

Dog Bite Prevention: An Assessment of Child Knowledge

Cinnamon A. Dixon, DO, MPH^{1,2}, E. Melinda Mahabee-Gittens, MD, MS¹, Kimberly W. Hart, MA³,
and Christopher J. Lindsell, PhD³

Objectives To determine what children know about preventing dog bites and to identify parental desires for dog bite prevention education.

Study design This cross-sectional study sampled 5- to 15-year-olds and their parents/guardians presenting to a pediatric emergency department with nonurgent complaints or dog bites. The parent/guardian-child pairs completed surveys and knowledge-based simulated scenario tests developed on the basis of American Academy of Pediatrics and Centers for Disease Control and Prevention dog bite prevention recommendations. Regression analyses modeled knowledge test scores and probability of passing; a passing score was ≥ 11 of 14 questions.

Results Of 300 parent/guardian-child pairs, 43% of children failed the knowledge test. Older children had higher odds of passing the knowledge test than younger children, as did children with white parents vs those with nonwhite parents. No associations were found between knowledge scores and other sociodemographic or experiential factors. More than 70% of children had never received dog bite prevention education, although 88% of parents desired it.

Conclusions Dog bites are preventable injuries that disproportionately affect children. Dog bite prevention knowledge in our sample was poor, particularly among younger children and children with nonwhite parents. Formal dog bite prevention education is warranted and welcomed by a majority of parents. (*J Pediatr* 2012;160:337-41).

Dog bites are a major public health issue and contribute to the burden of injuries seen nationwide.¹ According to the Centers for Disease Control and Prevention (CDC), in the US alone, an estimated 4.5 million dog bites occur each year.² Of these annual dog bite victims, 885 000 seek medical care²; nearly 370 000 are seen in emergency departments (EDs),³ and an average of 16 fatalities occur.⁴ Children are highly vulnerable to dog bites and make up a large percentage of dog bite victims; despite reported decreases in dog bite incidence in the past decade, children are still more likely to seek medical attention for their injuries² and account for approximately 70% of all bite-related fatalities.⁵ In the US, younger children, aged 5 to 9 years, are disproportionately at risk, with the highest incidence among all children^{2,6} and a large portion of their injuries occurring to the head, face, or neck.^{3,6}

Consequences of dog bite injuries can be temporary or lasting and include pain, disfigurement, infection, time lost from school or employment, fear, and anxiety. According to the American Society of Plastic Surgeons statistical data, there were >30 000 reconstructive procedures performed for dog bite injuries in 2009.⁷ Infections due to bacterial pathogens have long been described in dog bite wounds and are estimated to occur in approximately 16% of cases.⁸ A United Nations Children's Fund–Alliance for Safe Children study reported animal bites to children as the number 2 cause for seeking medical care or time lost from school and work.⁹ Evidence of post-traumatic stress disorder 1 month after injury has been seen in over half of children who have been bitten by a dog.¹⁰

These injuries place a significant financial strain on the US medical system. The annual cost for dog bites is estimated at \$120 million for emergency services alone, of which children and adolescents account for >50% and government sources pay more than a quarter of the sums.¹¹ Combining direct and indirect medical expenditures, dog bites cost nearly \$250 million each year.¹²

Despite these statistics, and the inclusion of reduced dog bite incidence as a goal of the CDC's Healthy People 2010,¹³ dog bite prevention research has been largely ignored. Most literature on dog bites to date is limited to descriptive data of injury incidence, patterns, and treatments. Additionally, although many studies suggest that safety education is an important factor in the prevention of other types of childhood injury,¹⁴⁻¹⁸ dog bite prevention education is often not addressed by health care providers or researchers.

To begin the process of developing evidence-based dog bite prevention interventions, we conducted a cross-sectional study to explore gaps in child dog bite prevention knowledge and to identify sociodemographic and experiential factors

AAP	American Academy of Pediatrics
CDC	Centers for Disease Control and Prevention
CRC	Clinical research coordinator
ED	Emergency department
PI	Principal investigator

From the ¹Division of Emergency Medicine and the ²Center for Global Health, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, and the ³Department of Emergency Medicine, University of Cincinnati College of Medicine, Cincinnati, OH

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that could assist with targeting prevention education toward those most at risk. We hypothesized that the majority of children and parents presenting to our ED have little knowledge about dog bite prevention and that lack of knowledge is consistent across age, sex, socioeconomic status, race/ethnicity, prior dog bite history, dog ownership, safe-dog practices, and parent-child communication frequency.

