

ORIGINAL RESEARCH

# Fatalities From Venomous and Nonvenomous Animals in the United States (1999–2007)

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**Objective.**—To review recent (1999–2007) US mortality data from deaths caused by nonvenomous and venomous animals and compare recent data with historic data.

**Methods.**—The CDC WONDER Database was queried to return all animal-related fatalities between 1999 and 2007. Rates for animal-related fatalities were calculated using the estimated 2003 US population. Inclusion criteria included all mortalities that were a consequence of bite, contact, attack, or envenomation (ICD-10 codes W53–W59 and X20–X29).

**Results.**—There were 1802 animal-related fatalities with the majority coming from nonvenomous animals (60.4%). The largest percentage (36.4%) of animal-related fatalities was attributable to “other mammals,” which is largely composed of farm animals. Deaths attributable to *Hymenoptera* (hornets, wasps, and bees) have increased during the past 60 years in the United States and now account for more than 79 fatalities per year and 28.2% of the total animal-related fatalities from 1999 to 2007. Dog-related fatalities have increased in the United States, accounting for approximately 28 fatalities per year and 13.9% of the total animal-related fatalities.

**Conclusions.**—Prevention measures aimed at minimizing injury from animals should be directed at certain high-risk groups such as farmworkers, agricultural workers, and parents of children with dogs.

*Key words:* animal attack, envenomation, mortality, venomous animal

## Introduction

Injury, illness, and death caused by encounters with animals continue to be a significant public health issue in the United States.<sup>1–3</sup> Animals can induce harm through numerous mechanisms, including physically striking, biting, stinging, crushing, and bucking. These events result in millions of human injuries and several hundred fatalities per year in the United States.<sup>1,2,4</sup> The toll of animal-related injuries and fatalities costs the United States economically in lives lost, cost of treatment, and insurance claims; some of these encounters could be avoided through proper prevention methods.<sup>3,5–10</sup> The Centers for Disease Control and Prevention (CDC) maintains the Wide-ranging Online Data for Epidemiologic Research (WONDER) database (<http://wonder.cdc.gov/>), which is an online public-access repository of US epidemiologic mortality data. The data in WONDER are categorized using the International Classification of Dis-

eases (ICD) 10th revision, which is used to represent the underlying cause of death. The classification system uses the prefixes V-, W-, X-, and Y- to describe fatalities related to external causes. Within this broader description, animal-related fatalities use the prefix W- and X-. This study is a retrospective review of all nonvenomous and venomous animal-related fatalities reported to the CDC in the United States from 1999 to 2007.

## Methods

The CDC WONDER Database is a compilation of mortality data, produced by the National Center for Health Statistics, which assembles causes of death, as well as other epidemiologic data from death certificates at the county level in the United States excluding fetal deaths and deaths of nonresidents. The WONDER database was queried to return all animal-related fatalities between 1999 and 2007. Inclusion criteria included all mortalities that were a consequence of bite, contact, attack, or envenomation (ICD-10 codes W53–W59 and X20–X29).

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The codes for animal attacks resulting in fatalities were divided into those resulting from nonvenomous causes (W53 [bitten by rat], W54 [bitten or struck by a dog], W55 [bitten or struck by other mammal], W56 [contact with marine animal], W57 [bitten or stung by nonvenomous insect or other nonvertebrate], W58 [bitten or struck by crocodile or alligator], W59 [bitten or crushed by other reptiles]) and those resulting from venomous causes (X20 [contact with venomous snakes and lizards], X21 [contact with venomous spiders], X22 [contact with scorpions], X23 [contact with hornets, wasps, and bees], X24 [contact with centipedes and venomous millipedes], X25 [contact with venomous marine animals and plants], X27 [contact with other specified animals], X29 [contact with unspecified venomous animal or plant]), which include those attributable to a chemical released by an animal or insect; release of venom through fangs, hairs, spines, tentacles, and other venom apparatus; and venomous bites and stings; and exclude ingestion of poisonous animals or plants. Animal-related fatalities as a result of transportation accidents were excluded from this study (ICD-10 codes V80.0–V80.9). The fatalities were sorted by type of animal, age, race, gender, and region of the country. Age was grouped into six categories: 0–4 years old, 5–9 years old, 10–19 years old, 20–34 years old, 35–64 years old, and 65 years of age and older. Race was categorized into white, black, Latino, and other. The CDC WONDER Database divided the United States into four regions: the South (Alabama, Arkansas, Delaware, the District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia), the Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont), the West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming), and the Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin).

