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Pandemic Puppies: Man's Best Friend or Public Health Problem? A Multidatabase Study

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ABSTRACT

Introduction: The public health implications of the COVID-19 pandemic reach beyond those of the disease itself. Various centers have anecdotally reported increases in the incidence of dog bite injuries which predominate in pediatric populations. The reasons for this increase are likely multifactorial and include an increase in canine adoptions, remote learning, and psychosocial stressors induced by lockdowns. We hypothesized that there was a significant increase in the proportion of dog bite injuries at our institution and within a nationally representative cohort.
Methods: We queried our electronic health record and the National Electronic Injury Surveillance System (NEISS) for all records pertaining to dog bites between 2015 and 2020, and the annual incidence was calculated. Poisson regression was then used to estimate whether there was a significant difference in the adjusted risk ratio for each year.
Results: The institutional and national cohorts revealed relative increases in the incidence of dog bite injury of 243 and 147.9 per 100,000 over the study period, respectively. Both cohorts observed significant increases of 44% and 25% in the annual incidence relative to 2019, respectively. Poisson regression revealed a significantly elevated adjusted relative risk in the institutional cohort for 2020 (2.664, CI: 2.076-3.419, $P < 0.001$). The national cohort also revealed an increase (1.129, CI: 1.091-1.169, $P < 0.001$).
Conclusions: A nationwide increase in the incidence of dog bite injuries among children was observed during COVID-19 in 2020. These findings suggest that dog bites remain a public health problem that must be addressed by public health agencies.

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Introduction

Dog bites carry the spectrum of morbidity, ranging from superficial to disfiguring and up through fatal.[1] This poses a public health issue in the United States with an annual incidence of 4.5 M bites with an estimated healthcare cost of $400 M. Children are unfortunately at the greatest risk, spending more time at the height of the dog, often sustaining disfiguring bites to the head, face, and neck.[1,2] Although dog bite incidence increased from 2005 to 2011, there has been a decrease thereafter till 2018.[3] Prior data suggest that changes in dog ownership patterns have had a great influence on these trends.[4] However, it remains unknown whether the dramatic increase in canine adoptions, "pandemic puppies", seen during Coronavirus disease 2019 (COVID-19) has had any association with a dog bite—related injury.[5,6]

The lockdowns due to COVID-19 have driven behavioral changes in the lives of Americans. These daily life changes have clinical and public health implications that have taken a toll on mental health.[7] Dogs have been one of the ways people and families have mitigated the emotional stresses of the pandemic.[8] In addition, shelter in place orders have led more people to stay home from school and other activities. Increased dog ownership and time spent confined with dogs may be contributing to the reports of increased dog bites among pediatric centers.[9-11] Our center also observed a similar increase in the proportion of dog bite cases presenting to our emergency department (ED).

We report herein the incidence of pediatric dog bite patients at our center and in a nationally representative database during the COVID-19 pandemic. We hypothesized that multiple factors during this time period were associated with an increase in the volume of dog bite injuries seen in the ED setting both locally and nationally.

Materials and Methods

Study design, data source, and population

An institutional review board approval was obtained to perform a retrospective study using the National Electronic Injury Surveillance System (NEISS) (national sample) and an informed consent waiver to query our own electronic health record (EHR) (institutional sample).

The NEISS is a database of injury encounters at 100 reporting EDs, maintained by the Centers for Disease Control (CDC) and the Consumer Product Safety Commission (CPSC). The participating hospitals are stratified into four strata based on size and a fifth for children's hospitals. They are located in various geographic regions within the United States and are considered a representative probability sample of all 5000+ EDs across the United States when performing analyses using the supplied probability sample weights. We queried the years 2015-2020 and used the narrative field to identify the records pertaining to initial dog bite visits. We then excluded patients based on age (<18 y).

Our own institutional EHR was queried for all patients presenting with dog bite injuries to our ED (defined by the International Classification of Diseases, ninth revision, Clinical Modification [ICD-9-CM] diagnosis code E906.0 and International Classification of Diseases, 10th revision, Clinical Modification [ICD-10-CM] diagnosis code W54.0XXA). Patients were then excluded based on age (<18 y).

This study was designed in accordance with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines for observational studies (Supplemental Fig. 1).

Covariates

Relevant covariates extracted from both databases included age, gender, and race.

Outcome measures

The total number of dog bites was used along with the total number of ED visits in each respective cohort to calculate the incidence per 100,000 visits. The change in incidence was evaluated using the previous year's data. Poisson regression was then used to estimate the adjusted relative risk for each year using 2015 as a baseline.

