten on the head were more likely to seek medical treatment than those who were not (64.3%, 18/29; OR = 3.222, 95% CI = 1.448–7.169,

Table 3
Location of victim when the dog bite occurred (N = 402)

Location of victim	%	n
Private property	40.5	163
Inside own/someone else's home/garden/driveway		154
Inside own home/garden/driveway		63/154
Inside someone else's home/garden/driveway		63/154
Unclear if own or someone else's home/garden/driveway		28/154
Farm, farmyard, stables, paddock		6
Inside a car or caravan		3
Public	27.4	110
Residential area		41
Park, field, nature reserve, woods		29
Country lane, footpath, farm track		13
Outside a shop, school		6
Beach		5
Agricultural/dog event		4
Nonspecific/other (e.g., golf course, car park, canal path)		12
Public/private border (e.g., putting arm through fence)	0.7	3
Commercial (a location where the public have access to, but only at the owners discretion and is regarded as private property out of hours [e.g., supermarket, shop, or pub])	16.7	67
Animal related (vets, kennels, rescue, grooming parlor, dog training center, doggy day care)		52
Caravan site		2
Pub/pub garden		3
Workplace (limited detail "office/shop," "at work")		7
Other (car dealership, mechanics, horse-riding lesson)		3
Not stated	14.7	59
Total		402

$P=0.004$). Furthermore, it was more likely for the victim who had approached the dog (56.1%; 142/253) to be bitten on the upper extremities, whereas for the lower extremities, it was more common that the dog had approached the victim (76.1%; 89/117; $P < 0.001$).

Most injuries (62.3%) did not require medical treatment. Of those that did, the most common form of treatment was received at accident and emergency with the most common treatments being cleaning and bandaging (Table 7). There was an association between whether victims had ever owned a dog and whether they sought medical treatment, with victims who had never owned a dog being less likely to seek medical treatment when bitten (OR = 0.4; 95% CI = 0.2–0.8, $P = 0.01$).

Blame and postbite implication for the dog

Most respondents blamed either themselves (44.6%; 190/426) or the dog's owner (39.9%; 170/426) for the bite. The remaining blamed no one (18.5%), the dog (12.7%), or someone else (8.7%). Those who blamed themselves were significantly more likely to own the dog that bit them (37.4% 71/190; OR = 3.8; 95% CI 2.4–5.9; $P < 0.001$) in comparison to those who did not blame themselves.

In more than half of incidents (59.9%; 255/426), nothing was reported to have happened to the dog involved. In the remaining incidents, there was at least 1 consequence for the dog involved, including sent to, or sought advice on, training (11.3%, 48/426), euthanized (8%, 34/426), rehomed/sent back to breeder (3.5%; 15/426), seized by police (1.9%, 8/426), a control order was implemented (e.g., they were required to keep a dog on lead or muzzled at all times) (1.4%, 6/426), dog was separated for a few hours (0.9%; 4/426), was "told off" (0.5%; 2/426), and the dog was neutered/underlying health issues identified (0.5%; 2/426). A further 7 (1.6%) respondents described that they initiated human behavior change (e.g., handled the dog differently, did not tease the dog again, or changed routine) or changes to the environment (e.g., put a baby gate up, changes to prevent dog escaping, or made changes to the home) to avoid incidents in future. Finally, 10.6% (45/426) stated they did not know what happened to the dog.

Discussion

This study explored dog bite incidents using a self-report online survey method. Most (62.3%) respondents to this survey had not sought medical treatment. This emphasizes the need for data collection beyond medical facilities as bites that require medical treatment may differ from other bites. The results presented here represent a wide range of injuries, locations, and contexts in which dog bites occur. Although prevalence cannot really be taken from a convenience sample, it is interesting to note that the dogs were reportedly more often adult males (where known), known to the victim, and the victims were most frequently bitten on the upper extremities, on private property, and commonly while interacting with the dog. It was also more likely for the dog to approach the victim and perceptions of intention and blame were also affected by familiarity of the dog to the victim. Similarly, a previous qualitative study found that victims who knew the dog blamed themselves and victims who did not know the dog tended to blame the owner (Westgarth & Watkins, 2015).

