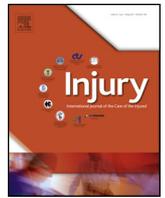




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Epidemiology of lower extremity injuries presenting to the emergency room in the United States: Snow skiing vs. snowboarding

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ABSTRACT

Purpose: To quantify and compare the incidence of lower extremity injuries in skiers and snowboarders who present to emergency rooms in the United States.

Methods: Cross-sectional study of lower extremity injuries in skiers and snowboarders that were evaluated in emergency rooms in the United States. The National Electric Injury Surveillance System (NEISS) database was queried from January 1st, 2014 and December 31st, 2014 and the reported cases of lower extremity injuries in skiers and snowboarders were examined.

Results: An estimated total of 13,381 snow skiing and 6061 snowboarding lower extremity injuries presented to the emergency department in 2014 representing a national incidence of 42 injuries per 1,000,000 person-years for skiers and 19 injuries for snowboarders. The most common region of the lower extremity that was injured was the knee for skiers (47%) and the lower trunk (e.g. pelvis, hip, lumbar spine) for snowboarders (34%). The incidence of injuries in the pediatric and young adult population in skiers (62 per 1,000,000 person-years) and snowboarders (40 per 1,000,000 person-years) was significantly higher than the incidence of these injuries in adult population (35 and 12 per 1,000,000 person-years respectively) ($P < 0.01$). The incidence of these injuries was significantly higher in males compared to females in both skiing (46 per 1,000,000 person-years vs. 38 per 1,000,000 person-years, $P < 0.01$) and snowboarding (30 per 1,000,000 person-years vs. 9 per 1,000,000 person-years, $P < 0.01$). The rate of injuries from 2010 to 2014 for skiers remained stable while snowboarding injuries down trended approaching significance.

Conclusion: The incidence of lower extremity injuries in skiers was higher than that of snowboarders in 2014, with the 0–19 year old age group and males being those most likely to sustain an injury. The most common region of the lower extremity that was injured was the knee for skiers and the lower trunk (e.g. pelvis, hip, lumbar spine) for snowboarders. Physicians and consumers alike should be aware of this data when considering participation in these sports as well as strategies for injury prevention.

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Introduction

Individuals with a wide range of age and skill levels participate in snow skiing and snowboarding. Snowboarding has gained significant popularity since its introduction in the 1970s and its first appearance in the Olympics in 1998 [1]. According to the Snowsports Industries America Snow Sports Fact Sheet, 17,988,000 individuals participated in snow skiing and 7,676,000 individuals participated in snowboarding in the 2014–2015 season [2]. Within these groups 57.1% of skiers were male while 61.5% of

snowboarders were male. Additionally 21.2% of skiers were in the pediatric (0–17) age group while 28.5% of snowboarders were less than 18 years old [2]. Multiple regional and international studies have compared the injuries sustained in these activities [3–8]. Xiang et al. reviewed the skiing and snowboarding related injuries that were evaluated in Emergency departments in 2002 [9]. Their investigation reviewed all injuries reported. They reported that 77,300 skiing related injuries and 62,000 snowboarding related injuries were evaluated at emergency departments in the United States in 2002. The most common injuries sustained by snowboarders included wrist (17.9%) and arm (16.6%) injuries whereas the most common injuries sustained by skiers were knee injuries (22.7%). They found that the age group of skiers with the highest injury rate was 55–64 year olds (29 per 1000 participants)

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whereas the age group with the lowest injury rate was 10–13 year olds (15.9 per 1000 participants).

While increased awareness of injuries and improved equipment has been theorized to decrease lower extremity injury rates, participating in snow skiing and snowboarding is not without risk. Daniels et al. studied injuries in skiers and snowboarders in 1996 and 2013 and found that lower extremity injuries, particularly of the knee, were the most common injury at rates of 31% in skiers and 33% in snowboarders respectively [10]. Injuries of the lower extremity range from strains to fractures depending on mechanism of injury. While twisting is typically the mechanism of injury implicated in ACL tears, one study of snowboarders reported 35 ACL tears in expert riders landing large jumps [11]. Of the 35 snowboarders who sustained an ACL tear, 31 experienced tear in their lead leg after landing with a flexed knee. The authors hypothesized that the internal rotation of the tibia associated with the snowboarding stance pre-loaded the ACL and increased its risk of tear during eccentric contraction of the quadriceps during landing [11]. Stenroos et al. reported 372 patients with tibia fractures of which 342 were related to skiing and 30 to snowboarding [12]. Skiers were more likely to have tibial shaft fractures (63%) while snowboarders suffered intrarticular fractures at a statistically significantly higher rate, potentially indicating a higher energy mechanism of injury despite the lower overall injury rate [12]. Our study hypothesizes that skiers will have a higher incidence of lower extremity injuries than snowboarders. Additionally we believe that young males are at a high risk of injury as has been demonstrated in other studies [5,7,9,11,13–15]. Lastly we believe that with an increased awareness in injury prevention that injury rates are declining.