Table 1 — Demographic data of institutional and NEISS dog bite presentations from 2015 to 2020.						
Covariate	Year					
	Median (IQR)/n (%)					
	2015	2016	2017	2018	2019	2020
Institutional cohort, n = 621						
Age, Y	7 (4-11)	8 (4-11)	5 (2-9)	7 (3-12)	8 (5-11)	8 (4-12)
Gender						
Male	109 (56)	61 (53)	58 (54)	72 (55)	74 (54)	75 (57)
Race						
White	124 (64)	65 (57)	65 (61)	84 (65)	86 (63)	87 (66)
Black	36 (18)	28 (24)	22 (21)	19 (15)	26 (19)	27 (20)
Other	36 (18)	22 (19)	20 (19)	27 (20)	25 (18)	18 (14)
National cohort, n = 25,592						
Age, Y	8 (3-13)	8 (3-13)	8 (3-13)	8 (3-13)	8 (3-13)	6 (2-12)
Gender						
Male	3627 (61)	3940 (64)	4558 (60)	4077 (59)	4230 (58)	3834 (59)
Race						
White	921 (15)	914 (15)	1918 (25)	1571 (23)	1481 (20)	1523 (24)
Black	3425 (57)	3404 (55)	3835 (51)	3685 (53)	3928 (54)	3539 (55)
Other	1612 (27)	1860 (30)	1823 (24)	1662 (24)	1843 (25)	1401 (22)

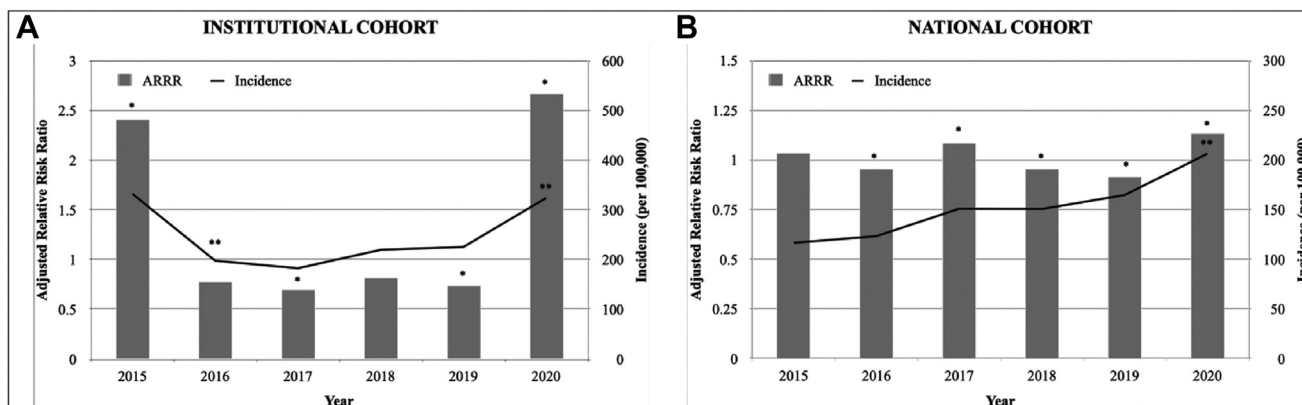NEISS = National Electronic Injury Surveillance System.

Fig. — Adjusted relative risk and incidence of dog bite presentations from 2016 to 2020. (A) Institutional database. (B) NEISS. Ratios estimated using Poisson regression model. * denotes significance value in adjusted relative risk of $P < 0.01$. ** denotes significant difference in incidence from previous year of $P < 0.01$. NEISS = National Electronic Injury Surveillance System.

Statistical analysis

Counts and proportions were used to summarize categorical variables and non-normally distributed continuous variables were reported as medians with interquartile ranges (IQR). Pearson's chi-squared test was used to compare each year's incidence with the previous year's data. Poisson regression was used to evaluate whether there was an increase in the relative number of dog bite presentations during the pandemic in both cohorts. Adjusted relative risk ratios were estimated to reveal significant departures from the general trend. Model validation was then performed using deviance and Pearson's goodness-of-fit tests. There were no missing data on outcomes of interest; a complete case analysis was undertaken. The threshold for statistical significance was set at $P < 0.01$. Statistical analyses were performed using StataMP release 16 (College Station, TX).

Results

Within the institutional cohort, there were 817 of 336,387 ED visits due to dog bite injuries from 2015 to 2020 (Table 1).

Overall, the median age was 7 y (IQR: 4-11), 55% were male, and 62% were White. There was a relative increase of 243 per 100,000 during the study period which translated to 41 per 100,000 per year. In 2020, the incidence increased relative to 2019 by 44% to 324 per 100,000 ($P = 0.003$). The adjusted relative risk increased significantly in 2020 (2.664, CI: 2.076-3.419, $P < 0.001$; Fig. and Table 2).