Despite the wide range of contexts in which dog bites occurred, the most frequent location was on private property, most commonly within a house. This is generally consistent with, but somewhat lower than, previous research, which has reported 65% or more of bites to occur within victim's own home (Shewell & Nancarrow, 1991; Sacks et al., 1996; Kahn et al., 2003; De Keuster et al., 2006; Kasbekar et al., 2013; Rezac et al., 2015). Given this

Table 4
Situation just before the dog bite occurred

Situation just before the bite occurred	Example of response	%	n
Interacting or attempting to interact with dog	Playing with the dog—she hadn't seen me in a long time and got very excited	34.7	138
Walking, walking with dog, walking past dog	Walking along the street with my mother and younger brother	20.1	80
Sat down, "watching TV"	Sitting on a sofa with the dogs around me watching telly	4.5	18
Standing, bending over	I bent over to pick up my keys from the floor	4.3	17
Interacting with owner of dog/another person	Playing in my garden with another child, the dog was in a neighbor's garden	7.8	31
Entering, existing house/room, property, garden	I was letting myself into the house to visit my then boyfriend who was expecting me but had told me to let myself in	6.5	26
Cycling, running, dancing, roller-skating	I was running down a narrow backstreet entry with my brother and ran past an open back door of a house	4.5	18
Dog on dog aggression, trying to split	Trying to break up serious fight between this dog and another older dog in my friend's household	4.5	18
Delivering post, newspapers, leaflets, cards	Approaching the house to put a flyer through the door	3.0	12
Interacting with dog-related items (bowl, toys, food)	I was doing jobs in the kitchen, then I went to pick up food bowl	1.5	6
Car, van, (exiting, entering, or "in car")	Getting my own dogs out of the van, on lead ready to walk them	1.3	5
Eating (human)	I was eating a peach Melba yogurt	0.8	3
Gardening	Cutting ivy from the side of my house	0.5	2
Other/unclear		5.3	21
Can't remember		0.8	3
Total			398

finding, it is understandable that most (66.1%) dogs were also known to some extent to the victim, a finding consistent with some (Rosado et al., 2009; Reisner et al., 2011), but not all (Horisberger et al., 2004), previous studies.

The most commonly reported bite location was the upper extremities (hands, lower and upper arms) and lower extremities (feet, ankles, lower and upper legs), similar to Rosado et al. (2009) in which those victims who approached the dog were more likely to be bitten on the upper extremities, whereas when the dog approached the victim, a bite to the lower extremities was more common. This may be associated with the commonly reported preceding activities, such as stroking, as these would involve the use of arms and hands. Furthermore, as the most common direct interaction with the dog was stroking, and similar interactions such as restraining were common, this could explain why most dog bites were perceived as intentional compared to other situations which may have been deemed unintentional, such as splitting up fighting dogs. This may also be the case where the dog approached the victim as the victims may be moving away from the dog (e.g., running away, waking past) without the victim initiating contact and therefore the lower extremities is the closest part of the body to the dog. It was evident that the both upper and lower extremities may be used in trying to separate dogs fighting in some

instances (e.g., "I had no option but to shove my arms and leg in"). Therefore, education is needed for not just dog-human aggression but also what to do regarding dog-dog aggression if human injury is to be reduced.

