

Risk factors for dog bites involving children

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GOBBO, E., M. Z. ŠEMROV: Risk factors for dog bites involving children. Vet. arhiv 92, 609-616, 2022.

ABSTRACT

Although children are the most frequent victims of dog bites, gaps remain in understanding of the factors that lead to biting incidents. Using a retrospective and victim self-report questionnaire, risk factors for dog bites with respect to younger and older children in Slovenia are examined. The results showed that younger children were more commonly bitten in a non-public place, outside or inside a house when the owner was absent. They had approached and interacted with a dog they knew, which had a history of aggression and had displayed tense or aggressive behaviour before the bite. Older children were mainly bitten outside in a public space, when the owner was not there. They were approached and bitten by an unknown dog while running or cycling, while entering the dog's personal space, or it was completely unprovoked. The dog involved had a history of aggression and before the bite the victims had neither interacted nor attempted to interact with the dog. These results suggest that the risk factors for dog bites involving children might be age-related calling for due attention and further assessment.

Key words: dog; aggression; bites; children; risk factors

Introduction

Growing up with a domestic dog (*Cannis familiaris*) can benefit a child's psychological and physical development (PUREWAL et al., 2017). Still, despite the many benefits, child-dog interaction is not without risk. Dogs often exhibit aggressive behaviour and children (SÚILLEABHÁIN, 2015) and teenagers (BREGMAN and SLAVINSKI, 2012) are the most frequent victims of dog bites. Injuries range from minor superficial wounds to serious injuries, especially since children are more commonly bitten in the face, head and neck (MORGAN and PALMER, 2007). Injuries can lead to hospitalisation (MCGUIRE et al., 2018), even death (MORA et al., 2018).

The reason for biting is not always known. Aggression often does not follow from painful, agonistic or aversive interactions with the dog. It could be elicited by interaction with affectionate intentions, for example, by petting and hugging (REISNER et al., 2011) or even changes in posture or eye contact (REISNER et al., 2007). Infants and small children can occasionally be perceived as prey and attacked by dogs exhibiting predatory behaviour (LUESCHER and REISNER, 2008). Aggression towards children may also be associated with fear as well as food-, resource- and territory-guarding (REISNER and SHOFER, 2008). Dogs are very expressive when distressed and often

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show signals like looking away and lip licking (FIRNKES et al., 2017). However, recent studies show that people do not have sufficient knowledge regarding both safe dog–children (DIXON et al., 2012) and dog–adult interactions (TAMI and GALLAGHER, 2009). A dog’s distress signals are often misinterpreted or even go unnoticed (MARITI et al., 2012), especially by young children who may not understand the meaning of warning signals (FRANK, 2013). For example, it was shown that children are often unable to read a dog’s expressions or mental state and can misinterpret the face of an angry dog as a smiling one (MEINTS et al., 2010) or have problems identifying fearful dogs among shown videos (LAKESTANI et al., 2014). Overall, dog owners generally lack knowledge about safe interaction with dogs and warning signs of aggression and potential risks associated with aggression and bites (REISNER and SHOFER, 2008) and parents often do not offer the supervision and intervention needed during a child–dog interaction (ARHANT et al., 2016).

As well as proper educational interventions for preventing bites (LAKESTANI and DONALDSON, 2015; MEINTS et al., 2018) and behavioural dog training (SCHALAMON et al., 2006), we believe it is important to identify the factors that increase the risk for bites. Additional knowledge about risk factors for dog bites may help improve existing preventive strategies.

The aim of the present study was to assess potential risk factors for dog-biting incidents involving children using information about biting incidents reported by victims.

Materials and methods

Data collection. The questionnaire contained 20 questions, 6 being open- and 14 closed-ended. It was shared through various social media platforms in Slovenia from December 2017 until February 2018. OneClick survey software (www.lka.si) was used to compose the questionnaire. The questions touched on victim demographics (gender, current age, age when the attack happened, relationship to the dog), information about the dog (age, sex, size, breed, past aggressive behaviour) and information about the incident (precise location, presence

of owner, restriction of movement, approach, victim and dog prior behaviour, interaction right before and during the bite). Before participating, respondents had to give their consent for the use of their information for research purposes and read the terms which stated they had to be currently older than 18 years of age but bitten by a dog as a child. No specific ethical approval was required.

