Level I Trauma Center Studies Characterizing Dog Bite Injuries Across Major U.S. Geographical Regions (2011-2022)

Summary

Table 1. From 2011 to 2022, 18 peer-reviewed scientific medical studies from Level I trauma centers spanning all major geographical regions in the United States—Northeast, Southeast, South, Southwest, Midwest, West Coast and Northwest—all report similar findings. Pit bulls are inflicting a higher prevalence of injuries than all other breeds of dogs. The majority of these studies (14 of 18) also report that pit bulls are inflicting the most severe injuries, requiring a higher number of operative interventions—up to five times higher—than other dog breeds.

Table 2. Four studies from this period—all from Level I trauma centers in the Denver metro area—show a mixture of results, possibly due to Denver and the surrounding metropolitan regions enforcing pit bull bans from 1989 to 2020.

Criteria for inclusion in this trauma study table requires being a multi-year retrospective study[1] of U.S. Level I trauma center dog bite patients (≥ 15 patients), published from 2011 to 2022, the inclusion of dog breed information, and the scientific research conducted by medical doctors.

Table 1: Major U.S. Geographical Regions

Years	Region	Breed & Injury Prevalence	Severity Information	Ref
Published: **Jun. 2022** Study period: 2011-2017 *L. Boyd*	**South** - Regional Pediatric Level I trauma center - Memphis, Tennessee	1422 pediatric patients studied: predominantly male (63.5%), African-American (57.4%), and < 10 years (69.4%). Head and neck areas sustained most injuries (64.7%). Pit bulls inflicted the highest prevalence of injuries (n = 245, 47.9%). Breed was known in 36% of all cases (511/1422).	Operative repair was necessary in 16.9% of all cases. Head and neck bites accounted for 54.2% of all operative cases. Pit bulls were the most commonly identified breed in cases requiring operative repair (52.2%). No fatal dog bites occurred in this study.	1
Selected Findings: "The typical pediatric dog bite case was male (63.5%), African-American (57.4%), and less than 10 years old (69.4%). The head and neck were the most commonly affected areas (64.7%) … Pit Bulls were the most frequently identified breed (n = 245, 47.9%) of the 511 cases in which the breed was known and were the most commonly identified breed in cases requiring operative repair (52.2%)."				

Published: **Jun. 2021** Study period: 2007-2017 *K. Munoz*	**Southeast** - Pediatric Level I trauma center - Richmond, Virginia	356 pediatric patients studied. Patient ages 6-12 suffered the most injuries, 45.7%. Pit bulls inflicted the highest prevalence of injuries, 53%, when breed was known and 29.8% of cases studied. Pit bulls were more likely to bite ages 6-12 (36.2%). Huskies were more likely to bite infants (5.9%).	Facial injuries were the most common, 56.2% followed by extremities, 37.1%. Infants and preschoolers were more likely to sustain bites to the head/face. Approximately 25% of the patients required advanced reconstructive techniques.	2
Findings: "Most pediatric dog bite injuries afflicted male children (55.6%), ages 6 to 12 years (45.7%), by a household dog (36.2%). The most common offending breed was a pit bull or pit bull mix (53.0%) … Other frequently identified breed groups included Labrador/Labrador mix (10%), German Shepherd/German Shepherd mix (6.5%) … Specific dog breed was not associated with need for surgical repair or location of surgical repair."				
Published: **Jun. 2021** Study period: 2008-2019 *B. Parent*	**Northeast -** Pediatric Level 1 trauma center - western Pennsylvania	114 pediatric patients studied divided into two groups: craniofacial fractures (38) and those without (76). Across both groups, the most commonly identified breed was pit bull, 22%, followed by mixed-breed, 14%. Breed was known in 77% of cases (88).	A total of 60 craniofacial fractures were identified among 38 pediatric patients. The most commonly identified breed was pit bull, 37%, followed by mixed-breed, 13%. Breed was known in 92% of cases (35).	3
Selected Findings: "The most commonly reported dog breeds for both groups were Pit Bull Terriers (25 patients, or 22%), followed by a mixed breed dogs (16 patients, 14%)." "The most commonly reported breed among these fracture patients was the Pit Bull Terrier: a breed which has been previously identified as particularly high risk for aggressive and destructive behavior."				
Published: **Aug. 2020** Study period: 1997-2018[2] *N. Zhu*	**Northeast** - Level I trauma center, pediatric and adult, Boston, Massachusetts	321 patients studied -- facial dog bite injuries only. 141 males and 180 females. The majority of patients were adults (> 18 years, 69.5%). Most dogs (87.5%) were known, and provocation was recorded in 207 cases (64.5%). Pit bulls led in the number of injuries to both children and adults.	Among all age groups, 207 patients (64.5%) required surgical treatment. The most common wounds were lacerations (88.5%), followed by puncture (22.4%), avulsion (15%), facial fracture (2.5%), and 28 patients (8.7%) required revision surgery.	4