Although only 6.1% of bites occurred on the head, we found that children aged under 19 years were significantly more likely to be bitten on the head in comparison to older age groups. Young people (<20 years) were found to be more likely to be bitten on the head/neck/face in other studies which have investigated dog bites in general (Schalamon et al., 2006; Rosado et al., 2009; Reisner et al., 2011) and those specifically focusing on bites to the head and neck (Mannion et al., 2015; O'Brien et al., 2015; Golinko et al., 2016). The reasons for children being more likely to be bitten on the head may include the head of a child being more likely to be closer to the mouth of the dog and the tendency for children to show inappropriate behavior toward the dog or to misinterpret dog behavior (Schalamon et al., 2006; Lakestani et al., 2014; Lakestani & Donaldson, 2015; Mannion & Graham, 2016).

The German shepherd was the most frequently reported breed in our study, which is similar to some previous studies (Schalamon et al., 2006; Klaassen et al., 1996; AVMA, 2014). This finding should be interpreted with caution. First, accuracy of the dogs' breeds reported by victims may be questionable and German shepherds may

Table 5
Further details on type of victim interaction with dog

Interacting or attempting to interact with dog	Example of response	%	n
Stroking or attempting to stroke dog	I was not used to dogs and put my hand over its head to stroke it (like I would do to a cat) and got a nip on my finger.	27.5	38
Lifting, holding, restraining, and/or handling dog	Trying to pick the dog up as he wouldn't get off the bed to go outside to toilet after being in all night.	17.4	24
Playing, teasing dog	Just playing with him on the floor	12.3	17
Feeding or preparing feed for dog, near dog while eating	I offered the dog a treat by hand	9.4	13
Grooming dog (e.g., brushing, nail clipping)	Using scissors to remove matted fur from the dog's stomach	9.4	13
Medical procedure, admin treatment, or medicine	I had been asked to put eye drops in his eyes, as on his daily health check, it was noted that they appeared slightly red and sore. It was just after I got the drops in 1 eye that the bite occurred. He had not had drops in his eyes before.	8.7	12
Putting back taking-out of kennel, reaching into kennel, stop dog escaping	Trying to stop her escaping from her kennel—she was panicking but she was attached to a drip line and it was not safe to let her run away.	5.8	8
Attempting or putting dog on lead, removing lead, untangle lead	I was trying to untangle his lead and keep away from an approaching man	4.3	6
Removing toy, food, item from mouth	Calling dogs in from garden and then trying to retrieve something dead from 1 dog's mouth when the bite occurred (stupid I know)	3.6	5
Telling dog off dog verbally	I was telling her off... While I was telling her off, her expression suddenly changed, she snarled and bit my hand...	1.4	2
Total			138

Table 6
Respondents answer to the question “What damage did the bite cause?”

Statements	%	n
Dog only made contact with clothing	1.4	6
Skin contact by teeth but no skin puncture or bruising	9.4	40
Skin contact by teeth and bruising but no skin puncture	32.6	139
One to four punctures from a single bite with no puncture deeper than half the length of the dog's canine teeth	34.0	145
One to four punctures from a single bite with at least 1 puncture deeper than half the length of the dog's canine teeth	12.4	53
Multiple-bite incident with at least 2 deep bites	3.5	15
Other*	6.6	28

* Other categories varied from limited detail to very specific detail (e.g., “half my middle finger was half torn off,” “bite split my lip in two”).

simply be easily recognizable (Mills & Levine, 2006). Second, the German shepherd is a popular breed and thus likely to be over-represented (De Keuster et al., 2006); it was the fourth and sixth most frequently registered pedigree dog breed in the United Kingdom in 2006 and 2015, respectively (Kennel Club Library, pers comms). Furthermore, there is no robust evidence that breed is an indicator of dog bite risk (Newman et al., 2017).