Statistical analysis. Content analysis was performed on qualitative data from open-ended questions regarding the attacking dog’s breed, location of the bite, interaction before and during the bite, using the qualitative text analysis software QDA Miner Lite (Provalis Research, Montreal, Canada). The survey software automatically converted the data from a closed-ended question into a numerical form. Continuous variables were presented as means and standard deviations, and categorical variables as frequencies. The categorical variables obtained with the open-ended questions were grouped into two classes. Interaction with the dog was grouped as present or not present prior to the bite, location was grouped as a non-public or public area, familiarity with the dog was grouped as a known or unknown dog and victim’s age was grouped as younger and older children. Risk factors for bites were estimated using a binary logistic regression model and variables for the final models were selected using a backward elimination until all of the main effects were significant. All analyses were performed using the statistical software package IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). Statistical significance was accepted at $P \leq 0.05$.

Results

Characteristics of victims, dogs and biting situations. A total of 271 adult respondents described a biting incident that had occurred when they were a child. The respondents were mostly female (80.1%) and aged between 18 and 69 (mean $29.9 \pm SD 10.3$) at the time of completing the questionnaire. When the bite occurred, they were aged between 1 and 9 years (younger children) in 97 cases (35.8%) and between 10 and 19 (older children) in 174 cases (64.2%). Most bites occurred at age 10 (15.9%), 12 (11.1%) and 8 (7.7%). The

majority (72.3%) knew the dog involved, with the dog mainly belonging to the family or a friend (28.4%) or a neighbour (20.3%).

The dogs involved were primarily male (71.6%), adult (69.4%) and large (47.6%) in size, with 25.8% of dogs small in size. Most dogs were purebred 145 (53.5%), with German shepherds being the most common (22.5%). The dog's history of aggression was known for 126 dogs, with 45 (16.6%) being aggressive towards people and dogs, 23 (8.5%) only towards people, 10 (3.7%) only towards other dogs while 48 (17.7%) had no history of aggression.

The biting incidents mainly occurred in a low-populated area (69%), with 142 cases (52.4%) in a non-public area such as outside or inside a house, and 120 in a public area (44.3%), generally on roads

and streets, and 3.3% missing data. The owner was present in almost half the cases (44.9%) and the dog was mainly moving around freely without any restriction (69%). The victim's behaviour before the bite was mostly relaxed (36.5%) or excited (20%), while the dog was excited (15.5%), happy (15.9%), but also tense or aggressive (14.8%). Just before the dog bite occurred, the victims had generally been walking past or towards the dog (22.9%) or were interacting (21.8%) or attempting (15.1%) to interact with the dog. When the biting incident happened (Table 1), less than half of the bites came during interaction with the dog (43.9%) and the other half of the bites occurred during incidents where there was no prior interaction with the dog (48.4%).

Table 1. Circumstances during the dog bites involving children

Interaction	Description of the circumstances	n	%
Yes	Attempting to pet the dog	31	11.4
	Petting the dog	26	9.6
	Restraining the dog	15	5.5
	Playing with the dog	14	5.2
	Interacting with an eating dog	13	4.8
	Attempting to separate fighting dogs	11	4.1
	Interacting with a sleeping or resting dog	9	3.3
No	Entering the dog's personal space (e.g. standing nearby)	52	19.2
	Unprovoked attack	44	16.2
	Fast movements near the dog (e.g. cycling, running)	24	8.9
	Other	11	4.1
Missing data		21	7.7
Total		271	100

Risk factors for dog bites. Younger children were more likely to be bitten in a non-public area than in a public area (Table 2) and by a dog exhibiting tense or aggressive behaviour (30.9%) than a calm dog. Older children were more likely to be bitten in a public area and by an unknown dog (Table 2). Bites by a known dog were more likely to involve younger children than older children and more likely in a non-public space than a public area. They more likely involved a dog with a history of aggression and more likely occurred if

the dog owner was absent. Bites by an unknown dog more likely occurred in a public compared to a non-public area and during circumstances where there was no prior interaction (Table 2).

In non-public spaces, known dogs were more likely to bite than unknown dogs, younger children were more likely to be bitten than older children, while a bite was more likely to occur if the dog was approached by the child and not *vice versa*. In public areas, unknown dogs were more likely to bite than known dogs, older children were more

likely to be bitten than younger children, and a bite was more likely if the owner was absent and if the victim was approached by the dog and not *vice versa* (Table 2). Bites with a prior interaction more commonly occurred in a non-public than a public area and known dogs with a history of aggression were more likely to bite than unknown

dogs without a history of aggression. Bites with no prior interaction were more common in a public area than in a non-public area while unknown dogs with a history of aggression were more likely to bite than known dogs. Bites were also more likely to happen if the dog had approached the person and not *vice versa* (Table 2).