Methods

This was a cross-sectional survey study conducted in the ED of an urban, inner city, Level 1 pediatric trauma center with >90 000 pediatric visits. The ED treats >300 patients with dog bites each year. This study was approved by the hospital institutional review board.

The survey instrument was designed in 2 parts. The first captured sociodemographic and experiential information, of which 2 versions were developed: 1 for adults (parents or legal guardians) and 1 for the children. The adult survey included questions about parent age, sex, race, and level of education; household income; dog ownership; and the perceived need and/or desire for formal dog bite prevention education. The child survey included questions about child age, sex, and perceived feelings of safety around dogs. Both surveys included questions about previous dog bites, prior dog bite prevention education, and frequency of parent-child communication about safe practices around dogs. The second part of the survey was developed on the basis of consistent dog bite prevention recommendations advocated by the American Academy of Pediatrics (AAP), CDC, Humane Society of United States, and American Veterinary Medical Association. Fourteen questions (7 text and 7 text with accompanying picture) were posed as scenarios that depicted a dog in various situations, such as standing behind a fence, being tied up, eating, or nursing puppies. The participant (child or adult) was asked how he or she would interact with the dog in each scenario by answering "Yes" or "No" to the text portion of the question (see [Appendix](#); available at www.jpeds.com).

Survey implementation occurred between April 2008 and January 2009, during which the principal investigator (PI) or a clinical research coordinator (CRC) enrolled a convenience sample of potential participants. Participants were eligible if the child was aged 5-15 years, had been triaged with any nonurgent complaint or any dog bite, and was accompanied by a parent or legal guardian; potential participants were identified using a computerized patient tracking system. Participants were excluded if they were non-English speaking, had previously been enrolled in this study, or were unable to complete the study because of severe illness, injury, or developmental delay. Informed consent was obtained from all parent/legal guardian participants; assent was obtained for all child participants who were aged ≥ 11 years.

Initially, the parent/guardian and child independently completed their respective sociodemographic and experiential survey questions. Depending on the reading ability of the child, child surveys were either individually read and an-

swered by the child, or read to the child by the PI or CRC with documentation of the child's answer. Next, the child and their parent/guardian separately answered the 14 knowledge-based simulated scenario questions. This portion of the survey was given in the same manner, and the questions in the same order, to each participant. Although parents/guardians and children were not physically separated when answering questions, parents/guardians were asked to write down their answers without communicating with their children; children answered the questions either written or verbally to the PI or CRCs without having knowledge of their parent's/guardian's answers. Parents/guardians were not allowed to help their children with the surveys. All survey administration occurred during the ED visit, and at the end of their involvement in the study participants received the AAP dog bite prevention pamphlet to aid in dog-bite prevention education/awareness.

Parent/guardian and child knowledge scores were calculated by summing correct answers to the 14 simulated scenario questions; this total constituted a range of 0-14 (0 having no knowledge and 14 having the highest knowledge). Missing values were coded as zero (incorrect). Because a dog bite can be catastrophic, a relatively high passing threshold of ≥ 11 of 14 questions correct (78.5%) was selected.

Statistical Analysis

Data were described using means and SDs or frequencies and percentages as appropriate. Comparison of categorical variables between groups used χ^2 or Fisher exact test. To explore factors associated with knowledge, generalized linear models were fit to the knowledge score, and logistic regression was used to model the odds of passing. All analyses were conducted using SPSS 17.0 for Windows (SPSS Inc, Chicago, Illinois).