Rates for animal-related fatalities were calculated using the estimated 2003 US population, which is the median for this 9-year period.<sup>11</sup> The death rate was calculated by dividing the total death numbers as given by the CDC WONDER database by the 2003 population estimate. Death rates for venomous, nonvenomous, and all animal deaths were calculated based on the number of attacks during the 9-year period with the 2003 US population as the representative for this period's population. Note that some deaths are suppressed, especially when analyzing the data by geographic location, owing to confidentiality constraints and do not display in the corresponding search. Animal fatality percent of total re-

gional fatality was determined by dividing all regional animal attack deaths by the total number of fatalities in each region during the same period. The Fisher's exact test was used to determine significance of difference in all cases, and a  $P < .05$  was considered a significant value. All statistical analyses were performed using Microsoft Excel (Microsoft Corp, Redmond, WA).

## Results

Between 1999 and 2007, 1802 people were fatally injured by animals (Table 1). An average of 200.2 deaths occurred annually, with a range of 167 deaths in 2001 and 230 deaths in 2005 (Table 2). Venomous animals were responsible for 713 deaths, with an average of 79.2 per year and a range of 61 to 105. Nonvenomous animals were responsible for 1089 deaths, with an average of 121.0 per year and a range of 106 to 149. Of the venomous animals, contact with hornets, wasps, and bees accounted for the majority of fatalities (28.2%). Males accounted for the majority of the animal-related fatalities from 1999 to 2007 with 73.2% caused by both venomous and nonvenomous animals combined (Table 3). The most frequent venomous animal-related fatality, related to contact with hornets, wasps, and bees, accounted disproportionately for males with 80.9% of deaths. Males were most often killed by "other mammals," with 76.9% of deaths, which was statically significant ( $P < .05$ ). The only 2 types of animals in which females were the majority of fatalities were "other reptiles" (50.6% of cases) and scorpions (60.0% of cases) (Table 1).

By race, whites had the highest percentage of fatalities caused by animal attacks from 1999 to 2007, accounting for 84.0% of the deaths. The death rate per million people was 0.58 for whites, 0.053 for blacks, 0.044 for Latinos, and 0.013 for all other races (Table 3). The most common age group to be fatally injured by an animal was between 35 and 64 years old, with a total of 863 people, representing 47.9% of the deaths (Table 4). The 35- to 64-year-old age group was most often fatally injured by venomous animals with 474 total deaths, representing 66.5% of the total deaths attributable to venomous animals (Table 4). The two older age categories, 35 to 64 years old and 65 years old and older, were overrepresented in fatalities as a result of contact with hornets, wasps, and bees (93.1%), whereas infants and the very young (0 to 4 years of age) were highly represented in dog-related fatalities (34%; Table 4).

The CDC divides the country into 4 regions, and the South is the most represented in animal-related fatalities, accounting for 46.7% of deaths, which was statistically

