

Injuries Due to Falls from Hunters' Tree Stands in Pennsylvania

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Background: People who hunt deer from elevated tree stands may improve the chances of a successful hunt but also risk serious injury from a fall to the ground.

Purpose: The objective of the current investigation is to estimate the rates of injuries from falls from tree stands using a population-based study design.

Methods: Annual and age-specific rates were calculated using injury data collected from 1987 to 2006 from all accredited Pennsylvania trauma centers and hunting license sales and game-take mail surveys from the Pennsylvania Game Commission.

Results: From 1987 through 2006, 2.73 people ($n=499$) per 100,000 licensed deer hunters were injured from falls from tree stands; seven people died. Rates increased from 0.59 in 1987 to 7.08 in 2006 ($p<0.001$). Rates increased with age ($p<0.001$) and were highest among hunters aged 40–49 years. The case-fatality rate was 1.4%.

Conclusions: Falls from tree stands associated with deer hunting are an increasing and important cause of injuries, especially for older hunters. Surveillance for tree stand-related injuries should be enhanced and preventive initiatives developed and tested.

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Introduction

Tree stands are elevated platforms used to hunt deer. The stand provides the hunter with an expanded field of vision and reduces ground scent. According to a magazine survey in 1993, 9.5 million (86%) of the 11 million U.S. deer hunters used a tree stand and 2.5 million fell from the stand, resulting in 105,000 disabling injuries.¹ Although previous studies have described serious injuries to the hunter after falling from a stand,^{2–12} the epidemiology of these injuries is not well described because few studies have been population-based. The objective of the current population-based study was to estimate the rates of and temporal trend for injuries due to falls from tree stands in Pennsylvania (PA).

Methods

Victims of falls from tree stands in PA from 1987 through 2006 were identified by electronically searching for *tree stand*

in the injury description in the PA Trauma Systems Foundation database, which collects injury reports from all accredited PA trauma centers. Falls involving individuals aged ≥ 12 years, the PA legal hunting age, and occurring on legal deer-hunting days or on the day immediately preceding legal deer-hunting days were considered deer hunting related. Data included day, time, and height of fall as well as the victim's age, gender, blood alcohol content (BAC) and drug screen results; length of time to emergency department arrival; injury complex including Glasgow Coma Scale (GCS)¹³ and Injury Severity Score (ISS)¹⁴; length of intensive care unit (ICU) and hospital stay; and outcome, including functional status and survival at hospital discharge. The GCS measures a person's conscious state (range=3 [worst] to 15), while the ISS measures the severity of multiple injuries (range=0 [no injuries] to 75). The PA Game Commission (PGC) estimated the number and age of licensed deer hunters from annual hunting license sales and annual game-take mail surveys of individuals who purchased a general hunting license.¹⁵

Total injury rates (per 100,000 licensed deer hunters) and age-specific injury rates were calculated. The trend test of ordered Poisson rates was used to test the statistical significance of trends for annual rates and age groups.¹⁶ A two-sample *t* test or Pearson correlation coefficient was used to examine the association between height of fall and injury patterns and outcomes. All tests were two-sided. Differences for all analyses were considered significant if $p \leq 0.05$. SAS 8.1 and StatXact 5.0 were used for data analysis. This study was approved by the IRBs of the

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Results

From 1987 to 2006, a total of 499 people were injured in deer-hunting–related falls from a tree stand (Table 1). The mean age was 45 years (range=13–82). For the 325 (65%) victims with a BAC, 24 (7%) were legally intoxicated (BAC>0.1%). For the 455 (91%) victims with a drug screen, only seven (1.5%) were positive for an illegal substance, namely, marijuana or cocaine. Eight people were wearing a safety restraint at the time of the fall. Average length of time to arrival at an emergency department was 4.2 hours, with only 6% of the victims arriving within 1 hour. The mean height of a fall was 18 feet for the 386 (77%) incidents with a reported height.