Findings: "In total, 321 patients were identified. There were 141 males and 180 females. The majority of patients were adults (age > 18 years; n = 223, 69.5%). Most dogs (n = 281, 87.5%) were known, and provocation was recorded in 207 cases (64.5%) ... Only 5.6% of the animals had a history of aggressive behavior ... Pit bulls led as the offending breed in injuries caused to both children and adults."				
Published: **Mar. 2020** Study period: 2009-2018[3] *K. Khan*	**Southeast** - Regional Level I trauma center - Charleston, West Virginia	182 patients studied -- craniofacial and related injuries. Patient gender, 53% girls ≤ 10 and 65% female ≥ 11. Pit bulls inflicted the highest prevalence of attacks, 27% (49), followed by German shepherds, 6% (11), among the top-biting breeds. Breed was known in 90% (163/182) of all cases.	Pit bulls inflicted the most complex wounds, 63% (41/65), the most mauling injuries, 71% (12/17), when 3 or more bites occurred over 2 or more distinct regional anatomic areas, and the most fractures, 47% (7/15), within the top-biting breeds.	5
Findings: "The data showed that compared with other dog breeds, pit bull terriers inflicted more complex wounds, were often unprovoked, and went off property to attack ... The probability of a bite resulting in a complex wound was 4.4 times higher for pit bulls compared with the other top-biting breeds ... and the odds of an off-property attack by a pit bull was 2.7 times greater than that for all other breeds."				
Published: **Jul. 2019** Study period: 2011-2016[4] *J. Abraham*	**South** - [Blinded] emergency department ([Blinded]), Texas[5]	102 pediatric patients studied, 57% were girls. 80 dogs were identified by breed in 75 encounters (74% of total 102 encounters). Pit bulls inflicted the highest prevalence of injuries, 36.2%, when breed was known, followed by Labradors, 10%.	92.1% of injuries involved the head-neck region and 72.5% were of major severity. The pit bull was the most commonly identified breed involving major injury, including the only patients that required ICU monitoring.	6
Findings: "Parental presence was reported in 43.6% of cases, and most attacks occurred in the evening (46.8%). Injuries often involved the head–neck region (92.1%), and 72.5% were of major severity." "The most commonly identified breed was the pit bull, followed by the Labrador retriever. Pit bulls were also the most commonly identified breed involved in major injuries."				
Published: **May 2019** Study period: 2010-2014	**West Coast** - Level I trauma center - Irvine, California	189 patients studied, all adults ≥ 18. Breed identified in 61 cases, 32.2%. Pit bulls inflicted the highest prevalence of injuries, 47.5% (29), when breed was known	Pit bulls were responsible for 36.8% of head and neck injuries when breed was known (7/19). 65.5% of pit bull attacks involved the extremities. Other dog breeds were	7

