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Analysis of Dog Bites in Children Who Are Younger Than 17 Years

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ABSTRACT

OBJECTIVES. This study focuses on the pattern of incidence, mechanisms, and circumstances of accident and injury in a series of pediatric patients who sustained dog bites.

METHODS. In our retrospective survey, the medical charts of all children who were younger than 17 years and sought medical attention after a dog bite between 1994 and 2003 were reviewed. To obtain the total number of each dog breed in the administrative district, we analyzed 5873 files from the community dog registers. For establishment of a risk index, the representation of a dog breed among the total canine population was divided by the frequency of dog bites from this breed.

RESULTS. A total of 341 children (mean age: 5.9 years) were identified. The annual incidence of dog bites was 0.5 per 1000 children between 0 and 16 years of age. Incidence was highest in 1-year-old patients and decreased with increasing age. The relative risk for a dog attack by a German shepherd or a Doberman was ~5 times higher than that of a Labrador/retriever or cross-breed. The vast majority (82%) of the dogs were familiar to the children. Most (322; 94%) of the children had injuries to 1 body region; in the remaining 19 (6%) children, up to 3 body regions were injured. Of 357 injuries, the face, head, and neck region was the leading site affected (50%). Inpatient treatment was required in 93 (27%) patients.

CONCLUSIONS. Dog bites in children are frequent and influenced by the breed-related behavior of dogs, dog owners, children, and parents. Therefore, prevention strategies should focus on public education and training of dogs and their owners. Children who are younger than 10 years represent the high-risk group for dog attacks.

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In many families, dogs play an important role as guards, companions, and friends. Unfortunately, this partnership is not without problems. In recent years, it has become more and more apparent that dog bites are a serious and often underestimated public health problem.[1] In the United States, an overall incidence of 1.3:1000 for dog bites that require medical treatment is reported.[2] In particular, children tend to underestimate the danger arising from dogs because they are more careless and inexperienced than adults in their interaction with dogs. This is confirmed by studies showing that children are more likely than adults to sustain canine bite wounds, with the highest incidence being among 5- to 9-year-old boys (6:1000 people).[2] The likelihood of a child's sustaining a dog bite in their lifetime is ~50%.[3] The aesthetic and psychosociological consequences of trauma caused by a dog bite reportedly burden the quality of life of the affected child and his or her family.[4] Hence, pediatric dog bites represent a serious medical and public health issue. For developing proper prevention strategies, it is important to understand the circumstances and characteristics of dog bites. The major objectives of this study were to analyze the incidence, the mechanisms of accident, and the injury pattern as well as the required surgical treatment in a series of pediatric patients who sustained dog bites. Therefore, we evaluated retrospectively the charts of 341 children who sought medical assistance in our department as a result of dog-bite–related injuries.

METHODS

The Department of Pediatric Surgery at the Medical University of Graz is a level 1 trauma center that treats ~11 000 children annually. The census population aged 0 to 16 years in the respective catchment area is 62 457. Our retrospective survey included all children who were younger than 17 years and sought medical attention after a dog bite between 1994 and 2003. Patients' charts were analyzed for personal data, type of injury, and clinical course. The standard medical treatment of dog bites at our department consists of meticulous wound cleaning and closure of gaping wounds. Surgical closure was indicated when a firm wound closure without a suture was not possible. In the case of deep lacerations, wound drainage and/or systemic antibiotic treatment with either amoxicillin/clavulanate or cefuroxime/metronidazole was performed. Children with facial wounds or deep lacerations that required surgical closure under general anesthesia were admitted to the ward. A veterinarian's certificate was requested from the identified dog owners to exclude rabies. When the certificate could not be obtained within 24 hours after the dog bite, the child was assigned to rabies vaccination.

All children and/or their parents were interviewed and completed a questionnaire that contained the following items: dog ownership, the circumstances of the accident, and long-term consequences for patients or dogs. The dog breed was taken from the veterinarian report.