**Table 1.** Deaths and percentage of deaths from animal attacks by gender (1999–2007)

Animal	Gender		Total (%)
	Male (%)	Female (%)	
Rat	3 (100.0%)	0 (0.0%)	3 (0.17%)
Dog	137 (54.8%)	113 (45.2%)	250 (13.9%)
Other mammal	504 (76.9%)	151 (23.1%)	655 (36.3%)
Marine animal	9 (90.0%)	1 (10.0%)	10 (0.6%)
Other nonvenomous insect or other nonvertebrate	64 (75.3%)	21 (24.7%)	85 (4.7%)
Crocodile or alligator	5 (55.6%)	4 (44.4%)	9 (0.5%)
Other reptiles	38 (49.4%)	39 (50.6%)	77 (4.3%)
Venomous snakes and lizards	47 (79.7%)	12 (20.3%)	59 (3.3%)
Venomous spiders	41 (58.6%)	29 (41.4%)	70 (3.9%)
Scorpions	2 (40.0%)	3 (60.0%)	5 (0.3%)
Hornets, wasps, and bees	412 (80.9%)	97 (19.1%)	509 (28.2%)
Centipedes and venomous millipedes	2 (100.0%)	0 (0.0%)	2 (0.1%)
Other specified venomous arthropods	51 (81.0%)	12 (19.0%)	63 (3.5%)
Venomous marine animals and plants	1 (100.0%)	0 (0.0%)	1 (0.1%)
Unspecified venomous animal or plant	3 (75.0%)	1 (25.0%)	4 (0.2%)
Total	1319 (73.2%)	483 (26.8%)	1802 (100%)

significant ( $P < .05$ ). The South is overrepresented in all deaths except for the Midwest representing the majority of the reptile-related fatalities (Table 5).

## Discussion

Animal-related fatalities continue to be a significant public health problem within the United States. During

the 9-year period of 1999 to 2007, 1802 deaths were attributed to animals (not including transportation accidents involving humans riding or colliding with animals). The average number of animal-related fatalities of 200.2 per year from 1999 to 2007 has increased from 177 fatalities per year from 1991 to 2001 and 157 fatalities per year from 1979 to 1990; however, the death rate per million population has remained con-

**Table 2.** Rank order and percent of deaths, average number of deaths, and death rate (1999–2007)

Animal	Number of deaths	Percent of deaths (from total)	Average number of fatalities per year	Death rate per million per year
Venomous animals		39.6	79.5	0.273
Hornets, wasps, and bees	509	28.3	56.6	0.195
Venomous spiders	70	3.9	7.8	0.0267
Other specified venomous arthropods	63	3.5	7.1	0.0241
Venomous snakes and lizards	59	3.3	6.6	0.0225
Scorpions	5	0.3	0.6	0.0019
Unspecified venomous animal or plant	4	0.2	0.4	0.00153
Centipedes and venomous millipedes	2	0.1	0.2	0.000764
Venomous marine animals and plants	1	0.1	0.2	0.000382
Nonvenomous animals		60.4	121.3	0.416
Other mammal	655	36.4	72.9	0.250
Dog	250	13.9	27.8	0.0955
Other nonvenomous insect or other nonvertebrate	85	4.7	9.4	0.0325
Other reptiles	77	4.3	8.6	0.0294
Marine animal	10	0.6	1.2	0.00382
Crocodile or alligator	9	0.5	1.0	0.00344
Rat	3	0.2	0.4	0.00115
Total	1802		200.2	0.689

**Table 3.** Animal-related fatalities in the United States by race (1999–2007)

<i>Animal</i>	<i>Race</i>				<i>Total</i>
	<i>White</i>	<i>Black</i>	<i>Latino</i>	<i>Other</i>	
Rat	3	0	0	0	3
Dog	166	46	27	11	250
Other mammal	593	15	38	9	655
Marine animal	9	1	0	0	10
Other nonvenomous insect or other nonvertebrate	62	9	11	3	85
Crocodile or alligator	8	0	1	0	9
Other reptiles	64	8	3	2	77
Venomous snakes and lizards	54	0	4	1	59
Venomous spiders	56	7	6	1	70
Scorpions	4	0	1	0	5
Hornets, wasps, and bees	439	41	24	5	509
Centipedes and venomous millipedes	1	1	0	0	2
Other specified venomous arthropods	51	10	1	1	63
Venomous marine animals and plants	0	1	0	0	1
Unspecified venomous animal or plant	3	0	0	1	4
Total	1513	139	116	34	1802

stant (0.689 fatalities per million from 1999 to 2007 versus 0.655 fatalities per million from 1991 to 2001; Table 6). For comparison, there were only 980 deaths

during the same period among those individuals riding animals or riding in vehicles drawn by animals recorded in the CDC WONDER dataset.

