Wilderness and Environmental Medicine, **20,** 234–238 (2009)

ORIGINAL RESEARCH

Skiing and Snowboarding Head Injuries in 2 Areas of the United States

Mark W. Greve, MD; David J. Young, MD; Andrew L. Goss, MD; Linda C. Degutis, DrPH, MSN

From the Warren Alpert School of Medicine at Brown University, Department of Emergency Medicine, Injury Prevention Center, Providence, RI (Dr Greve); Hospital of St Raphael, New Haven, CT (Dr Young); Montrose Memorial Hospital, Montrose, CO (Dr Goss); and Yale University School of Medicine and School of Public Health, New Haven, CT (Dr Degutis).

Objective.—To explore the use of helmets in skiers and snowboarders injured at ski runs and terrain parks in Colorado and the northeast United States and to examine differences in head injury severity in terrain parks as compared to ski runs.

Methods.—This was a retrospective cohort study. We reviewed emergency department medical records of injured skiers at 9 medical facilities in Colorado, New York, and Vermont to examine the frequency of helmet use, type of terrain on which injuries occurred, and effect of injury event type and helmet use on change in mental status. Injuries that occurred from July 2002 to July 2004 were included. Eligible patients were skiers and snowboarders who sustained a head injury as defined by International Classification of Diseases-9 codes for acute head injuries. Data elements included event location, mechanism of injury, helmet use, loss of consciousness, neurologic findings, Glasgow Coma Scale score, and initial outcome. Data were entered into SPSS for analysis.

Results.—Of 1013 patients, 52.6% were skiing, 46.7% were snowboarding, and the remainder engaged in other activities such as sledding or using a sit ski. Most (78.7%) were using a ski run, whereas 19.1% were at a terrain park when their injuries occurred, and 37.1% were wearing helmets. Most injuries (74.1%) occurred when the victim hit his/her head on the snow; 10.0% and 13.1% occurred in collisions with other skiers and fixed objects, respectively. There were significantly fewer instances of loss of consciousness in fall events in the Colorado group (χ^2: 4.127; $P < .05$), a significantly lower incidence of loss of consciousness in helmet users who struck a fixed object (χ^2: 5.800; $P < .05$), and a significantly higher incidence of skiers colliding with fixed objects in the Northeast (χ^2: 14.05; $P < .005$). There were significantly more documented head injuries in terrain parks, even when controlling for helmet use (χ^2: 5.800; $P < .05$).

Conclusion.—There is an increased risk of head injury, regardless of helmet use, at terrain parks as compared to ski runs, and helmets were notably protective in collisions with fixed objects. Regional differences in injury events were noted in that there were more fall-related head injuries and a higher incidence of collisions with fixed objects in the Northeast compared to Colorado.

Key words: skiing, snowboarding, brain injury

Introduction

Skiing and snowboarding have become staples in winter recreation, accounting for 58 million visits to US ski resorts in 2005.[1] Despite its inherent dangers comparatively few injuries result in permanent disability.[2] Traumatic brain injury is a leading cause of morbidity and mortality in skiing and snowboarding injury events, accounting for 14% to 17.6% of all skiing and snowboarding injuries and 50% to 88% of the fatalities.[3,4] The incidence of traumatic brain injury and spinal cord injury may be increasing.

Research was presented at the National Injury Prevention and Control Conference, Denver, CO, May 9–10, 2005, and the American College of Emergency Medicine Scientific Assembly, Washington DC, September 25–29, 2005.

Work attributed to Yale University School of Medicine, Department of Surgery, Section of Emergency Medicine, New Haven, CT.

Corresponding author: Mark Greve, MD, Department of Emergency Medicine, Injury Prevention Center, 593 Eddy St, Providence, RI 02903 (e-mail: mgreve@lifespan.org).

In 1996, the Council on Scientific Affairs of the American Medical Association concluded that there were insufficient data to justify the universal use of helmets during participation in winter sports and held that this should be done voluntarily.[5] They recommended that further study of the epidemiology of head injuries be undertaken and that other ways to reduce the risk of head injuries be examined.