To gain information about the local distribution of dog breeds, we analyzed 5873 files from the community dog registers (Fig 1) and added the information to a Microsoft Excel database that contained the data of the attacking dogs. For analysis, the 18 most popular breeds, accounting for 90% of all dogs, were considered, thereby excluding 31 breed populations with <64 dogs each. For calculation of the risk index, the representation of a dog breed among the total dog population was divided by the representation of this breed among all registered dog bites.

All children were followed up until wound healing and revisited 3 to 4 weeks after wound healing to document short-term results. Late follow-up was performed in 317 (93%) of the 341 children 2 to 11 years (mean: 7.2 years) after the dog attack. Seventeen of the remaining 24 children were contacted by telephone but declined to participate because of complete healing; 7 children could not be located.

Statistics

The χ^2 test was used to determine the statistical significance between groups. All computations were performed using the statistical software package SPSS 11.0.1 for Windows (SPSS, Inc, Chicago, IL). $P < .05$ was considered significant.

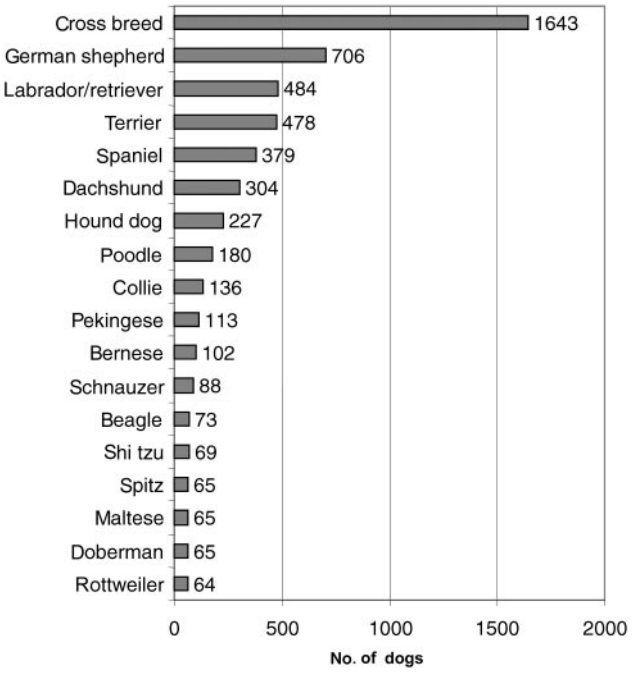

FIGURE 1
Local dog breed distribution as collected from the local community dog register. A total of 5873 files were analyzed, and 31 breeds with <64 dogs each were excluded.

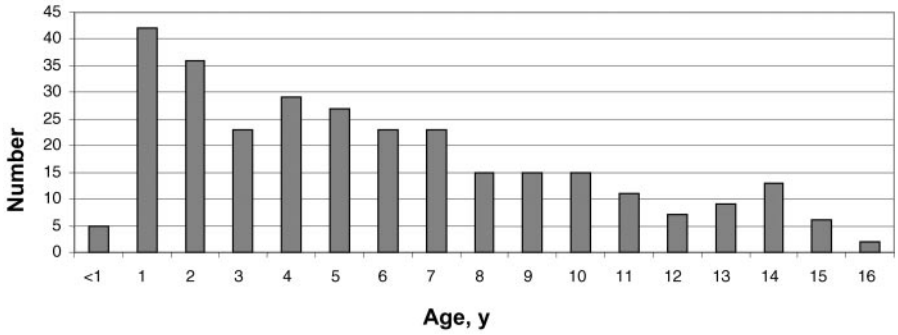

FIGURE 2
Distribution of child age in 341 pediatric cases of dog bites.

RESULTS

In this study, 341 children (174 boys, 167 girls) who were aged between 8 days and 16 years (mean age: 5.9 years) were included. In the respective catchment area, dog bites accounted for 0.31% of all trauma-related hospital visits. The annual incidence of dog bites was 0.5 per 1000 children between 0 and 16 years of age. The highest incidence was found in 1-year-old children, with the incidence decreasing thereafter with age (Fig 2). A total of 73% of all affected children were younger than 10 years. A seasonal fluctuation was detected: a majority of the children were injured in the summer months, and peak incidence occurred during August. There was an almost equal distribution of dog attacks between the days of the week.