**Table 4.** Age, gender, and animal-related fatalities in the United States (1999–2007)

<i>Variable</i>	<i>Age group (years)</i>						<i>Total</i>
	<i>0–4</i>	<i>5–9</i>	<i>10–19</i>	<i>20–34</i>	<i>35–64</i>	<i>≥65</i>	
Gender							
Male	81	34	32	106	663	403	1319
Female	50	23	25	31	200	154	483
Total	131	57	57	137	863	557	1802
Animal							
Venomous animals	9	5	3	49	474	173	713
Hornets, wasps and bees	3	0	1	31	342	132	509
Venomous spiders	0	2	0	4	45	19	70
Other specified venomous arthropods	1	0	0	5	47	10	63
Venomous snakes and lizards	3	3	2	7	35	9	59
Scorpions	2	0	0	1	1	1	5
Unspecified venomous animal or plant	0	0	0	1	2	1	4
Centipedes and venomous millipedes	0	0	0	0	1	1	2
Venomous marine animals and plants	0	0	0	0	1	0	1
Nonvenomous animals	122	52	54	88	389	384	1089
Other mammal	33	23	42	59	263	235	655
Dog	86	29	7	8	54	66	250
Other nonvenomous insect or other nonvertebrate	2	0	2	14	47	20	85
Other reptiles	1	0	0	2	15	59	77
Marine animal	0	0	3	1	5	1	10
Crocodile or alligator	0	0	0	4	3	2	9
Rat	0	0	0	0	2	1	3
Total	131	57	57	137	863	557	1802

**Table 5.** Animal-related fatalities in the United States, by region of country (1999–2007)

<i>Animal</i>	<i>Region</i>				<i>Total</i>
	<i>South</i>	<i>Northeast</i>	<i>West</i>	<i>Midwest</i>	
Rat	0	0	0	0	0
Dog	126	17	64	43	250
Other mammal	252	57	137	209	655
Marine animal	0	0	0	0	0
Other nonvenomous insect or other nonvertebrate	50	0	16	12	78
Crocodile or alligator	0	0	0	0	0
Other reptiles	12	15	0	42	69
Venomous snakes and lizards	38	0	15	0	53
Venomous spiders	45	0	14	10	69
Scorpions	0	0	0	0	0
Hornets, wasps, and bees	251	82	65	111	509
Centipedes and venomous millipedes	0	0	0	0	0
Other specified venomous arthropods	43	0	0	13	56
Venomous marine animals and plants	0	0	0	0	0
Unspecified venomous animal or plant	0	0	0	0	0
Suppressed	24	17	17	5	63
Total	841 ( $P < .05$ )	188 ( $P < .05$ )	328 ( $P = .46$ )	445 ( $P = .44$ )	1802
Percent total animal deaths/all regional deaths	0.0202	0.00437	0.00790	0.00861	

The most common animal-related fatality, accounting for 655 fatalities, involved the ICD-10 code of “other mammal.” In general, the fatalities accounted for by the “other mammal” category involved farm-related incidents.<sup>1</sup> The CDC WONDER database includes cats, cows, horses, pigs, raccoons, and other hoofed livestock within the category of “other mammal.” The majority of deaths associated with the “other mammal” category were located in the Midwest and South, regions with the largest percentage of farms within the United States.<sup>13</sup> Deaths attributed to nonvenomous animals, in particular the “other mammal” category, involve predominantly white males 35 years of age and older, consistent with the demographics of farm operators in those regions (95.9% white in 2007).<sup>4,14</sup> Males of all races were statistically more significant to die from encounters with other mammals than females ( $P < .05$ ). Of note, Latinos