Table 2. Risk factors for bites involving younger/older children, known/unknown dog, non-public/public area and prior/no prior interaction with the dog

Groups	Predictor	Wald Chi-Square	df	P	Odds Ratios (OR)	95% CI for Odds Ratio	
						Lower	Upper
Younger children	Area	4.965	1	0.05	0.621	0.360	1.068
Older children	Area	6.237	1	0.01	2.053	1.167	3.609
	Familiarity	5.883	1	0.02	1.698	0.921	3.129
Known dog	Area	6.718	1	0.01	5.730	1.531	21.451
	Age group	9.689	1	0.002	8.691	2.251	33.555
	Past aggression	4.450	1	0.04	4.050	1.104	14.856
	Owner presence	3.871	1	0.05	0.268	0.072	0.995
Unknown dog	Area	21.407	1	<0.0001	0.228	0.122	0.427
	Prior interaction	3.757	1	0.05	0.593	0.321	1.099
Non-public area	Familiarity	4.087	1	0.04	1.839	1.019	3.318
	Age group	23.758	1	<0.0001	2.041	1.007	3.860
	Approach	17.005	1	<0.0001	3.932	2.051	7.537
Public area	Familiarity	27.271	1	<0.0001	0.173	0.089	0.334
	Age group	6.676	1	0.01	0.459	0.254	0.828
	Owner presence	7.980	1	0.005	0.435	0.244	0.775
	Approach	11.633	1	0.001	0.563	0.404	0.783
Prior interaction	Familiarity	4.785	1	0.03	2.111	0.543	6.754
	Past aggression	4.825	1	0.03	2.430	1.100	5.365
	Area	5.694	1	0.03	0.353	0.150	0.830
No prior interaction	Familiarity	4.111	1	0.05	0.345	0.094	1.734
	Past aggression	4.352	1	0.04	3.343	1.761	7.911
	Area	4.122	1	0.04	0.398	0.163	0.969
	Approach	7.412	1	0.006	0.521	0.326	0.833

Discussion

Using a retrospective and victim self-report design, we gathered information on dog biting incidents involving children. We focused on four different aspects, the victims' age (younger or older children), familiarity with the attacking dog (known or unknown dog), the location (public or non-public area) and the interaction (bites with prior

or without prior interaction). The results showed two distinct risky situations for dog bites. Younger children were more likely to be bitten in a non-public place when approaching and interacting with a dog whose owner was absent. The dogs involved were known to them, had a history of aggression and displayed tense or aggressive behaviour before

the bite. Older children were more likely bitten in a public place after being approached by the dog and had not interacted or attempted to interact with the dog, whose owner was absent. The dogs involved were unknown to them and had a history of aggression.

Due to the convenience sample in our study, the majority of respondents were female as females are more likely to respond to a web questionnaire than men (SAX et al., 2003). This may be the cause of the overrepresentation of women in our study, which is not in harmony with previous findings that show younger and older boys are more frequently bitten than younger and older girls (HOLZER et al., 2019; BASCO et al., 2020). Most bites occurred between the ages of 8 and 12, differing from previous reports revealing the highest biting rate among children aged between 5 and 9 (QUIRK, 2012; BASCO et al., 2020). The profile of the attacking dogs was consistent with previous results (FLINT et al., 2017; SARCEY et al., 2017), comprising a male, adult dog that was large in size. German shepherds are often reported as the breed most commonly involved in biting incidents involving children (SCHALAMON et al., 2006; KHAN et al., 2020), as also seen in our sample. We also found a large number of reports about aggression by small breeds, which we presume might be due to such dogs attempting to exert their superiority over smaller children (SCHALAMON et al., 2006).

Our results in younger children regarding the area, familiarity, supervision and interaction correspond with earlier research (DE KEUSTER et al., 2006; REISNER et al., 2011). Own or known dogs, lack of supervision and being indoor or outdoor in a non-public area such as a house are closely connected. Known dogs in their own environment are more trusted and less supervised since many dog owners believe it is safe to leave a child unsupervised around the dog (REISNER and SHOFER, 2008). Children are likely to be more comfortable and less cautious around familiar dogs (SCHALAMON et al., 2006). The interaction between children and dogs might then be more aggressive, the display of affection more physical, as they tend to be close to the dog while petting and hugging it (MELSON et al., 2009). It also involves faster movements and