As public awareness of head injuries related to skiing increased, the Consumer Product Safety Commission issued *Ski Helmets: An Evaluation of the Potential to Reduce Head Injuries* in 1999.[6] They projected that the universal use of approved helmets by skiers would reduce head injuries by 44% and reduce skiing deaths by 11 per year. There is a fair amount of controversy about the commission's findings and the effect of helmets in preventing severe and fatal head injuries,[7,8] but helmets have been shown to provide protection against mild to moderate head injuries in at least 2 studies.[9,10] We undertook this study to explore head injuries in skiers and snowboarders injured on selected ski runs and terrain parks in Colorado and the northeast United States.

Methods

The study was a retrospective medical record review. Medical centers that provide emergency treatment for patients injured at ski resorts and terrain parks in the northeast United States and Colorado were contacted and asked to participate in the study. The study was approved by the Yale New Haven Medical Center Human Investigations Committee and the Institutional Review Boards of the participating medical centers. Five medical centers in Colorado participated, and 4 in the Northeast agreed to participate. All of these facilities were staffed by physicians and directly received injured skiers from designated ski areas. Any facility that used a nonphysician-staffed first aid clinic to decide who should be transferred to the medical facility was excluded from the study (in order to avoid sample bias, as areas that field triaged were more likely to transport more injured skiers). Facilities varied from level 2 trauma centers to free standing clinics.

Skiers and snowboarders who sustained a head injury as identified by the International Classification of Diseases-9 system were eligible. Patients who were transferred from other facilities were not included in the data collection. Data were collected for injuries that occurred during the time period July 2002 to July 2004. All hospital charts with discharge International Classification of Diseases-9 codes indicating any injury from the clavicles up were reviewed, and data were collected only on patients who sustained a head injury resulting from skiing, snowboarding, or other means of nonmechanized locomotion. Charts were reviewed exclusively by the physician authors of this study. Reviewers used ski patrol run sheets, nursing notes, and physician records to collect demographic data on the date of injury, facility where the patient presented, age, sex, skier type, and helmet use. Injury data were collected on injury type, terrain where injury occurred, Glasgow Coma Scale score, loss of consciousness (including amnesia or change in mental status), and patient report of a prior head injury. Loss of consciousness was reported by the patient, bystanders, or emergency medical services personnel. The location of the injury was used to differentiate between trail run, terrain park, or lift, and the mechanism of injury was defined as either person vs person, person vs fixed object, or person vs ground/snow. These data were collected on a standardized form.

Data were entered into an Excel spreadsheet and imported to SPSS for analysis. Descriptive analyses were performed and included frequencies for categorical variables and central tendencies for continuous variables. χ^2 tests were used to compare frequencies of injuries in helmeted and nonhelmeted skiers, as well as variables related to resort location and the mechanism of injury.

Results

Demographics of the study group are reported in Table 1. Most of the patients were young males. No helmet use was reported by 62.9%. Most (74.1%) injuries resulted from falls that did not involve a collision with another person or a fixed object (Tables 2 and 3).

There was a significantly higher incidence of skiers colliding with fixed objects in the Northeast (χ^2: 14.05; $P < .005$). Terrain park users were significantly more likely to have suffered a loss of consciousness than skiers, even when accounting for helmet use (χ^2: 5.800; $P < .05$). There were significantly fewer instances of loss of consciousness in fall events in Colorado than the Northeast (χ^2: 4.127; $P < .05$). Helmet users who struck a fixed object had a significantly lower incidence of loss of consciousness than nonhelmet users (χ^2: 5.800; $P < .05$).

Limitations

It is likely that some skiers and snowboarders who sustained minor head injuries did not present to the ski patrol or the local acute care treatment facility. Additionally there were a small number of patients with severe head injuries in our study. Victims who deteriorated after discharge or transfer would not have been included in our data. Likewise, victims who met

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