make up a larger proportion of animal-related fatalities in the “other mammal” category compared with blacks (5.8% of total deaths vs 2.3% of total deaths). The difference in farm-related fatalities is most likely attributable to the increased immigration of Latinos, with a total foreign-born Latino labor force of 4.6 million in 1994 increasing to 8.3 million by 2004, as well as the larger employment of Latinos on the farm compared with blacks (Latinos make up 47% of the crop-worker population and blacks make up 4%).<sup>15,16</sup> Approximately 5% of deaths involving the production of crops and animals are caused by incidents involving cattle.<sup>10</sup> Deaths most commonly occur while working in an enclosed area with cattle, moving or handling cattle, or loading and feeding cattle.<sup>10</sup> Approximately one third of all animal-related fatalities on the farm involve a farmer working alone.<sup>10</sup> Prevention efforts should focus on having multiple farm-

**Table 6.** Comparison of venomous animal deaths by percent for 1950–1959, 1979–1990, 1991–2001, and 1999–2007

<i>Animal</i>	<i>Parrish (1950–1959)<sup>12</sup></i>	<i>Langley and Morrow (1979–1990)<sup>1</sup></i>	<i>Langley (1991–2001)<sup>4</sup></i>	<i>Current study (1999–2007)</i>
Hymenoptera	49.8	73.4	70.2	71.0
Snake	30	9.2	7.5	8.4
Spider	14.1	6.8	8.7	10.0
Scorpion	1.7	0.6	0.7	0.7
Marine	0.4	0.4	0.3	0.1
Unknown/unspecified	3.9	1.1	2.5	0.6

workers present when working in high-risk situations. Dairy bulls can display aggressive behavior when protecting the herd during times of feeding or milking operations. Farmworkers should remain cognizant of the increased risk during these times. Sturdy barriers should be in place between cattle and people, and there should be a means to exit quickly from an unsafe area on the farm in case of danger.<sup>10</sup> The 1999 National Agricultural Workers' Survey reported that the primary language of the interviewed farmworkers was Spanish (87%), and 97% of the 1.44 million foreign-born agricultural workers reported they were from Mexico.<sup>17</sup> Consequently, with the increasing numbers of migrant Latino workers, education in multiple languages needs to be used in the farm environment.

Venomous animals accounted for 713 deaths from 1999 to 2007, an average of 79.5 deaths annually, up from 69 fatalities per year from 1991 to 2001, which increased from 60 per year from 1979 to 1990 and 46 per year from 1950 to 1959 (Table 6).<sup>4</sup> The increase in deaths is a true change with increasing population as the death rate per million owing to venomous animals has increased since 1979 (0.272 fatalities per million from 1999 to 2007, 0.256 fatalities per million from 1991 to 2001, and 0.251 fatalities per million from 1979 to 1990).<sup>1,4</sup> The most common venomous animal-related death involved contact with hornets, wasps, and bees, which accounted for 509 deaths in 1999 to 2007. The majority of fatalities involved white males (80.9% male fatalities and 86.2% white fatalities), which is consistent with previously reported data.<sup>4</sup> Hornet-, wasp-, and bee-related fatalities occurred mostly in the South (49.3%), which could be attributed to the warmer climate, as well as the invasion of habitat by humans.<sup>8</sup> The most significant danger of contact with hornet, wasp, or bee sting is the anaphylactic immune response that occurs after the initial exposure. The prevalence of a systemic reaction ranges from 0.3% to 8.9%, with children occupying the lower end of the range.<sup>5</sup> Risk factors for an anaphylactic reaction to a hornet, wasp, or bee sting is a previous history of a systemic reaction, older age, preexisting cardiopulmonary disease, elevated baseline serum tryptase levels, use of angiotensin-converting enzyme inhibitors, and mastocytosis.<sup>5</sup> Mastocytosis is a condition that is defined by an elevated number of mast cells in skin, bone marrow, gastrointestinal tract, liver, spleen, and lymph nodes.<sup>18</sup> People at risk for an anaphylactic reaction caused by contact with hornets, wasps, or bees are outdoor workers, who are predominantly male. Some of the more common outdoor workers placed in harm's way include beekeepers, farmers, gardeners, truck drivers, and masons.<sup>8</sup> Preventive measures against hornet, wasp, or bee stings, and subsequent anaphylactic reactions,