C. Lee		and 15.3% of total studied.	more evenly distributed.	
Results: "The most common breed of dog identified was pit bull (n = 29, 47.5%). The majority of pit bull attacks involved the extremities (65.5%) compared to other breeds of dogs. Pit bull victims were noted to have a lower average annual income compared to other breed victims … However, this was not statistically significant (0.16)."				
Published: **Feb. 2019** Study period: 2002-2017 *G. Essig Jr.*	**Midwest** - Two Pediatric Level I trauma centers - Columbus, Ohio and Charlottesville, Virginia	Meta-study analysis conducted across 43 studies (1970 to current) to determine breed prevalence in all bites. Pit bulls were responsible for the highest percentage of reported bites across all the studies (22.5%) followed by mixed-breed (21.2%) and German shepherds (17.8%).	240 pediatric patients studied -- head, neck injuries only. Each patient characterized into an ordinal scale of bite injury. Mixed-breeds and pit bulls had the highest relative risk of biting, and also had the highest average tissue damage per bite.	8
Findings: "Injuries from pit bulls and mixed-breed dogs were both more frequent and more severe … Physical characteristics like brachycephalic head shape and weight between 66 and 100 pounds were found to have both the highest bite risk and highest average tissue damage per bite." "We recommend separating children from high-risk breeds and high-risk phenotypes reported in this study. Selecting for animals with low risk for biting and tissue damage may lower the risk injury."				
Published: **Sep. 2018** Study period: 2010-2016 *J. Brice*	**West Coast** - Level I trauma center - Fresno, California	95 patients studied -- orthopaedic injuries requiring specialized treatment only. Pit bulls inflicted the highest prevalence of injuries, 50% (47), followed by law enforcement dogs, 22% (21), of total studied. Breed was known in 84% (80) of all cases.	Pit bulls were responsible for 78% of all amputation injuries. Of those bitten by pit bulls, 51% had a bony injury. Bites from law enforcement dogs resulted in 24% bony injuries. 66% of pit bull bite patients (31/47) sustained an amputation or bony injury.	9
Conclusions: "Thirty-nine percent of all dog bite-related emergency department visits at our facility resulted in an injury requiring orthopaedic treatment. Pit bull terrier bites were responsible for a significantly higher number of orthopaedic injuries and resulted in an amputation and/or bony injury in 66% of patients treated, whereas bites from law enforcement dogs and other breeds were less associated with severe injuries."				
Published: **Aug. 2018**	**South** - Two Level I trauma	740 patients studied, 574 children and 166 adults. Pit	Of the 31 adult trauma cases in which a breed	10

Study periods: 2011-2016, 2010-2016 *A. Smith*	centers, pediatric and adult - Little Rock, Arkansas	bulls inflicted the highest prevalence of injuries to children, 28.1% (55), when breed was known. Breed was recorded in 34% (195/574) of pediatric cases and 58.6% (17/29) of pediatric cases that required operative intervention.	was recorded, 42% (13/31), pit bulls were represented in 69% of cases. Of all child and adult cases combined that required operative intervention, pit bulls were represented in 62.5% of cases.	
Findings: "Our study corroborates much of the previous literature, supporting the notion that pit bull bites are severe enough to require operative intervention more frequently than the bites of other dog breeds … Indeed, when looking at cases that required operative interventions, pit bulls were disproportionately represented in 62.5% of cases."				
Published: **Oct. 2017** Study period: 2012-2014 *K. Alizadeh*	**Northeast** - Pediatric Level I trauma center - Westchester, New York	108 pediatric patients studied. 17 dog breeds identified in 56 cases, 52%. Pit bulls inflicted the highest prevalence of injuries, 48.2% (27), when breed was known and 25% of total studied.	47.8% of pit bull injuries required operative repair, which was 3 times more than other breeds. Of the 9 patients with extended hospitalization, 66.7% were caused by a pit bull.	11
Findings: "Of the 56 cases that had an identified dog breed, pit bulls accounted for 48.2% of the dog bites … More importantly, 47.8% of pit bull injuries required operative repair, which was 3 times more than other breeds." "Of the 9 patients with extended hospitalization, 6 (66.7%) were caused by a pit bull that confirms our theory that this breed results in the most devastating injuries at our center. The penetrating and crushing nature of these bites can lead to lifelong deformities."				
Published: **Apr. 2017** Study period: 4 years *M. Golinko*	**Southeast** - Pediatric Level I trauma center - Atlanta, Georgia	1616 pediatric patients studied. 46 dog breeds identified in 509 cases, 31.3%. Pit bulls inflicted the highest prevalence of injuries, 38.5% (196), when breed was known and 12% of total studied.	Pit bull bites were implicated in 50% of all surgeries performed and over 2.5 times as likely to bite in multiple anatomic locations as compared to other breeds. A pit bull inflicted the only fatality.	12
Findings: "Pit bull bites were implicated in half of all surgeries performed and over 2.5 times as likely to bite in multiple anatomic locations as compared to other breeds." "Our data were consistent with others, in that an operative intervention was more than 3 times as likely to be associated with a pit bull injury than with any other breed."				
Published: **Jul/Aug 2016**	**Northwest** - Regional Level I trauma center -	342 patients studied. Breed identified in 270 cases, 79%. Pit bulls inflicted the highest	5 patients (1.5%) ages < 7 sustained facial fractures. 3 sustained orbital	13