For over half of the incidents, no further action was taken regarding the dog that bit the victim. One reason for this may be because the blame for bites was commonly directed toward the victim (self-blame) or the owner, possibly due to leniency or generosity toward the dog (Rajecki et al., 1998), rather than blaming the dog involved (as also found previously by Westgarth & Watkins, 2015). It also may be that if the injury was not severe, the owner felt that nothing needed to be done. This finding is important in terms of injury prevention as it appears that it is rare for any action plan to be made to prevent future occurrences. It is worth noting that over half of biting dogs had a previous history of aggression, but most were aggressive toward other dogs, rather than people. The links between dog aggression and human aggression require further investigation. Several studies have noted that most dogs that bit had a history of aggression toward people and/or dogs (Wright, 1985; Pinckney & Kennedy, 1982; Reisner et al., 2007). For example, Reisner et al. (2005) found that English Springer spaniels that showed human-directed dog aggression toward familiar non-household individuals were more likely to have been reported as having a history of aggression. This is contrast to Gershman et al. (1994) who found no association between historical behavior and biting of household and nonhousehold members. More research is

Table 7
Victims who sought medical treatment, treatment source, and treatment type (multiple choice)

Treatment source & type	% (out of 160)	n
Treatment source		
Accident and emergency	51.3	82
GP surgery	24.4	39
Walk-in center	15.6	25
Hospital—admitted	11.3	18
Other (first aider, family/friend (medically trained), veterinary surgery, nurse at rescue center)	7.5	12
Type of treatment		
Cleaned/bandaged	76.9	123
Tetanus injection	55.0	88
Antibiotics	50.0	80
Stitches	31.3	50
Surgery	7.5	12
Counseling	0.6	1
Other (wound glued, physiotherapy, wound dressed daily, wound drained, antidepressants, suture, cauterized, morphine)	6.3	10

needed to investigate the role of historical aggression, for example, longitudinal studies of both dog-dog and dog–human directed aggression.

A particular concern is the cases where the dog had previously been known to have bitten someone (26.5%). Clearly, an initial bite incident is a potential precursor to future bite incidents, and relevant interventions for both dog and owners involved are required to prevent future bites from occurring.

The main limitation of this study is that it used a convenience sample, thus results may not be representative of the general population. For example, victims who sustained more severe injuries may have been more likely to respond due to the salience of a traumatic incident. Recall bias may have also influenced the findings, particularly as three quarters of bites occurred over a year before the study. Parental influence on perceived events could have influenced or distorted a young victim's interpretation of incidents. In addition, this study found the most frequent behavior observed before the bite was “active/excited”; however, the accuracy of such behavioral interpretation by the victims is unknown. However, the importance of this study is that it is the first detailed report of the context and consequences of a range of dog bites that both did and did not require medical treatment. It is also important to highlight that most respondents were recorded as females, whereas it is often reported that males are more likely to be bitten (e.g., Sacks et al., 1996). This could be simply due to the method of survey distribution as it is common for online surveys to have reported high frequencies of female respondents (e.g., Rohlf et al., 2010).

Conclusion

Dog bites are caused by multiple factors and occur to people who are both well known and unknown to the dog. The results of this study, which has explored reports from victims with bites of varying degrees of severity, the majority of which did not require medical treatment, can shed more light on the surrounding circumstances of dog bites, enabling improved education and awareness strategies. Some of this information has not been reported previously possibly due to the data collection methods used at medical centers.

Prevention schemes, which focus on the owner/child's behavior around a dog, although important, require broadening to a much more general audience. In particular, bites within the work place need to be targeted, and strategies provided for safely restraining and separating dogs when fighting. Furthermore, as suggested by Westgarth & Watkins (2015), more general education about how to deal with dog bites when they occur would also be of use to minimize injury. For example, in addition to prevention advice, advice can be provided on how a victim should behave during a bite to minimize injury, deter the dog(s), and seek help.

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Ethical considerations

The University of Liverpool Veterinary Ethics committee approved the study (VREC346), and the questionnaire is available on request.

Conflict of interest

The authors declare no conflict of interest.