Results

Three hundred pairs completed the study. The majority, 90% (271 of 300), of parent/guardian participants were women, with a mean age of 35.2 (SD 8.2) years. Of these individuals, 51% (146 of 300) were white, 57% (170 of 300) had greater than a high school education, and 62% (186 of 300) had a household income $> \$20$ 000. For child participants, mean age was 8.7 (SD 3.7) years, 69% (206 of 300) were aged 5-9, and 51% (154 of 300) were female. Eleven percent of children presented to the ED for a current dog bite; the remaining children presented for other nonurgent complaints. Prior dog bites in the child was reported by 23% (68 of 300) of parents/guardians and previous or current dog ownership was reported by 72% of participants (218 of 300).

The mean child knowledge score was 10 (SD 2.5) with a passing score achieved by 57% (170 of 300). Child age, parental age, and parental race/ethnicity were noted to predict the odds of the child passing the knowledge test in a univariable analysis ([Table I](#)). No significant relationship was found between child passing the knowledge test and other sociodemographic and experiential factors (eg, child/parent sex, level of parental education, household income, dog

Table I. Univariable predictors of child passing the knowledge test

	OR	95% CI	P value
Child age	1.14	1.06-1.24	.001
Parent age	1.03	1.00-1.06	.053
Parent race (white vs nonwhite)	1.76	1.11-2.79	.017

ownership, previous dog bites in the family, reported prior dog bite prevention education, or parent-child communication about safe practices around dogs [data not shown]).

Multivariable logistic regression revealed that older children had higher odds of passing the knowledge test than did younger children, as did children with white parents vs those with nonwhite parents. Multivariable linear modeling showed that with every increased year of age, children gained 0.25 in total score, and children with white parents had an overall score 0.97 point higher than that of children with nonwhite parents (Table II).

The mean parent/guardian knowledge score was 13 (SD 1.6) with the majority (92%) achieving a passing grade. Multivariable logistic and linear modeling suggested that only age was a significant predictor of score: older parents had higher odds of passing the knowledge test and with every increased year of age, parents gained 0.005 in total score (Table II).

Among parents/guardians, 27% (81 of 300) stated that they or their children had received prior dog bite prevention education; 88% (256 of 300) reported that they and their children would benefit from this type of prevention education. Few (26%, 82 of 300) stated they knew where to go to receive this education. The pediatrician's office and the ED were reported as the "right place" to receive this dog bite prevention education by 86% (258 of 300) and 82% (242 of 300) of parents, respectively.

Discussion

Despite high incidence, high annual cost, and a disproportionate burden among children, dog bite prevention education and research to date have been limited. Many US national organizations advocate consistent dog bite prevention recommendations; however, large-scale dissemination of these messages is rare, and it is unknown whether children have gleaned the necessary knowledge to maximize the effec-

tiveness of the recommendations. The results of our study help to answer this question by determining what a sample of children know about dog bite prevention. Further, we identify factors associated with this knowledge and describe parental desires and acceptance regarding this type of prevention education.

Our results show a notable lack of awareness and knowledge regarding dog bite prevention among children, as nearly half of child participants failed a dog bite prevention knowledge test based on well-accepted dog bite prevention recommendations. Moreover, based on parent/guardian responses, less than one-third of children had ever received formal dog bite prevention education. Others have shown that children who are educated on safe-dog interactions act more safely around dogs,^{19,20} and a recent Cochrane review of dog bite interventions found that although there is no direct evidence linking dog bite education to decreased dog bite rates, "educating children who are less than 10 years . . . could improve their knowledge, attitude and behavior towards dogs."²¹ Given this potential for education to prevent unsafe behavior combined with the magnitude of the child knowledge deficits and lack of formal education found in our study, we propose that universal dog bite prevention interventions have the potential to prevent these injuries and alleviate the unnecessary burden of dog bites on the US health care system.