Study period: 2003-2013 *M. Prendes*	Seattle, Washington	prevalence of injuries 27% (92) of total studied and 25% (22.7) of all ocular injuries. Among dogs unknown to patients, pit bulls inflicted 60% of all injuries and 63% of ocular injuries.	fractures inflicted by a doberman, husky and Labrador, 1 sustained a nasal bone fracture by a pit bull, and 1 sustained a depressed skull fracture by a German shepherd.	
Findings: "Importantly, this study is the first to accurately establish that pit bulls are the breed most commonly associated with ocular injuries (25%). Most alarming is the observation that when attacks come from unfamiliar dogs, the pit bull was responsible for 60% and 63% of all injuries and ocular injuries, respectively."				
Published: **May 2015** Study period: 2006-2013[6] *M. Foster*	**Southeast** - Level I trauma center - Knoxville, Tennessee	20 patients studied -- head, neck and facial injuries only treated by oral and maxillofacial surgery. Breed identified in 16 cases, 80%. Pit bulls inflicted the highest prevalence of injuries, 56% (9), when breed was known and 45% of total studied.	Pit bulls were more frequently associated with injuries than other dog breeds (9/20). Two cases involved multiple dogs, all of which were pit bulls. A pit bull inflicted the only fatality.	14
Results: "The medical records from 20 patients were included and reviewed. More than one half (60%) of the patients were younger than 12 years old. The dog was owned by the patient or a relative in 58% of the cases. The children sustained injuries requiring hospital admission and repair in an operating room setting more often than did the adults. Pit bulls were more frequently associated with injuries than other breeds (9 of 20)."				
Published: **Feb. 2015** Study period: 2007-2013 *E. Garvey*	**Southwest** - Pediatric Level I trauma center - Phoenix, Arizona	282 pediatric patients studied. Breed identified in 213 cases, 75.5%. Pit bulls inflicted the highest prevalence of injuries, 39% (83), when breed was known and 29.4% of total studied.	Among the 11 patients with the highest AIS (3–5), pit bulls were responsible in 45.5% of cases. Pit bulls also accounted for 38% of all head, neck or facial bites.	15
Findings: "Pit bulls were most frequently responsible, accounting for 39% (83/213) of incidents in which dog breed was documented … Among the 11 patients with the highest AIS (3–5), Pit bulls were responsible in 45.5% of cases, followed by mixed-breeds in 18.2% (2/11) of cases. Pit bulls were also responsible for 38% of all head, neck or face bites." "Dog familiarity did not confer safety, and in this series, pit bulls were most frequently responsible. These findings have great relevance for child safety."				
Published: **Jan/Feb 2015**	**West Coast** - Level I trauma center -	334 patients studied. Breed identified in 211 cases, 63%. Pit bulls inflicted the highest	Bites from pit bull terriers were more severe than other dog breeds	16

