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Research Article

Epidemiology of Chain Saw Related Injuries, United States: 2009 through 2013

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Problem. Chain saws are a commonly used tool with the potential to inflict severe injuries. *Methods*. Descriptive epidemiological estimates for emergency department (ED) visits for injuries associated with the use of a chain saw were calculated using data from the National Electronic Injury Surveillance System for the years 2009–2013. *Results*. A total of 115,895 ED visits for injuries related to the use of a chain saw occurred during the study period. Most injury visits occurred among males (95%) and persons aged 30–59 years and during the months of September through November. The main body sites injured were the hand/fingers and knee. The majority of injuries were lacerations (80%). *Conclusions*. Chain saw injuries present with characteristic patterns which can aid in prevention of injuries related to the use of these tools. Examination of the epidemiology of chain saw injuries will help to ascertain targeted needs for prevention and control efforts.

1. Introduction

Chain saws are a common tool utilized at home and also specific to some occupations. Injuries associated with chain saws can be very severe; however, there is little published research on injuries related to chain saw use [1–8]. Safety information concerning the proper use of chain saws is available. For consumers, chain saw manufacturers typically include safety manuals with purchase of the machine [9], though it is not known how effective this information is for the consumer or how consumers utilize this information. For occupations which use chain saws, the Centers for Disease Control and Prevention, National Institute of Occupational Safety and Health, and the Bureau of Labor's Occupational Safety and Health Administration have produced training guides specific to forestry related occupations, inclusive of injury prevention measures [10]. While information concerning the safe use of chain saws is accessible, little is known about injuries associated with these machines, especially at a population level. The majority of research conducted to date has focused on cases studies of fatal injuries associated with chain saw use [1, 3–5, 7, 8]. We found few studies that examined injuries at a population level [2, 6], with one focused on an occupational cohort of forestry workers [6]. Therefore, we sought to examine injury visits related to chain saw use among patients presenting in emergency departments (EDs) in the United States.

2. Methods

2.1. Data Sources. Data from the National Electronic Injury Surveillance System (NEISS) for the years 2009 through 2013 were analyzed. NEISS provides national estimates for initial visits to emergency departments for injuries related to consumer products. The NEISS consists of a nationally representative, stratified probability sample of US hospitals that have a minimum of 6 beds and house a 24-hour ED. From this sample, the total number of product-related injuries treated in hospital emergency rooms nationwide can be estimated [11].

2.2. Measures. The NEISS has established product codes for consumer products that were implicated in injuries. We utilized the NEISS coding manual to establish inclusive criteria for injuries related to chain saws. Injuries were attributed to a chain saw if the product code was 1411, which

was indicative of injuries produced by "chain saws" [12]. The month of the injury visit was estimated on 3-month intervals which coincided with the seasons, since chain saw usage tends to vary across the calendar year. Also examined were demographic characteristics, the physician's diagnosis, body site injured, patient's disposition, and the location of the injury occurrence.

2.3. Analysis. Sample weights were applied to the patient visits to produce national estimates. To account for the multistage sampling design of the NEISS, standard errors were determined using STATA MP 13 software. Because the NEISS records are based on visits to EDs for injuries, population based incidence and prevalence estimates cannot be calculated. Rather, the figures reported are the average annual visits for injuries. Sample size estimates which were based on fewer than 20 raw cases (or 1,200 weighted cases) or which had a coefficient of variation equal to or greater than 30% were considered unreliable. Verbatim narrative entries that characterize the circumstances precipitating the injury were also analyzed. This study has received institutional review board approval.

3. Results

During the five-year time period, there were an estimated 115,895 emergency department visits for injuries related to the use of a chain saw occurring in the US. This yielded an average annual frequency of 23,179 injuries. Table 1 depicts the frequency and percentage estimates of injuries. Adults aged 30–59 accounted for the majority of ED visits for injuries (57%), with males representing 95% of the visits for an injury related to a chain saw. Most of the injury visits occurred during the spring, summer, and fall months, while 58% of the injuries occurred at the person's home.