References

- APDT. Dr Ian Dunbar's Dog Bite Scale. n.d. Available at: <http://www.dogtalk.com/BiteAssessmentScalesDunbarDTMRoss.pdf>. Accessed May 14, 2017.
- AVMA (American Veterinary Medical Association), 2014. Literature Review on the Welfare Implications of the Role of Breed in Dog Bite Risk and Prevention. Available at: <https://www.avma.org/KB/Resources/LiteratureReviews/Pages/The-Role-of-Breed-in-Dog-Bite-Risk-and-Prevention.aspx>. Accessed May 14, 2016.
- Bernardo, L.M., Gardner, M.J., O'dair, J., Cohen, B., Lucke, J., Pitetti, R., 2002. The dog bites program: Documentation of growls and bites in the emergency setting. *J. Emerg. Nurs.* 28, 536–541.
- Casey, R.A., Loftus, B., Bolster, C., Richards, G.J., Blackwell, E.J., 2014. Human directed aggression in domestic dogs (*Canis familiaris*): Occurrence in different contexts and risk factors. *Appl. Anim. Behav. Sci.* 152, 52–63.
- De Keuster, T., Lamoureux, J., Kahn, A., 2006. Epidemiology of dog bites: a Belgian experience of canine behaviour and public health concerns. *Vet. J.* 172, 482–487.
- Diesel, G., Pfeiffer, D.U., Brodbelt, D., 2008. Factors affecting the success of rehoming dogs in the UK during 2005. *Prev. Vet. Med.* 84, 228–241.
- Golinko, M.S., Arslanian, B., Williams, J.K., 2016. Characteristics of 1616 consecutive dog bite injuries at a single institution. *Clin. Pediatr.* 56, 316–325.
- Gershman, K.A., Sacks, J.J., Wright, J.C., 1994. Which dogs bite? A case-control study of risk factors. *Pediatrics* 93, 913–917.
- Guy, N.C., Luescher, U.A., Dohoo, S.E., Spangler, E., Miller, J.B., Dohoo, I.R., Bate, L.A., 2001. Risk factors for dog bites to owners in a general veterinary caseload. *Appl. Anim. Behav. Sci.* 74, 29–42.
- Horisberger, U., Stärk, K.D., Rüfenacht, J., Pillonel, C., Steiger, A., 2004. The epidemiology of dog bite injuries in Switzerland—characteristics of victims, biting dogs and circumstances. *Anthrozoös* 17, 320–339.
- HSCIC, 2015. Accident and Emergency Attendances in England - 2014-15. Available at: <http://digital.nhs.uk/searchcatalogue?productid=18030&q=dog&sort=Most+recent&size=10&page=1#top>. Accessed June 10, 2017.
- Kahn, A., Bauche, P., Lamoureux, J., 2003. Child victims of dog bites treated in emergency departments: a prospective survey. *Eur. J. Pediatr.* 162, 254–258.
- Kasbekar, A.V., Garfit, H., Duncan, C., Mehta, B., Davies, K., Narasimhan, G., Donne, A.J., 2013. Dog bites to the head and neck in children; an increasing problem in the UK. *Clin. Otolaryngol.* 38, 259–262.
- Kikuchi, M., Oxley, J.A., 2017. The representation of human directed aggression in the popular media. In: Mills, D., Westgarth, C. (Eds.), *Dog Bites: A Multidisciplinary Perspective*. 5M publishing, Sheffield, England.
- Klaassen, B., Buckley, J.R., Esmail, A., 1996. Does the dangerous dogs act protect against animal attacks: a prospective study of mammalian bites in the accident and emergency department. *Injury* 27, 89–91.
- Lakestani, N., Donaldson, M.L., 2015. Dog bite prevention: effect of a short educational intervention for preschool children. *PLoS One* 10, e0134319.
- Lakestani, N., Donaldson, M.L., Waran, N., 2014. Interpretation of dog behavior by children and young adults. *Anthrozoös* 27, 65–80.