Study period: 2012-2013 *D. O'Brien*	Sacramento, California	prevalence of injuries, 54% (114), when breed was known and 34% of total studied. Pit bulls also inflicted the highest prevalence of head and neck injuries, 48% (32/67), when breed was known and 32% of total studied.	with a mean DBCI of 3.2 compared to 2.3, had a significantly higher rate of consultation (94%) and had 5 times the rate of operative repair when compared to other breeds.	
Results: "Of the more than 8 different breeds identified, one-third were caused by pit bull terriers and resulted in the highest rate of consultation (94%) and had 5 times the relative rate of surgical intervention. Unlike all other breeds, pit bull terriers were relatively more likely to attack an unknown individual (+31%), and without provocation (+48%)."				
Published: **Nov/Dec 2011** Study period: 2005-2009 *B. Horswell*	**Southeast** - Regional Level I trauma center - Charleston, West Virginia	40 pediatric patients studied -- facial, head and neck injuries only. Breed identified in 30 cases, 75%. Pit bulls inflicted the highest prevalence of injuries, 40% (12), when breed was known and 30% of total studied.	The skull and orbital fractures were caused by a pit bull bite, which is characterized as a "vice-grip" which crushes, avulses and strangles, potentially making it a more dangerous breed.	17
Findings: "Bites from large-breed dogs, especially pit bull-type dogs and rottweilers are more likely to result in more severe injuries, subsequent medical care and report, which may over-represent those breeds among biting dogs -- in other words, creating reporting bias. However the severity of injury necessitating medical attention should not be overlooked when considering the breed of dog generating more severe injuries."				
Published: **Apr. 2011** Study period: 1994-2009 *J. Bini*	**South** - Level I trauma center - San Antonio, Texas	228 patients studied. Breed identified in 82 cases, 36%. Pit bulls inflicted the highest prevalence of injuries, 35% (29), when breed was known. There were three dog bite fatalities; pit bulls inflicted all three deaths.	Attacks by pit bulls were associated with a higher median Injury Severity Scale score, a higher risk of an admission Glasgow Coma Scale score of 8 or lower, higher median hospital charges, and a higher risk of death.	18
Conclusions: "Attacks by pit bulls are associated with higher morbidity rates, higher hospital charges, and a higher risk of death than are attacks by other breeds of dogs. Strict regulation of pit bulls may substantially reduce the US mortality rates related to dog bites."				

Level I Trauma Center Studies Characterizing Dog Bite Injuries in Denver, Colorado Region (2013-2017)

Summary

In October 1989, the city and county of Denver adopted a pit bull ban. Notably, in 1994, one of the first epidemiological studies of "breeds of biting dogs" was carried out in the county of Denver, despite the absence of pit bull terriers due to the ban (Which Breeds Bite? A Case-Control Study of Risk Factors).[7] As a result, pit bulls did not appear in the case-control study's "biting" or "nonbiting" breed findings (Gershman, 1994).

From 2013 to 2017, one of four Level I trauma center studies in the Denver metro area showed that pit bulls continue to have a high prevalence of facial injuries (Gurunluoglu, 2014). Another study, also limited to facial injuries, states that while the prevalence of pit bull injuries was low during their study period (2003-2008), the severity of pit bull injury included, "the patient who suffered the most extensive injuries and the longest hospitalization of our entire population" (Chen, 2013).

On November 3, 2020, Denver voters repealed the city's longstanding pit bull ban and replaced it with a provisional "breed-restricted license" ordinance. The new law requires pit bull owners to register and microchip their dogs and limits the ownership of pit bulls to two per household.

Table 2: Denver Level I Trauma Centers

Children's Hospital Colorado and Denver Health Level I Trauma Center are regional Level I trauma centers that serve the Denver metro area and 7-state Rocky Mountain region.

Years	Region	Breed & Injury Prevalence	Severity Information	Ref
Published: **Jan. 2017** Study period: 2000-2015[8] *R. Kumar*	**West** - Regional Pediatric Level I trauma center - Denver, Colorado	17 pediatric patients studied -- neurosurgical consultation for head and neck injuries only. Patient gender, 53% girls. Akitas and German shepherds inflicted the highest prevalence of wounds (3 each) followed by American bulldogs, Labradors, large mixed-breed dogs and pit bulls (2 each).	All attacks requiring neurosurgical consultation were committed by large-breed dogs. Neurological deficits, all of which were considered catastrophic, developed in 3 patients involving an akita (1), American bulldog (1) and unknown breed (1).	19
Conclusions: "In this study, large-breed dogs were responsible for all attacks on children requiring neurosurgical consultation. Most dogs were family pets with no history of prior				