louder noises which, combined with an inability to read distress signalling, poses a very risky situation for dog bites (OVERALL and LOVE, 2001). For example, even bending over a dog can trigger fear-related aggression (KUHNE et al., 2014). A lack of knowledge about warning and distress signals in dogs was evident in our study as the victims reported the dog's tense or aggressive behaviour prior to the bite. Similar anxious behaviour has previously been linked to dogs that bit a child (REISNER et al., 2007) as anxiety provokes defensive aggression (LUESCHER and REISNER, 2008). We also found past aggressive behaviour to be a risk factor, corresponding with O'SULLIVAN et al. (2008), although it was previously reported that any dog, even one without a record of aggression, can exhibit biting behaviour in a specific context, typically as a response to a threat (BRADSHAW et al., 2009). Similar to the findings of KAHN et al. (2003), before the bite, it was the children approaching the dog, not *vice versa*. During child-initiated behaviour, the dog may not know what kind of interaction to predict or expect and may thus react inappropriately to the situation (LUESCHER and REISNER, 2008).

Except for the absence of the owner and a history of aggression of the dog involved, we found in our study biting situations concerning older children aged over 10 years to differ from those described with respect to younger children. The bites involving older children most commonly happened in a public area, mainly on the street, by an unknown dog that had approached the child and without any previous interaction with the dog. Bites occurring when the child was not seeking interaction with the dog were described as part of unprovoked attacks, while the child had entered the dog's personal space and during fast movements near the dog. For example, frequent bites as an attacking dog chases a child on a bicycle are already described (LODER and YAACOUB, 2018). Rapid movements, such as running or cycling near the dog, may be provocative for the dog and trigger predatory behaviour (LUESCHER and REISNER, 2008). They may also trigger territory guarding, especially towards unfamiliar children close to the dog's home or perceived territory, even without

a previous interaction (REISNER et al., 2011). Territorial aggression can also be a motivation for bites during a non-threatening entry to a dog's personal space (CHÁVEZ and OPAZO, 2012), especially when the dog is unfamiliar with the person (KUHNE et al., 2014). Movement of the dog towards the victim was earlier associated with outdoor bites (REISNER et al., 2011), as also seen in our study.

By discovering clear differences in risk factors for dog bites involving younger and older children, this study may serve as groundwork for future research. We believe that bites in older children call for further assessment, mainly regarding the risk factors and potential safety measures, since they involve bites that are not predictable, more difficult to prevent and thus more dangerous.

Conclusions

Our results show different risk factors for younger children aged up to 9 years and older children aged between 10 and 19. Bites occurring in a non-public space, in the absence of the owner and during an initiated interaction with a known and tense dog with a history of aggression were distinctive for younger children. For older children, bites mainly occurred outside in a public space when the owner was absent, involving approaching an unknown dog with a history of aggression that they did not intend to interact with. These results imply that further research is needed regarding children's age-focused assessment and methods designed to prevent dog bites.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgements

We are grateful to all the respondents who participated in our study. The authors received no specific funding for the research. This paper was presented in the form of abstract at the 1st RAWC Scientific Conference 2020 "Better Science for Better Animal Welfare" held online, 24-25 June 2021.

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Received: 7 June 2022

Accepted: 13 September 2022

GOBBO, E., M. Z. ŠEMROV: Čimbenici rizika za ugrize pasa koji uključuju djecu. Vet. arhiv 92, 609-616, 2022.

SAŽETAK

Premda su djeca najčešće žrtve ugriza pasa, i dalje nisu sasvim jasni uzroci koji dovode do ugriza. Primjenom retrospektivnog upitnika i upitnika o samoprijavlivanju žrtava istraženi su čimbenici rizika za ugrize pasa koji se događaju u mlade i starije djece u Sloveniji. Rezultati su pokazali da su mlađa djeca češće ugrizena na mjestima koja nisu javna, izvan kuće ili u kući, u odsutnosti vlasnika psa. Djeca su pristupila psu i imala interakciju sa psom kojega su poznavali, koji je već bio agresivan i u kojega je prije ugriza zapažena napetost ili agresivno ponašanje. Ugrizi u starije djece većinom su se dogodili vani, na javnom mjestu, dok vlasnik nije bio uz psa. Ugrizi su se dogodili tako da im je nepoznati pas prišao dok su trčali, ili su ušli u osobni prostor psa, ili ugriz nije bio isprovociran. Pas je već bio agresivan, a prije ugriza žrtve nisu imale interakciju sa psom niti su pokušale ostvariti kontakt s njim. Rezultati ovog istraživanja upućuju na to da bi čimbenici rizika za ugrize pasa koji se događaju u djece mogli biti povezani s dobi, na što bi trebalo obratiti pažnju u budućim istraživanjima.

Ključne riječi: pas; agresija; ugrizi; djeca; čimbenici rizika