The mean ISS was 13 and the mean GCS was 14.6. After emergency department evaluation, 258 (52%) victims were admitted to a medical–surgical unit; 122 (25%) to an ICU; 52 (10%) directly to an operating room; and 57 (11%) to a step-down unit. The injuries for seven individuals were fatal (case–fatality rate of 1.4%). For survivors, median length of hospital stay was 5 days (range=1–142); 157 (32%) victims received care in an ICU (median length of stay of 2.5 days; range=1–142). Of the 395 (79%) victims with a reported functional status at the time of discharge, 91 (23%) had at least one impairment. For the 77% that had a reported height, victims with a single injury fell an average of 17.7 feet, compared to an average of 17.5 feet for those with multiple injuries. ($p=0.81$). The seven victims who died fell an average of 24 feet; survivors fell an average of 17 feet ($p=0.33$). All six who had a gunshot wound were shot before falling.

The injury rate for 1987–2006 was 2.73 per 100,000 licensed deer hunters (95% CI=2.5, 2.98; Table 2). The rate increased from 0.59 (95% CI=0.22, 1.29) in 1987 to 7.08 (95% CI=5.32, 9.24) in 2006 ($p<0.001$). Rates increased with age ($p<0.001$) and were highest, 3.62 (95% CI=3.04, 4.27), for hunters aged 40–49 years.

Discussion

In this 20-year study, the rate of injuries from deer-hunting–related falls in PA was 2.73 per 100,000 licensed deer hunters, increased over time, and was highest among people aged 40–49 years. In a study of 1059 deer hunters in Vermont and North Carolina, 7% fell from a tree stand, and of those, 22% sustained an injury that required medical care.¹⁷ If only 22% of the people who fell in the current study required medical care, 2268 falls would have actually occurred, a rate of 12.4 per 100,000, which is higher than the Georgia rate (8.6 falls per 100,000).² The number of injuries from

Table 1. Characteristics of injuries from falls from tree stands in Pennsylvania, 1987–2006 ($n=499$)

	<i>n</i> (%)
CHARACTERISTICS OF THE VICTIM	
Gender	
Male	480 (96.2)
Female	19 (3.8)
Blood alcohol content (<i>n</i> missing: 174)	
≤0.1%	301 (92.6)
>0.1%	24 (7.4)
Drug use (<i>n</i> missing: 44)	
Negative	448 (98.5)
Positive (cocaine/marijuana)	7 (1.5)
CHARACTERISTICS OF THE INCIDENT	
Season	
Archery/muzzleloader	333 (66.7)
Rifle	166 (33.3)
Time of day (<i>n</i> missing: 143)	
4:00AM–10:59AM	128 (36.0)
11:00AM–2:59PM	73 (20.5)
3:00PM–9:00PM	155 (43.5)
Day of week	
Sunday	36 (7.2)
Monday	121 (24.3)
Tuesday	49 (9.8)
Wednesday	42 (8.4)
Thursday	50 (10.0)
Friday	52 (10.4)
Saturday	149 (29.9)
Time to arrival at ED (<i>n</i> missing: 143), hours	
<1	22 (6.2)
1–<3	158 (44.4)
3–<6	89 (25.0)
6–12	72 (20.2)
>12	15 (4.2)
CHARACTERISTICS OF THE HOSPITALIZATION	
Post-ED destination	
Medical–surgical unit	258 (51.7)
ICU	122 (24.5)
Step-down unit	57 (11.4)
Operating room	52 (10.4)
Other	10 (2.0)
Discharge status	
Alive	492 (98.6)
Dead	7 (1.4)
ICU stay of survivors	
Yes	157 (31.5)
No	342 (68.5)
Functional status of survivors at discharge (<i>n</i> missing: 104)	
Feeding impairment	13 (3.3)
Locomotion impairment	79 (20.0)
Expression impairment	4 (1.0)
Transfer mobility impairment	76 (19.2)
Social interaction impairment	6 (1.5)
Any impairment	91 (23.0)

ED, emergency department; ICU, intensive care unit

falls progressively increased in spite of the decreasing number of hunters, possibly because of the popularity of stands, which were reported to be used by 86% of deer hunters.