Lacerations were the primary diagnosis for 81% of the ED visits. Among body parts injured, 29% of the injuries occurred to the hand or fingers, 18% to the knee, 12.5% to the lower leg or ankle, and 11% to the upper leg. Closer analysis of injuries to these body sites revealed that lacerations were the predominant injury diagnosis, accounting for 87% of hand/finger injuries; 89.3% of lower leg/ankle injuries; 97.9% of knee injuries; and 97.4% of upper leg injuries.

Only 3.6 of the patients were hospitalized, with 94% treated and released. While we could not discern the severity of injuries in the present study, there were average annual 139 amputations and 983 injuries to the head and neck, with 69% (57.1–78.8) of head and neck injuries diagnosed as lacerations. No fatalities were reported, though deaths reported would have been specific to death on arrival to the ED or death in the ED.

Verbatim narrative entries that characterize the circumstances precipitating the injury were analyzed. However, the majority of the entries were vague (e.g., "cut arm with chain saw while cutting tree; laceration lower arm") and did not add enough information to further delineate the circumstances precipitating the injury. Therefore, analyses of verbatim injuries are not presented.

4. Discussion

Historically, few studies have been conducted that assess injuries associated with chain saw usage. Injuries among occupational exposures [8, 13], as well as case studies of injuries [1, 7], have been published. We noted only 2 population based studies [2, 6], which are more analogous to our present study. The majority of studies have examined serious injuries or deaths attributed to chain saws [4, 5, 7, 14]. Chain saws can pose a serious risk to the user, with a variety of factors influencing the likelihood of injury, such as the use of protective gear, type and age of chain saw, chain saw safety features, user training, experience, and ambient working conditions, such as tree/branch thickness [2, 4, 5, 8, 14]. Many improvements to the design of chain saws have been made in an effort to reduce the risk of injury. The majority of attention has been focused on kickback reduction, as most fatal injuries result from this event [1, 2, 5, 7, 14]. In the present study, having focused on ED visits associated with chain saw injuries, we found no deaths associated with chain saw usage. This is not surprising in that case studies indicate that deaths due to chain saw usage are exceedingly rare [1, 4, 5]. As such, we focus our discussion on the prevention and control of the most prevalent injuries reported in our study.

Several areas of the body showed a higher propensity for injuries, namely, lacerations, than other body areas. Seventy percent of the injuries occurred to four body sites, hand/fingers, knee, lower leg or ankle, and upper leg, with the majority of these injuries diagnosed as lacerations. Modern chain saws have many safety features designed to reduce laceration injuries. Chain brakes are manually engaged brakes that prevent the chain from moving in between cuts or other operations. Generally located on the top of the tool, a handle can be pushed forward to engage the brake or pulled back to release the brake. Some models also have a safety throttle that acts as a "dead man" switch in the event the chain saw slips or is knocked out of the operator's hand, thereby immediately disengaging the throttle and activating the chain brake automatically. Similar to a chain brake, many chain saws are equipped with a centrifugal clutch which disengages the chain when the chain saw is resting at idling speed. Lastly, a chain catcher is a metal or plastic guard designed to prevent a broken chain from striking the operator [13, 15, 16].

In addition to product design, several operator behaviors may be implicated in injuries found in the current study. Operators should cut at waist level or below due to the difficulty in managing the chain saw when trying to cut overhead. A sharp chain will result in much smoother cuts and require less force by the operator to complete the cut, thereby reducing the risk of the operator using excessive force or movement of the chain saw [16, 17]. Leg protection in the form of chain saw chaps has been suggested as a preventive product, though some research indicates the effectiveness of such an item is not robust [17].

5. Limitations

Without the use of narrative text entries, we cannot be certain that the laceration injuries to these body sites were indeed

Table 1: Average annual number and percent of emergency department visits for injuries related to chain saws, United States, 2009–2013.