The vast majority (73%) of the dogs were familiar to the children, whereas in only 15% of the cases, the dog owner was considered as unfamiliar. A total of 12% of the affected patients could not specify the dog ownership (Table 1). In 75% of all known circumstances that led to the injury, the child interfered with the dog (Table 2).

A majority (n = 322; 94%) of the children had injuries to just 1 body region; in the remaining 19 (6%) children, up to 3 body regions were injured. Of 357 injuries, the face, head, and neck region was the leading body part affected (50%), followed by upper (28%) and lower extremities (18%). Injuries to the trunk/chest were less common (4%). A total of 290 (85%) children sustained deep wounds; 51 (15%) children presented with superficial scratches and minor lacerations. Children with injuries to the head and neck were significantly younger compared with the total study population (mean age: 4.1 year; $P < .01$).

TABLE 1 **Distribution of Dog Owners in a Series of 341 Children Who Sustained a Dog Bite**

Owner	% (n)
Household member	24 (83)
Friend	20 (68)
Stranger	15 (51)
Neighbor	15 (50)
Relatives	14 (49)
Unknown	12 (40)

According to the local veterinary guidelines, 198 (58%) of the biting dogs were classified as large (>44 cm of acromial height), 94 (28%) dogs were small; and the size of 49 (14%) dogs was unknown. In 305 (89%) of 341 dog attacks, the exact breed of the dog could be determined. The breed-related proportion of dog attacks is shown in Table 3. Bites from German shepherds and Dobermans accounted for 37% of all dog bites despite that these breeds account for only for 13.1% of the dog population. The relative risk for a dog attack by a German shepherd or a Doberman was >5 times higher that that associated with a Labrador/retriever or cross-breeds. Children who were younger than 5 years sustained significantly more attacks by small dogs compared with older children (P = .04).

Treatment

A total of 337 (99%) children presented within the first 24 hours after the dog bite. The remaining 4 children sought medical advice 24 to 72 hours after the attack with signs of wound infection subsequent to initial treatment at home. A total of 219 children visited the emergency department directly from the scene of the accident; 118 children were referred from general practitioners. In the emergency department, all children were examined by pediatric surgeons.

Inpatient treatment was required for 93 (27%) patients. The mean hospital stay of these children was 4.9 days (range: 1–13 days). Surgical procedures for wound adaptation were performed in 89 (26%) of 341 children, with 32 patients requiring wound drainage. The majority (n = 77, 87%) of these 89 children required general anesthesia for wound repair. Twenty-two children with soft tissue injuries of the extremities and 2 additional children with finger fractures had splint or cast immobilization. For 6 children, an ophthalmologist was consulted as a result of eye injuries.

Complications

Complications occurred in 40 (12%) children. Thirty-four (10%) children had wound infections, 27 of whom received primary antibiotic treatment. Delayed wound healing without clear signs of infection was recorded in

TABLE 2 External Circumstances of Dog Bites

Circumstance	%
Playing with/near dog	28
Passing the dog (walking)	14
Cuddling the dog	10
Feeding the dog	8
Passing the dog (cycling)	4
Disturbance of dog while eating	4
Surprising the dog	2
Pulling the dog's tail	2
Interfering during dog fight	2
Unknown	26

TABLE 3 Incidence of Dog Attacks According to Breed in a Total Study Population of 341 Children Aged 0 to 16 Years

