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Original Contribution

Surfing USA: an epidemiological study of surfing injuries presenting to US EDs 2002 to 2013

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ABSTRACT

Introduction: Surfing is a popular recreational and competitive sport in the United States and worldwide. Previous studies indicate surfers are frequently injured, but most studies are survey based, and little is known about surfing injuries that present to emergency departments (EDs).

Aims: This study examines the epidemiology of surfing injuries presenting to US EDs.

Methods: A retrospective analysis was performed using data from the National Electronic Injury Surveillance System database from the US Consumer Product Safety Commission from 2002 to 2013.

Results: A total of 2072 cases were analyzed, corresponding to a national estimate of 131 494 total injuries over the 12-year period (95% confidence interval, 34 515–228 473). The median age of included cases was 27 years (interquartile range, 19–37). Lower extremity injuries were most common (25.9%), followed by the face (23.1%) and head and neck (22.7%). Lacerations were the most common injury type (40.7%), followed by sprains and strains (14.4%), contusions (12.9%), and fractures (11.9%); 95.7% of cases were treated and released. Patients older than 60 years, those injured to the trunk, and those suffering fractures or internal organ injuries were admitted at a statistically significant increased frequency ($P < .05$).

Conclusion: Surfing injuries are common but rarely serious. The injuries most commonly affect the lower extremity, head, neck, and face and are most frequently lacerations. Age older than 60 years, injuries to the trunk, and internal organ injuries were associated with a statistically significant increased frequency of hospital admission.

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1. Introduction

Surfing is a popular recreational and competitive sport. There are an estimated 37 million surfers worldwide, 2.1 million in the United States alone [1,2]. Furness et al [1] reported that up to one-third of surfers sustain an acute injury causing them to seek medical attention, miss work, or take time off surfing each year. A recent study by Woodacre et al [3] reported that 91% of surfers polled had sustained injuries while surfing during their lifetime.

Despite knowledge of injury rates and mechanisms from peer-reviewed studies, few studies have investigated injuries that present to emergency departments (EDs) around the United States. The purpose of this study is to describe the epidemiology of surfing injuries presenting to US EDs, using the National Electronic Injury Surveillance System (NEISS), a nationally representative sample.

2. Patients and methods

2.1. Data source

The NEISS is a free, deidentified database of injuries related to consumer products. The database is produced and maintained by the US

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Consumer Product Safety Commission. An NEISS coordinator at each of the approximately 100 participating hospital EDs transcribes patient data, assigning a product code based on details found in the medical record [4]. Information regarding diagnoses, disposition, patient age, race, sex, body location, weight, and a brief narrative field describing the injury and mechanism are also recorded [5]. Coders are specifically trained and receive continuous training to ensure intercoder reliability, and participating hospitals provide approximately 400 000 records annually to the database [4]. Previous studies including articles describing skiing and snowboarding injuries and head and neck injuries in extreme sports have shown the utility of the database for identifying recreational sport injuries [6–9].

Injuries related to surfing among patients of all ages from 2002 to 2013 were identified by NEISS consumer product code 1261 (Surfing). Data before 2002 were excluded because it did not contain the narrative field. This study sought to describe injuries related to traditional stand up surfing, defined as a surfer paddling into a nature-generated wave, on an open body of water, and riding the wave in a standing position. Injuries identified by the narrative as bodyboarding, boogieboarding, bodysurfing, skimboarding, skinboarding, waterboarding, wakeboarding, stand up paddling, river surfing, kneeboarding, knee surfing, kitesurfing, kiteboarding, wakesurfing, and swimming were excluded by a trained data abstractor. Cases in which a narrative was not present or the injured body part was listed as not stated or not known were also excluded, as we

were unable to determine the circumstances surrounding the injury. Finally, cases with injuries that did not occur during the act of surfing, for example, a decorative surfboard falling from a wall onto a person, or a case where a person was injured while repairing a surfboard was excluded.

2.2. Study variables

To facilitate interpretation of findings and allow comparison with existing work, NEISS variables were regrouped into clinically meaningful categories. These categories included age, sex, race, body region injured, injury diagnosis, and ED disposition as detailed in Table 1.

2.3. Data analysis

To generate a national estimate of surfing injuries presenting to US EDs, statistical weights were applied using the standard approaches as outlined by CPSC NEISS using the PROC SURVEYMEANS procedure in SAS version 9.3 (Carey, NC). Because of significant variability in the national estimate of total injuries, statistical weights were not applied to subsequent analyses. Rather, data were analyzed based on the actual cases contained in the NEISS data set. Descriptive statistics, including medians, proportions, and corresponding measures of variability (interquartile range [IQR] and 95% confidence intervals [CIs]), were used to describe the study sample and injury patterns. Differences in ED disposition based on injury type and body region injured were compared using χ^2 tests and Fisher exact test where indicated.