	Number of visits weighted (95% CI)[a]	Percent of visits (95% CI)[a]
Total	23,179	100
Gender		
Male	22,049 (18,104–25,994)	95.1 (94.2–95.9)
Female	1,130 (835–1,425)	4.9 (4.1–5.8)
Age group		
<10	159 (76–243)	<1 (.4–1.2)
10–14	293 (152–433)	1.3 (.8–2.0)
15–19	1,187 (867–1,508)	5.1 (4.2–6.2)
20–29	3,551 (2,766–4,336)	15.3 (13.5–17.3)
30–39	4,084 (3,175–4,992)	17.6 (16.0–19.3)
40–49	4,794 (3,860–5,728)	20.7 (18.9–22.6)
50–59	4,358 (3,443–5,274)	18.8 (16.7–21.2)
60–69	3,227 (2,496–3,957)	13.9 (12.2–15.9)
70+	1,526 (1,173–1,880)	6.6 (5.5–7.9)
Race		
White	16,570 (12,880–20,261)	71.5 (62.0–79.4)
Black	757 (393–1,120)	3.3 (2.0–5.3)
Others	1,011 (495–1,528)	4.4 (2.7–6.9)
Unknown	4,840 (2,610–7,071)	20.9 (13.3–31.3)
Month of injury visit		
December–February	3,947 (3,090–4,805)	17 (14.8–19.6)
March–May	6,019 (4,959–7,078)	26 (24.0–28.1)
June–August	6,200 (4,931–7,469)	26.7 (24.3–29.4)
September–November	7,013 (5,469–8,557)	30.3 (27.6–33.0)
Diagnosis		
Laceration	18,748 (15,406–22,089)	80.9 (79.0–82.7)
Sprain	849 (582–1,116)	3.7 (2.9–4.7)
Contusions and abrasions	839 (562–1,117)	3.6 (2.7–4.8)
Fracture	705 (490–921)	3.0 (2.3–4.0)
Foreign body	405 (233–576)	1.8 (1.2–2.6)
Amputation	139 (59.5–218)	0.6 (.4–1.0)
Others	1,494 (1,103–1,886)	6.5 (5.5–7.6)
Body site injured		
Hand/fingers	6,685 (5,351–8,019)	28.8 (26.1–31.7)
Knee	4,090 (3,227–4,954)	17.6 (15.6–19.9)
Lower leg/ankle	2,886 (2,171–3,601)	12.5 (10.8–14.4)
Upper leg	2,608 (1,977–3,240)	11.3 (9.4–13.4)
Lower arm/wrist	1,912 (1,421–2,402)	8.5 (6.9–9.8)
Foot/toe	1,330 (992–1,668)	5.7 (4.8–6.8)
Eye	1,003 (730–1,275)	4.3 (3.4–5.5)
Head/neck	983 (751–1,215)	4.2 (3.5–5.2)
Trunk	966 (663–1,270)	4.2 (3.3–5.2)
Upper arm/elbow	344 (188–499)	1.5 (1.0–2.2)
Others	355 (196–514)	1.5 (1.1–2.2)
Disposition		
Treated and released	21,798 (17,943–25,654)	94.0 (92.2–95.5)
Hospitalized/transferred and hospitalized	836 (442–1,230)	3.6 (2.4–5.4)
Others	545 (336–753)	2.4 (1.7–3.3)
Location of occurrence		
Home	13,572 (10,885–16,258)	58.6 (48.6–67.9)
Other public property	410 (100–720)	1.8 (.8–3.7)
Recreation area	223 (76–370)	1.0 (.5–1.9)
Others	<1	(.1–.2)
Missing	8,949 (5,699–12,200)	38.6 (29.2–48.9)

CI, confidence interval.
[a]Average annual number.

caused by contact with a running chain saw. However, given that the injuries in question were related to chain saw usage and the patients sought treatment in an ED, the presumption is likely. However, with this limitation, our assumptions as to the circumstances of the injury occurrence would be somewhat suspect. As such, we keep our assumptions of circumstances to a minimum and acknowledge that recommendations for prevention are difficult. However, it is highly plausible that several safety features and operator behaviors play a role in laceration injuries to the body sites found in the current study.