Additionally, our findings contribute to knowledge about dog bite risk factors. We demonstrated that younger children and those with nonwhite parents/guardians may be at higher risk of a dog bite as they tended to have lower dog bite prevention knowledge scores. Thus, it is not surprising that younger children are highly vulnerable to dog bites, possibly because their prevention knowledge is significantly lower than that of older children. The trends associated with race noted in our results, while not previously recognized in epidemiologic studies,^{2,22} may still imply a potential disparity in injury risk. Research to understand the possible association between these sociodemographic factors and dog bite prevention knowledge is necessary to elaborate any causes and consequences of this disparity. Further, whether knowledge differences actually translate to differences in injury risk and outcome requires exploration; thus, we echo the Cochrane review statement of needing "high quality studies that measure dog bite rates as an outcome."²¹

Interestingly, some experiential factors that one might assume would have an effect on dog bite prevention knowledge—such as current or prior dog ownership, previous

Table II. Multivariable predictors of the child or parent passing the knowledge test, and predicting their respective knowledge scores

	Logistic regression model			Generalized linear model		
	OR	95% CI	P value	Parameter estimate	95% CI	P value
Child test predictors						
Child's age	1.15	1.06-1.25	.001	0.25	0.16-0.33	<.001
Parent's race (white vs nonwhite)	1.88	1.17-3.02	.009	0.97	0.43-1.51	<.001
Parent test predictors						
Parent's age	1.07	1.01-1.15	.035	0.005	0.001-0.009	.013

dog bite in the family, prior dog bite education, and parent-child communication about safe practices around dogs—did not reveal significant correlation in our analysis. Possible reasons for these findings are: (1) dog ownership does not necessarily equate to knowledge of how to prevent dog bites, evidenced by the fact that the majority of dog bites to children are by familiar dogs²³; (2) having an experience of a dog bite does not mean that the victim or his or her family member has subsequently learned how to prevent dog bites; and (3) reports from children regarding their prior education and/or parent-child communication about dog bite prevention are not generalizable as it is difficult to know the specific type of education experienced and/or if appropriate dog bite prevention messages have been communicated.

Last, our results suggest that dog bite prevention interventions would be well received. Even though nearly 90% of parents/guardians recognized the need and indicated a desire for their families to be educated about how to minimize the risk of dog bites, >70% did not know where they could go to learn this information. The majority indicated that both the pediatrician's office and the ED would be good settings in which to conduct this intervention. Identifying the ED as a place for public health prevention programs is consistent with trends in disease screening,^{24,25} injury prevention,²⁵⁻²⁷ and brief intervention research^{25,28}; thus, EDs should consider providing dog bite prevention information and education.

It is important to interpret the results of our study within the context of its limitations. First, this study was conducted in a convenience sample of patients in a single busy pediatric ED that is the region's only major pediatric trauma. Although the study sample had similar demographics to our overall ED population, it is possible that this sample does not reflect the local population or other ED populations and/or that certain groups may seek nonurgent care in the ED more frequently. Thus, generalizability might be questioned and we would encourage validation of our findings in other settings. Second, though the test questions used in our study were based on dog bite prevention recommendations espoused by several national organizations, questions have not been validated and it is unclear if participants would respond to real situations in a similar manner as stated in response to hypothetical scenarios. Additionally, while dog bite recommendations are typically stated in the negative tense (eg, "Do not pet a dog that is behind a fence" and "Do not pet a dog that is eating"), the correct answers for all of the pictorial questions were "No," which might lead some test-takers to reconsider their answer. Further research on dog bite prevention knowledge would benefit from validation and careful assessment of any knowledge test used. Third, because this test was the first of its kind, an arbitrary cut-off for passing the test was made and it is expected that a lower passing threshold would result in fewer children failing the test. Even though we did not validate this cut-off, we replicated all of our analysis using a linear regression with the continuous test result as the dependent variable, and no differences were observed between the 2 modeling strategies, suggesting the choice of cut-off did not adversely affect interpretation of our results.

Last, it is unknown whether knowledge of dog bite prevention actually decreases the number or severity of dog bites. Although dog bite prevention education recommendations are consistent, we are not aware of any studies that explore an association between prevention knowledge and dog bite incidence. Evidence demonstrating a benefit of prevention interventions on reducing the incidence of injury would be persuasive in translating our recommendations for dog bite prevention intervention into practice.