Dog Breed	Dog Bites	Dog Bites, %	Dog Population, %	Risk Index
German shepherd	105	34	12	2.83
Doberman	8	3	1.1	2.71
Spitz	5	2	1.1	1.81
Pekingese	10	3	1.9	1.56
Dachshund	22	7	5.2	1.35
Schnauzer	5	2	1.5	1.33
Collie	10	3	2.3	1.30
Hound dog	15	5	3.9	1.29
Poodle	10	3	3.1	0.98
Rottweiler	3	1	1.1	0.92
Beagle	3	1	1.2	0.80
Terrier	15	5	8.1	0.61
Bernese dog	3	1	1.7	0.58
Labrador/retriever	11	4	8.2	0.49
Cross-breed	39	13	28	0.46
Spaniel	5	2	6.5	0.31
Shi Tzu	1	0.3	1.2	0.26
Maltese	0	0.0	1.1	0.00

The data about the distribution of the dog population was collected from the local community dog register. The risk index was calculated by dividing the representation of a dog breed among the total dog population by the representation of this breed among all evaluated dog bites.

5 (1%) children with major primary soft tissue lacerations. Two of these 5 children sustained hypertrophic scars. In 1 additional child with a finger fracture, a rereduction was required as a result of a secondary fracture displacement.

Late Problems

Five children complained of nightmares after the dog attack; fear of dogs remained with another 34 children. The 2 children with hypertrophic scars were underwent surgery for scar revision. Two dogs were euthanized as a consequence of repeated aggressive behavior.

DISCUSSION

The present report covers dog bites over a 10-year period. Taking into consideration that <50% of all dog bites are reported to doctors or police,[4] it can be estimated that there is an annual incidence of 1:1000 children who sustain dog bites. Despite significant morbidity related to dog bites, only a small number of fatal dog attacks on children have been reported previously. For example, Reuhl et al[5] described 20 fatal dog attacks in a 10-year period in Germany, Switzerland, and Austria, with half of the victims being children who were younger than 8 years (median: 2 years, 7 months). Death was caused either by multiple trauma or by injuries to the head and neck. In agreement with previous publications,[6–8] our data showed that the most common area targeted by dogs was above the shoulders, reflecting the closer proximity of the child's head to the attacking dog. Fortunately, none of the children included in this report died, although the face, head, and neck region was primarily affected and 6% of our patients sustained multiple injuries.

Injuries to the face, head, and neck area occur more frequently in younger children. Scarring is a common consequence related to dog bites, and the resulting emotional distress should not be underestimated, particularly for face wounds. As Schmitt[9] stated, "A child attacked by a dog and bitten above the shoulders is equivalent to an unarmed adult sustaining a bear bite. The human emotional coping is overwhelmed." Eleven percent ($n = 39$) of the children in our series reported prolonged emotional distress, including nightmares and subsequent augmented fear of dogs. The number of unreported cases of emotional distress likely is much higher than reported. Therefore, treatment strategies should include early psychological support considering the different trauma processing and coping strategies in children and their families. More assistance that focuses on these subjects will be required in the future.

We propose that the individual behavior of the attacking dog or the dog breed may be directly related to the severity of injuries. Voelker[1] stated that certain breeds are more aggressive than others. In addition, Gershman et al[16] found male and unneutered dogs more likely to be aggressive compared with female and neutered dogs. In several countries, certain dog breeds are considered "fighting dogs" and are subject to legal regulations. In Germany, these breeds include mastiff, bull mastiff, bulldog, bullterrier, pit-bull, Tosa-Inu, and others. Media reports that have focused on aggressive behavior of fighting dogs and special training for dogs to make them more violent have led to an increased public awareness. This may explain why we did not identify any of these fighting dog breeds to be likely to attack more frequently than average. On the basis of the dog population in our catchment area, German shepherds and Dobermans were the most aggressive breeds. These findings are similar to other reports (Table 4). However, every breed poses the threat of dog bites; any dog may attack. Our data show that not only a proper education of dog owners and behavioral training of dogs are required for "high-risk" breeds; rather, legislation should regulate training of all dogs and dog owners and leashing

TABLE 4 **Review of Several Dog-Bite Reports Identifying the Dog Breed That Caused the Most Incidents**