Within the national sample, we identified 40,343 dog bite presentations of 27,281,076 ED visits over the study period. Overall, the median age was 9 y (IQR: 5-13), 55% were male, and 45% were White (Table 1). There was a relative increase of 147.9 per 100,000 from 2015 to 2020 which translated to 25 per 100,000 per year. In 2020, there was a 25% increase in the incidence relative to 2019 ($P = 0.001$). The adjusted relative risk increased significantly (1.129, CI: 1.091-1.169, $P < 0.001$; Fig. and Table 3).

Discussion

The impact of the COVID-19 pandemic on the United States healthcare system extends beyond the healthcare utilization directly related to the disease. The pandemic has affected many

Table 2 — Institutional dog bite data and results of Poisson regression from 2015 to 2020.							
Year	Number of bites	Number of ED visits	Incidence (per 100,000)	P value[*]	Adjusted risk ratio	95% CI	P value
2015	196	59,034	332.0	Ref.	2.413	1.884-3.090	<0.001
2016	115	58,150	197.8	<0.001	0.771	0.625-0.951	0.015
2017	107	58,552	182.7	0.556	0.696	0.568-0.854	0.001
2018	130	59,146	219.8	0.156	0.821	0.679-0.994	0.043
2019	137	60,758	225.5	0.834	0.741	0.603-0.911	0.005
2020	132	40,747	324.0	0.003	2.664	2.076-3.419	<0.001

[*]Change in incidence determined with Pearson's chi-squared test performed using previous year's data.

Year	Number of bites	Number of ED visits	Incidence (per 100,000)	P value*	Adjusted risk ratio	95% CI	P value
2015	5958	5,111,192	116.6	Ref.	1.032	0.996-1.070	0.082
2016	6178	5,011,974	123.3	0.249	0.954	0.926-0.982	0.002
2017	7576	5,023,094	150.8	0.069	1.083	1.056-1.111	<0.001
2018	6916	4,593,440	150.6	0.634	0.949	0.924-0.973	<0.001
2019	7251	4,406,914	164.5	0.548	0.916	0.891-0.942	<0.001
2020	6463	3,134,462	206.2	0.001	1.129	1.091-1.169	<0.001

Table 3 – NEISS dog bite data and results of Poisson regression from 2015 to 2020.

NEISS = National Electronic Injury Surveillance System.
*Change in incidence determined with Pearson's chi-squared test performed using previous year's data.

facets of our lives and has driven behavioral changes for coping with the associated lockdowns and social-distancing measures. Our study found that there was a significant increase in the incidence and risk ratio of dog bite presentations to the ED during the pandemic both within an institutional cohort and a nationally representative sample. These results have important public health implications that warrant further investigation to develop and implement preventive measures to mitigate the associated morbidity and burden on the healthcare system.

Other studies have anecdotally reported increases in the incidence of dog bite injuries at various centers.[10-12] Although our study also uses institutional level data to add to this evidence, we evaluated a nationally statistically representative sample which showed similar results. This observed increase is likely multifactorial. As schools across the country closed and began delivering education to children at home on devices, it is likely that children spent a greater time in proximity to family dogs. Other evidence has shown that a greater number of canine adoptions occurred during the pandemic, presumably leading to increased children and dog cohabitation.[6,8,13] In addition, some studies indicate that a dog's behavior can reflect those of their owners and that stressful situations, such as those observed during lockdowns, can lead to an increased aggressive behavior.[14] As public health agencies at the state and local level are coping with the consequences of COVID-19, less emphasis may have been placed on providing a proportional effort to public health education regarding dog safety and animal control enforcement which may be an additional contribution.

This study has the inherent limitations of a retrospective review. The NEISS, although funded by the federal government and characterized as a nationally representative probability sample, is still subject to bias in terms of the limited number of hospitals that participate. In addition, our institutional data contain the inherent bias of being an exclusively pediatric sample. Dog bite incidence is higher in children and our results may be affected by these factors. The study is also possibly limited by the number of years used. Poisson regression relies on the expected changes based on data trends and results could differ depending on how much data are used to build the model. Finally, the multifactorial nature of these population level changes should inform the interpretation of our results.

In summary, 2020 saw an increase in the incidence of dog bite injury in children. Various factors such as "pandemic puppies", remote learning, and psychosocial stressors may have played a role in this increase. Prior to the pandemic, pediatric dog bites were considered a public health problem. The increase we have observed during the pandemic should inform public health agencies to expand prevention and public education measures. In addition, although emergency departments are seeing a decreased volume, hospitals should be aware of the possibility of an increased proportion of dog bite presentations as a result of the greater number of household dogs now and in the future.

Supplementary Materials

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jss.2022.02.041.

Author Contributions

Disclosure

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