include wearing light-colored clothing that fully covers the extremities, avoiding flowering plants, and keeping garbage cans covered.<sup>8,19</sup> Once stung by a bee, the stinger should be removed and the area covered so as to not allow additional insects to be attracted by pheromones.<sup>8</sup> Additionally, people at an increased risk for anaphylaxis, such as those with mastocytosis or a history of a systemic reaction caused by hornets, wasps, or bees, should carry an emergency kit including an epinephrine autoinjector and an antihistamine.<sup>5</sup>

Dogs accounted for the third most common animal-related fatality, and second most common nonvenomous animal-related fatality, with 250 deaths from 1999 to 2007. The average of 28 dog-related fatalities per year from 1999 to 2007 has increased from an average of 19 per year from 1979 to 2005.<sup>2</sup> The majority of deaths occurred in children younger than 10 years of age and adults older than 65 years of age, which is consistent with previously reported data.<sup>2,9</sup> Males and females were equally likely to be victims (54.8% vs 45.2%, respectively;  $P = .09$ ), with whites making up the majority of victims (66.4%). Greater than 885,000 people per year require medical attention after being bitten by a dog.<sup>6</sup> The cost to the United States is large economically: dog bites account for greater than one third of all US homeowners' insurance liability claims, costing the United States \$413 million in 2010, with total losses related to dog bites possibly exceeding \$1 billion per year.<sup>3</sup> There are prevention measures that should be undertaken with regard to dog bites. The most severe dog bites in childhood are by dogs that are known to the victim. One major prevention method involves careful supervision of young children with the family or neighbor's dog.<sup>9</sup> Supervision is important as young children most often do not know or are unfamiliar with common dog behaviors and can unknowingly perform acts that spur aggressive reactions from the dog.<sup>6</sup> Our data support these findings, as the largest proportion of dog-related fatalities occurred in the 0- to 4-year-old age group. It is also interesting to note that the attacks most often occur in daylight between the hours of 11 AM and 7 PM. The majority of dog-related fatalities are associated with unrestrained dogs on the owner's property. The victim is usually the owner or a member of the owner's family.<sup>9</sup> Prevention efforts against dog attacks on infants and young children need to begin in the home environment. With more than 75 million dogs in the United States and 46.3 million homes owning a dog, dog-related fatalities will likely increase.<sup>3</sup> Because of the large number of dogs in the United States, communities and families need to educate their young children and implement prevention strategies in the home to avoid injury and death associated with dog attacks.

## Conclusions

From 1999 to 2007, there were 1802 animal-related fatalities and the majority came from nonvenomous animals. Animal-related fatalities continue to be a significant public health problem in the United States. Although the epidemiology of animal-related fatalities has remained in large part consistent for several decades, there are notable increases in deaths from venomous stings, as well as changes in the ethnic demographic of some types of fatalities that are consistent with changes in the labor force in certain sectors. Unfortunately, many reported fatalities, particularly among the aged and the very young, could be avoided by following well-established preventative measures. A disproportionate number of fatalities result from animal encounters in the South. This region is one that could possibly benefit from improved education about risky animal encounters as well as legislation to reduce potentially fatal encounters. Interactions in the agricultural environment, preventive techniques and rapid treatment for those exposed to hornets, wasps, and bees, and preventing encounters between children and potentially aggressive canines represent 3 possible arenas for improvement. By understanding which subpopulations are at risk for fatal animal encounters, interventions can be implemented or reinforced to minimize the mortality associated with these encounters.

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