- Mannion, C.J., Graham, A., Shepherd, K., Greenberg, D., 2015. Dog bites and maxillofacial surgery: what can we do? *Br. J. Oral Maxillofac. Surg.* 53, 522–525.
- Mannion, C.J., Graham, A., 2016. Dog bite injuries in hospital practice. *Br. J. Hosp. Med.* 77, C165–C168.
- Mills, D.S., Levine, E., 2006. The need for a co-ordinated scientific approach to the investigation of dog bite injuries. *Vet. J.* 172, 398–399.
- Newman, J., Christley, R., Westgarth, C., Morgan, K., 2017. Risk factors for dog bites—An epidemiological perspective. In: Mills, D., Westgarth, C. (Eds.), *Dog Bites: A Multidisciplinary Perspective*. 5M publishing, Sheffield, England.
- O'Brien, D.C., Andre, T.B., Robinson, A.D., Squires, L.D., Tollefson, T.T., 2015. Dog bites of the head and neck: an evaluation of a common pediatric trauma and associated treatment. *Am. J. Otolaryngol.* 36, 32–38.
- Pinckney, L.E., Kennedy, L.A., 1982. Traumatic deaths from dog attacks in the United States. *Pediatrics* 69, 193–196.
- Rajecki, D.W., Rasmussen, J.L., Modlin, S.J., Holder, A.M., 1998. Dog bites boy: Judgments of blame and shame. *Anthrozoös* 11, 66–73.
- Reisner, I.R., Houpt, K.A., Shofer, F.S., 2005. National survey of owner-directed aggression in English Springer Spaniels. *J. Am. Vet. Med. Assoc.* 227, 1594–1603.
- Reisner, I.R., Shofer, F.S., Nance, M.L., 2007. Behavioral assessment of child-directed canine aggression. *Inj. Prev.* 13, 348–351.
- Reisner, I.R., Nance, M.L., Zeller, J.S., Houseknecht, E.M., Kassam-Adams, N., Wiebe, D.J., 2011. Behavioural characteristics associated with dog bites to children presenting to an urban trauma centre. *Inj. Prev.* 17, 348–353.
- Rezac, P., Rezac, K., Slama, P., 2015. Human behavior preceding dog bites to the face. *Vet. J.* 206, 284–288.
- Rohlf, V.I., Bennett, P.C., Toukhsati, S., Coleman, G., 2010. Why do even committed dog owners fail to comply with some responsible ownership practices? *Anthrozoös* 23, 143–155.
- Rosado, B., García-Belenguer, S., León, M., Palacio, J., 2009. A comprehensive study of dog bites in Spain, 1995–2004. *Vet. J.* 179, 383–391.
- Sacks, J.J., Kresnow, M.J., Houston, B., 1996. Dog bites: how big a problem? *Inj. Prev.* 2, 52–54.
- Salman, M.D., Hutchison, J., Ruch-Gallie, R., Kogan, L., New Jr., J.C., Kass, P.H., Scarlett, J.M., 2000. Behavioral reasons for relinquishment of dogs and cats to 12 shelters. *J. Appl. Anim. Welf. Sci.* 3, 93–106.
- Schalamon, J., Ainoedhofer, H., Singer, G., Petnehazy, T., Mayr, J., Kiss, K., Höllwarth, M.E., 2006. Analysis of dog bites in children who are younger than 17 years. *Pediatrics* 117, e374–e379.
- Shewell, P.C., Nancarrow, J.D., 1991. Dogs that bite. *Br. Med. J.* 303, 1512–1513.
- Westgarth, C., Watkins, F.A., 2015. A qualitative investigation of the perceptions of female dog-bite victims and implications for the prevention of dog bites. *J. Vet. Behav.: Clin. Appl. Res.* 10, 479–488.
- Winkler, W.G., 1977. Human deaths induced by dog bites, United States, 1974–75. *Public Health Rep.* 92, 425–429.
- Wright, J.C., 1985. Severe attacks by dogs: characteristics of the dogs, the victims, and the attack settings. *Public Health Rep.* 100, 55.