Table 2. Rate of injuries from falls from tree stands in Pennsylvania, 1987–2006

	Number of injured victims	Number of licensed deer hunters	Rate per 100,000 licensed deer hunters (95% CI) ^a
Total	499	18,253,741	2.73 (2.50, 2.98)
By age (for all years)			
<16	6	860,099	0.70 (0.26, 1.52)
16–19	9	846,222	1.06 (0.49, 2.02)
20–29	47	2,936,160	1.60 (1.18, 2.13)
30–39	125	4,210,672	2.97 (2.47, 3.54)
40–49	140	3,868,842	3.62 (3.04, 4.27)
50–59	94	2,719,133	3.46 (2.79, 4.23)
60+	78	2,812,613	2.77 (2.19, 3.46)
By year (for all ages)			
1987	6	1,012,430	0.59 (0.22, 1.29)
1988	3	1,006,994	0.30 (0.06, 0.87)
1989	3	1,024,560	0.29 (0.06, 0.86)
1990	11	1,013,974	1.08 (0.54, 1.94)
1991	9	1,007,178	0.89 (0.41, 1.70)
1992	14	1,008,725	1.39 (0.76, 2.33)
1993	14	973,662	1.44 (0.79, 2.41)
1994	23	983,703	2.34 (1.48, 3.51)
1995	32	959,880	3.33 (2.28, 4.71)
1996	12	940,127	1.28 (0.66, 2.23)
1997	15	909,489	1.65 (0.92, 2.72)
1998	28	899,965	3.11 (2.07, 4.50)
1999	23	882,580	2.61 (1.65, 3.91)
2000	38	913,646	4.16 (2.94, 5.71)
2001	45	858,622	5.24 (3.82, 7.01)
2002	44	793,502	5.55 (4.03, 7.44)
2003	37	790,595	4.68 (3.30, 6.45)
2004 ^b	39	771,641	5.05 (3.59, 6.91)
2005	49	739,532	6.63 (4.90, 8.76)
2006	54	762,936	7.08 (5.32, 9.24)

^aThe injury rate significantly increased by age ($p < 0.001$) and significantly increased with time ($p < 0.001$).

^bValue for number of licensed deer hunters was imputed; game take survey was not done in 2004.

Of the 499 injured people in this study, only those six (1.2%) who had a gunshot wound would have been among the 549 identified by the PGC shooting surveillance system.^{18,19} It is estimated that there were at least 1042 deer-hunting-related injuries (493 falls only, six fall and shooting, and 543 shooting only) in PA, 47.3% of which were fall associated—higher than the Georgia estimate of 36%.²

The case-fatality rate in the current study was less than the rates reported from Georgia,^{2,9} western New York–central Maryland,⁶ and West Virginia,⁴ but not than that reported from Wisconsin.²⁰ This difference could be due to the fact that only one of the seven (14%) PA deaths involved a gunshot wound, compared to eight of 17 (47%) in Georgia. The New York–Maryland study included medical examiner data possibly identifying more fatal falls.

Commonly reported factors associated with falls are structural failure, slips while entering or exiting the

stand, alcohol use, and falling asleep.^{2,6,9} In 1999, the PGC incorporated tree-stand safety into their hunter-trapper education program that is mandatory for first-time hunters. Injury rates did not decrease after this change. Older hunters who have higher injury rates infrequently are first-time hunters. A Louisiana safety program, including letters to licensed hunters, hunting clubs, and hunting supply retailers, reduced spinal cord injuries from falls.⁵

The study is limited in several aspects. First, injured people without a hunting license may have been included in the numerator; the PGC does not investigate falls from stands. Also, injured people may have not been in the numerator because they did not receive care at a PA trauma center or had died at the accident scene. Nevertheless, trauma centers have been reported to be a reliable source of data.²¹ Second, data are not available regarding stand type or manufacture, nor are complete data for all injured people.

The results of this population-based study suggest that injuries from falls from tree stands are increasing with time and should be under routine public health surveillance.²² Rates were highest for older hunters. These findings could guide further studies of the epidemiology, risk factors, and prevention strategies related to injuries from falls from tree stands.

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