Author	Year	No. of Cases	Dog Breed That Caused Most Incidents
Avner and Baker[13]	1991	168	German shepherd
Greenhalgh et al[14]	1991	159	German shepherd[a]
Unshelm et al[15]	1993	284	German shepherd
Gershman et al[16]	1994	178	German shepherd
Thompson[17]	1997	356	Doberman[a]
Gandhi et al[18]	1999	67	Pit bull
Reuhl et al[5]	2001	20 (deaths)	German shepherd
Kahn et al[4]	2003	100	German shepherd[a]
Mitchell et al[19]	2003	44	Rottweiler
Schalamon et al	2004	341	German shepherd[a]

In all studies that were based on dog population, German shepherd and Doberman are the breeds that are most likely to be involved in dog-bite accidents.
[a] Based on dog population.

of dogs when using public areas. Improved skills of dog owners and better training of the dogs may have prevented several of the reported attacks. Concordant with the findings of other authors,[2,4] a peak incidence of dog attacks was noted during the summer months. This may be explained by the fact that on warm, summer days, children as well as dogs are more active and tend to play outside, increasing the possibility of encountering each other. Running past dogs or startling the dog can trigger a possible attack.

A majority (73%) of the attacking dogs in the present report were familiar to the children. However, only 33% of these familiar dogs were "household members." Furthermore, the children interfered with the dog in a majority of the cases. In addition to well-known situations such as disturbing a dog while eating or pulling its tail, running or cycling past the dog without direct contact provoked several attacks. Children likely feel comfortable with dogs that they know and therefore may reduce distance and lose respect, not realizing that this attitude may not be reciprocated. Small dogs attacked small children significantly more frequently than older children, presumably because small dogs are more likely to feel superior to little children.

Borud and Friedman[10] discussed possible prevention strategies in their report about dog bites in New York City. They recommended behavioral modification, especially of children, when interacting with a dog. Despite being helpful in adolescents, this approach may fail in younger children. This is important as the incidence of dog bites in the present report was highest in 1-year-old children. Because of the accumulation of dog bites in younger children, we agree with Thompson et al[17] that parents should postpone purchase of a dog until children are of school age. Throughout evolution, dogs have lived in packs with a specific order of dominance. In view of this rigorous hierarchal system in a pack, dogs may regard newborns as well as toddlers as subordinate. Thus, they may feel the need to defend their own position in the pack against this intruder, especially if a new child enters the family while the dog is already an integrated member. School-aged children can be trained successfully in precautionary behavior when approaching a dog. Chapman et al[11] conducted an educational program in 8 Australian primary schools. Children who had received the training displayed significantly greater precautionary behavior than children in the untrained group. Despite possible training programs for school-aged children, it still seems to be more reasonable to teach the dog owners and parents to pay attention when children are close to dogs than to place the blame/responsibility for a dog attack on the children. Table 5, which includes the recommendations of Presutti[12] and Voelker,[1] summarizes a code of behavior to prevent dog bites.

CONCLUSIONS

Dog bites in children are more prevalent in certain dog breeds. Specific circumstances such as breed-related behavior of dogs and behavior of dog owners, children, and parents seem to increase the risks for dog bites. Therefore, prevention strategies should focus on public education and training of dogs and their owners. Children who are younger than 10 years represent the high-risk group for dog attacks.

TABLE 5 **Code of Behavior When Handling a Dog**

Dogs	Humans
Dogs sniff as a means of communication.	Before petting a dog, let it sniff you.
Dogs like to chase moving objects.	Do not run past dogs.
Dogs run faster than humans.	Do not try to outrun a dog.
Screaming may incite predatory behavior.	Remain calm if a dog approaches.
The order of precedence needs to be in evidence.	Do not hug or kiss a dog.
Direct eye contact may be interpreted as aggression.	Avoid direct eye contact.
Dogs tend to attack extremities, face, and neck.	If attacked, stand still (feet together) and protect neck and face with arms and hands.
Lying on the ground provokes attacks.	Stand up. If attacked while lying, keep face down and cover the ears with the hands. Do not move.
Fighting dogs bite at anything that is near.	Do not try to stop 2 fighting dogs.

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