Despite alarming injury statistics, children aged 5-15 in our sample population often lacked the knowledge to minimize the risk of dog bites and few had received formal dog bite prevention education. In this study, younger children and children with nonwhite parents had a greater knowledge deficit than did older children and children with white parents. We conclude that this may place younger children and those with nonwhite parents at greater risk of dog bites. The vast majority of parents in our study recognized the need for dog bite prevention education and indicated health care settings as appropriate venues for providing it. Our findings reinforce that dog bite prevention education should be included in injury prevention discussions with children and parents. Further research on this topic will be helpful in addressing this problem and discovering other strategies and interventions to reduce dog bite injuries and outcomes in children. ■

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Reprint requests: Cinnamon A. Dixon, DO, MPH, Assistant Professor of Clinical Pediatrics, Cincinnati Children's Hospital Medical Center, Division of Emergency Medicine and Center for Global Health, 3333 Burnet Ave., MLC 2008, Cincinnati, OH 45229. E-mail: Cinnamon.dixon@cchmc.org

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Appendix

**Complete Dog Bite Prevention Knowledge Test
(Correct Answers Underlined.)**

1. You are at a friend's house and their dog is tied in the yard; do you pet the dog?

Yes No

2. Your cousin's dog is playing with a toy; do you run up and take the toy?

Yes No

3. A mommy dog is nursing her puppies; do you try to pet her or the puppies?

Yes No

4. Your uncle gets a new dog; do you ask him before petting the dog?

Yes No

5. Walking home from the bus stop, a strange dog comes near you and starts barking; do you run away?

Yes No

6. A dog you have never seen before is sniffing a tree in the neighbor's yard; do you reach out and try to grab the dog?

Yes No

7. A dog you don't know runs up to you; do you stand very still and wait for the dog to walk away?

Yes No

8. Should you pet this dog?

Yes No



9. Should you pet this dog?

Yes No



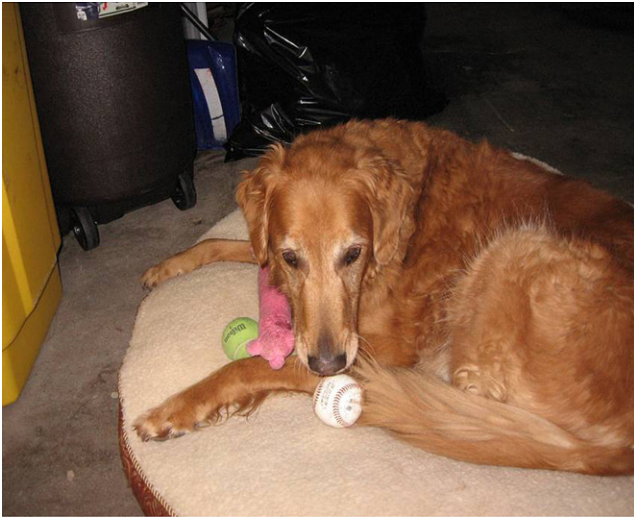
10. Should you pet this dog?

Yes No



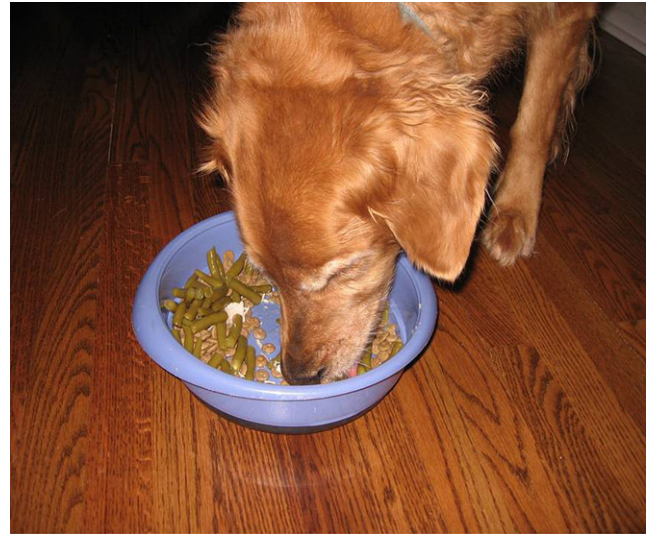
11. Should you pet this dog?

Yes No



13. Should you pet this dog?

Yes No



12. Should you pet this dog?

Yes No



14. Should you pet this dog?

Yes No