aggression, and most of the attacks occurred at home." "Parental supervision, though important, may not be enough, given that the majority of attacks in this series occurred in the presence of an adult, even those with catastrophic neurological injury."				
Published: **May 2014** Study period: 2006-2012 *R. Gurunluoglu*	**West** - Regional Level I trauma center - Denver, Colorado	75 patients studied, 98 total wounds -- facial dog bite injuries treated by plastic surgery only. Pit bulls and German shepherds inflicted the highest prevalence of wounds, 11.6% each (11/95), when breed was known and 11.22% each of total wounds.	Over half of all wounds inflicted by pit bulls and German shepherds required reconstruction procedures (7/11 each). Combined, the two breeds accounted for 37% (14/38) of all reconstruction procedures performed.	20
Findings: "Ninety-eight wounds in the head and neck region were repaired. Twelve different breeds were identified. There was no significant association between the type of dog breed and the number of bite injuries ... There was no statistically significant association between wounds needing reconstruction versus direct repair according to dog breed."				
Published: **Dec. 2013** Study period: 2003-2008 *H. Chen*	**West** - Regional Pediatric Level I trauma center - Aurora, Colorado	537 pediatric patients studied -- facial dog bite injuries only. Breed identified in 366 cases, 68.2%. Mixed-breed inflicted the highest prevalence of injuries, 23% (84), when breed was known and 16% of total studied.	There were 11 victims of pit bull bites from 2003 to 2008, including the patient who suffered the most extensive injuries and the longest hospitalization of our entire population.	21
Findings: "Pit bulls were banned in Denver because of several gruesome maulings and fatalities that occurred between 1984 and 1989. Our study found 11 victims of pit bull bites from 2003 to 2008, including the patient who suffered the most extensive injuries and the longest hospitalization of our entire population, indicating that despite legislation, pit bull bites continue to be a public health concern."				
Published: **May/Jun 2013** Study period: 2003-2011[9] *L. Wei*	**West -** Regional Pediatric Level I trauma center - Aurora, Colorado	17 pediatric patients studied -- facial fracture dog bite injuries only. Patient gender, 53% girls. Breed identified in all 17 cases. German shepherds inflicted the highest prevalence of injuries, 23.5% (4 of 17) followed by pit bulls 17.6%.	15 of the 17 patients required hospitalization. One patient suffered "degloving injury to the face" and the amputation of his left arm after being severely mauled by his family's pit bull.	22

Findings: "Seventeen of 1,201 (1.4%) children with dog bite injuries to the face also sustained facial fractures. The average age of patients was 3.9+/-3.2 years and 53% were female. Thirty-five percent of patients presented with multiple facial fractures … Almost a quarter (4 of 17, 23.5%) of the attacking dogs that caused facial fractures were German Shepherds," followed by pit bulls with 17.6% (3 of 17).

Citations

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Footnotes

[1] (Parent, 2021) is a case-control study that compared characteristics of dog bites in children with craniofacial fractures to children without between the years of 2008 to 2019 from a single institution.

[2] (Zhu, 2020) Indicates gender reversal in patients, a female predilection instead of male. “Our study, however, found … a female predominance in all age groups.”

[3] (Khan, 2020) indicates gender reversal in patients, a female predilection instead of male. “We recorded data from 182 patients, of whom 104 were female and 78 were male patients.”

[4] (Abraham, 2019) indicates gender reversal in pediatric patients, a female predilection instead of male. “Patient age ranged from 3 days to 16 years, and 57% of patients were girls.”

[5] (Abraham, 2019) 72.5% of dog bite injuries in this study were of “major severity.” Thus, it is presumed the blinded institution was a pediatric Level I trauma center and is included in our literature review.

[6] (Foster, 2016) indicates gender reversal in patients, a female predilection instead of male. “Of the 20 patients, 12 were younger than 12 years old (60%), and 9 were male and 11 female.”

[7] Gershman KA, Sacks JJ, and Wright JC, Which Dogs Bite? A Case Control Study of Risk Factors, *Pediatrics*, 1994 Jun;93(6 Pt 1):913-7.

[8] (Kumar, 2017) indicates gender reversal in pediatric patients, a female predilection instead of male. “In this subset of 17 patients, 9 females (53%) and 8 males (47%) were victims of a dog attack.”

[9] (Wei, 2013) indicates gender reversal in pediatric patients, a female predilection instead of male. “The average age of patients was 3.9+/-3.2 years and 53% were female.”