3. Results

Query of the NEISS database over the 12-year period from January 1, 2002, to December 31, 2013, yielded 3464 documented injuries, but 1391 entries were excluded due to insufficient information or activities that did not meet the aforementioned definition of surfing. Therefore, 2072 cases were included in the final data analysis (Figure). This corresponds to a national estimate of 131 494 total injuries over the 12-year period (95% CI, 34 515–228 473). There was no statistically significant difference in injury patterns over the years of the study period. In our final sample, at least 1 case was represented from 57 of the primary sampling units (individual participating hospitals). Three primary sampling units contributed more than 75% of the total cases.

Age of subjects ranged from 4 to 82 years, with a median age of 27 years (IQR, 19–37). The sample was 81.9% male and 76.3% white. Table 2 summarizes the demographic characteristics of the included subjects.

3.1. Types and body areas injured

Table 3 summarizes the types of injury and corresponding body region injured. The lower extremity was the most commonly injured

body area (25.9%), followed by the face (23.1%), head and neck (22.7%), upper extremity (16.7%), and trunk (8.6%).

The most common injury diagnoses were lacerations (40.7%), followed by sprains and strains (14.4%), contusions (12.9%), and fractures (11.9%). Lacerations were primarily to the face (41.3%) and lower extremity (28.3%). Concussions accounted for 2.7% of all injuries. Of note, head, neck, and face accounted for 62.7% of the lacerations. Fractures were relatively common and occurred primarily in the upper extremity (31.7%) and lower extremity (30.9%). Sprains and strains were most common in the lower extremity (34.8%) and neck (28.8%). Dislocations represented 4.5% of all injuries with 84.9% corresponding to the upper extremity, primarily the shoulder.

Submersion injury was an uncommon diagnosis ($n = 6$); however, 1 case was fatal. There was 1 anterior myocardial infarction. Noteworthy but uncommon injuries included 1 finger amputation and several tympanic membrane ruptures. Although not explicitly coded for in NEISS, a search of the narrative fields for marine zoonoses revealed 1 shark-related injury, 1 seal attack, 2 urchin-related injuries, and 9 stingray-related punctures or envenomations. Surprisingly, there were no reported visits related to jelly fish envenomations.

3.2. Patient disposition

Table 4 summarizes the overall disposition of injured surfers; 95.7% were treated and released, 3.5% admitted or transferred to another hospital, 0.8% of cases left without treatment, and there was 1 fatality (0.05%). The left without treatment ($n = 16$) and fatality (dead on arrival or died in ED) ($n = 1$) groups were excluded from bivariate analyses looking at differences in ED disposition based on sex, age, race, injury location, and body region injured due to insufficient sample size so calculations based on disposition included only 2055 of the total 2072 subjects (Table 5).

We did not find a statistically significant difference in ED disposition (admitted vs treated and released) between males and females (3.8% vs 2.2%). There was a statistically significant difference in ED disposition based on patient age ($P < .001$), with older adult patients having increased frequency of hospital admission (13.6% and 9.4% of subjects aged 60–69 years and 70 years or older, respectively). There were statistically significant differences in ED disposition based on injury type and injured body region ($P < .001$ for both comparisons). Injuries to the trunk were the most likely to require hospital admission (10.3%), whereas injuries to the face were unlikely to require admission (0.4%). Injuries coded as internal, mostly closed head injuries in this study, and fractures were associated with the highest proportion of admissions (13.4% and 11%, respectively), whereas sprains, lacerations, and contusions very rarely required admission or transfer (0.8%, 0.3%, and 1.1%, respectively).

4. Discussion

To our knowledge, this is the largest epidemiological study of surfing injuries to date and one of only a few studies looking at cases seeking medical attention.

Table 1
Study variables

Study variables					
Sex	Age	Race	Body region injured	Injury diagnosis	Disposition
Male	0–9	White	Head/neck	Concussion	Treated and Released
Female	10–19	Black	Face	Contusion/Abrasion/Hematoma	Admitted or Transferred
	20–29	Asian	Trunk	Laceration	Left without treatment
	20–39	Other/Native/Hawaiian/Pacific Islander ^c	Upper extremity	Fracture	Dead on arrival or died in ED
	40–49	Unknown	Lower extremity	Dislocation	
	50–59		Other ^a	Sprain/Strain	
	60–69			Internal injury	
	70 and older			Other ^b	

^a Systemic (>25% of body area involved), pubic region, ear.

^b Crush injury, nerve damage, puncture, amputation, hemorrhage, avulsion, foreign body, radiation injury, dermatitis, conjunctivitis, poisoning, dental injury, and submersion injury.

^c Combined variable made up of the categories

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