6. Conclusions

Prevention and control of nonfatal chain saw injuries will require more research. While occupational industry must comply with federal safety standards and training with respect to chain saw use, there are no regulations requiring training for persons who purchase a chain saw for personal use. Older population based study in Ireland indicated that most injury cases did not wear protective gear and few were competent in chain saw operation and cited a lack of appreciation and disregard for safety procedures [2]. Given that the majority of the injuries in the present study occurred at the patients home, it may be reasonable to conclude that chain saws are typically used infrequently and are precipitated by storm damage or some other novel event, and therefore users may not be familiar or comfortable with chain saws, which in itself may promote an increased risk of injury. Circumstantial factors such as cutting position, type and size of timber being cut, type and size of chain saw being used, safety practices, knowledge of injury risk, and experience level of the operator represent some of the major factors that would help to elucidate why and how injuries occur. However, further research will be needed to ascertain the circumstances precipitating chain saw injuries. Chain saws represent a potentially severe injury risk and may result in expensive health care costs, lost productivity from work, and potentially permanent damage. Examination of the epidemiology of chain saw injuries will help to ascertain targeted needs for prevention and control efforts. Given these issues, continued efforts are needed to prevent and control injuries associated with these products.

Disclosure

All work was conducted while all authors were affiliated with the University of Arkansas.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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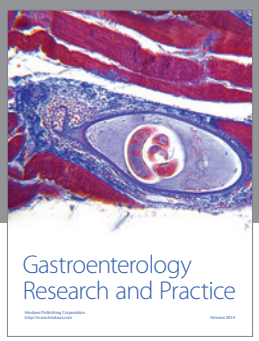

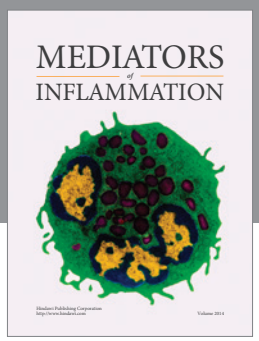

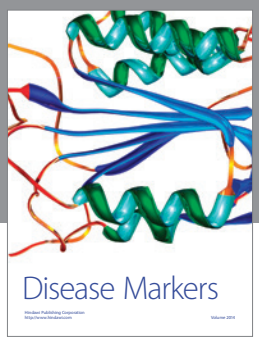

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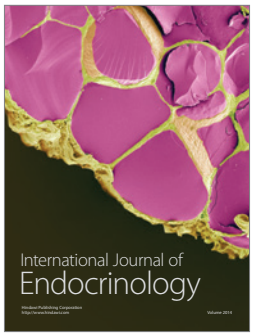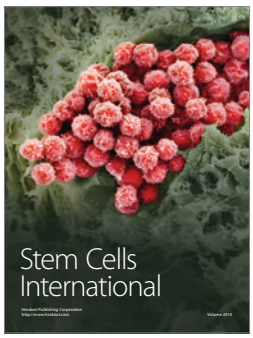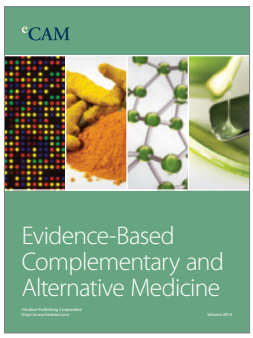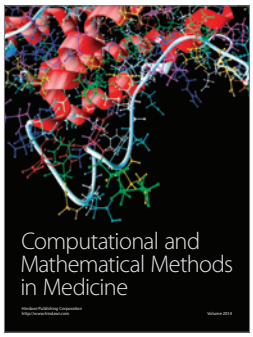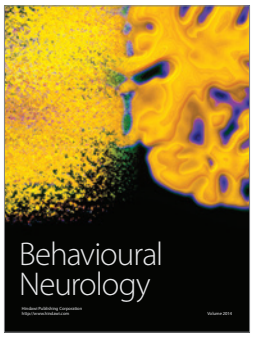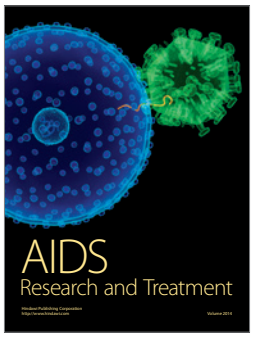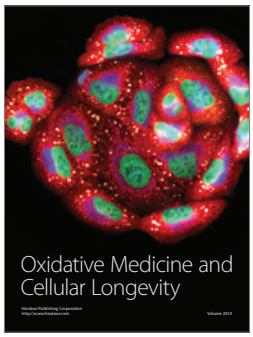
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