Methods

This is a cross-sectional study of snow skiing related and snowboarding related lower extremity injuries presenting to the emergency room in the United States. We queried the reported cases of these injuries in the National Electric Injury Surveillance System (NEISS) database compiled by the United States Consumer Product Safety Commission (CPSC) in order to determine the number of emergency room visits due to skiing and snowboarding injuries in 2014. The NEISS database is a publically available national probability model for hospitals with emergency departments in the United States [16]. The database includes a stratified, randomized sampling of 100 emergency departments grouped into five strata. Four of the strata represent hospital emergency departments of different sizes and the fifth represents emergency departments from pediatric hospitals. CPSC annually ensures the accuracy of the sample by utilizing a new sampling frame each year. A sampling frame lists all of the hospital emergency departments and reports the number of emergency room visits that occurred during that year. This sampling frame allows the CPSC to ratio-adjust the statistical weights for the associated NEISS database sample to the relevant number of emergency room visits.

This allows the NEISS sample weights to accurately reflect the total number of the emergency room visits that occurred during a specific year. Injuries from the year 2014 were further stratified into the type of injury that occurred. Annual queries for snow skiing and snowboarding lower extremity injuries were performed from 2010 to 2014 in order to determine the confidence intervals for injury over this five-year period. United States Census Bureau population estimates were utilized to calculate the incidence of these injuries per 1,000,000 person-years.

Statistical analysis was performed utilizing Microsoft Excel (Microsoft Corporation, Redmond, WA) and StatPlus: LE (AnalytSoft Inc, Walnut, CA). A P value of <0.05 was defined as statistically significant. Analysis of the injury rates over the defined time period allowed calculation of incidence ratios with 95% confidence intervals (CI). Chi-square analysis was utilized to identify differences between subgroups (i.e. age and sex).

Results

An estimated total of 13,381 snow skiing and 6061 snowboarding lower extremity injuries presented to the emergency department in the United States during the time period between January 1st, 2014 and December 31st, 2014 in the NEISS database (Fig. 1). This represents a national incidence of 42 injuries per 1,000,000 person-years for skiers and 19 injuries for snowboarders. Considering the Snowsport data which reports that 17,988,000 individuals participated in snow skiing and 7,676,000 in snowboarding this data shows that skiers (0.07%) and snowboarders (0.08%) get injured at similar rates overall. The most common region of the lower extremity that was injured was the knee for skiers (47%, incidence 20 per 1,000,000 person-years) and the lower trunk (e.g. pelvis, hip, lumbar spine) for snowboarders (34%, 6 per 1,000,000 person-years). The most common injury of the knee in skiers was sprain/strain with an incidence of 13 per 1,000,000 person-years (Table 1). The most common lower trunk injury in snowboarders was contusion with an incidence of 2.5 per 1,000,000 person-years (Table 2).

In 2014, the incidence of lower extremity injuries in the pediatric and young adult population (0–19 years old) in skiers was 62 per 1,000,000 person-years which was significantly higher than the incidence of these injuries in adult population 35 per 1,000,000 person-years ($P < 0.01$). Similarly, the incidence of lower extremity injuries in the pediatric and young adult population of snowboarders (40 per 1,000,000 person-years) was significantly higher than the incidence of these injuries in adult population (12 per 1,000,000 person-years) ($P < 0.01$) (Fig. 2). The incidence of these injuries was significantly higher in males compared females in both skiing (46 per 1,000,000 person-years vs. 38 per 1,000,000 person-years, $P < 0.01$) and snowboarding (30 per 1,000,000 person-years vs. 9 per 1,000,000 person-years, $P < 0.01$) (Fig. 2).

The average incidence of lower extremity injuries in skiers from 2010 to 2014 was 53 ± 7.9 (95% CI, 38.4–67) injuries per 1,000,000 person-years. This was significantly higher than the average

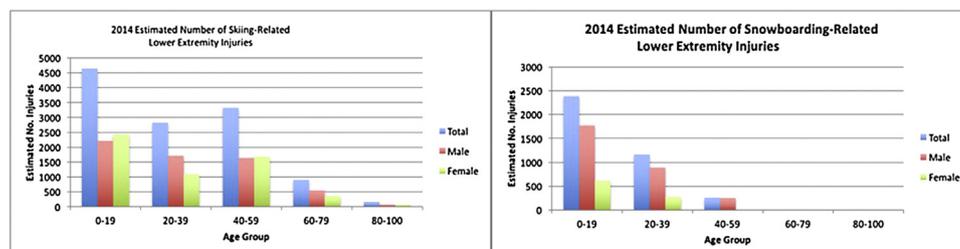


Fig. 1. Estimated lower extremity injuries in skiers (A) and snowboarders (B) in 2014.

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