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BRIEF REPORT

Epidemiology of Feature-Specific Injuries Sustained by Skiers in a Snow Park

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Objective.—The objective of the present case series study was to analyze injury types and injured anatomic locations resulting from skiing in snow park (SP) features and to determine potential risk factors for ski injuries in an SP.

Methods.—The study was conducted during the 2013–2014 winter season in the SP of a major winter resort located in the Spanish Pyrenees. Cases involved skiers who experienced feature-related injuries in the SP. A total of 113 cases met the inclusion criteria. Logistic regression was used to calculate the odds of injury types and injury to anatomic locations on aerial versus nonaerial features.

Results.—The overall injury rate was 0.9 per 1000 skier runs. The proportion of injuries was higher for aerials (1.18% of uses) than for nonaerials (0.66% of uses). Results revealed that the upper extremities were the most commonly injured body region, and sprains/strains/dislocations and fractures were the most common injury type.

Conclusions.—The most commonly injured anatomic location on nonaerial features was the face, while on aerial features it was the head. A higher proportion of fractures was observed on aerial features, while a higher proportion of sprains/strains/dislocations was observed on nonaerial features. Prevention strategies to reduce injury risk include SP redesign, safety and communication policies, instruction on technical skills, and promotion of the use of protective equipment.

Key words: skiing, snow park, feature, anatomic location, injury type

Introduction

Snow parks (SPs) are delimited facilities designed to contain different manmade features that allow users, also known as "freestylers," to perform a wide range of maneuvers and stunts ("freestyling").[1,2] Russell et al[3] classify these features into 2 groups: aerial features and nonaerial features.

Aerial features consist of halfpipes and jumps (snow or snow-covered dirt piles) of various heights that allow users to project themselves into the air, where a variety of tricks such as twists, grabs (the freestylers grab their skis while in the air), somersaults, or spins may be performed. A halfpipe is a cut into a snow-covered slope to form a U-shaped structure resembling a half section of a large-diameter pipe in which 2 concave walls face each other across a flat transition. The freestyler launches off the lip of one of the walls and straight up into the air, performs a maneuver, lands on the same wall, rides down the wall, crosses the transition, and repeats on the opposite wall. The sequence can be repeated as many times as the length of the halfpipe permits.

Nonaerial features, also known as "jibs," commonly include different shapes of rails and boxes on which to slide. Rails are long (~15 to 20 feet in length), thin (~2.5 to 4.5 inches in diameter) metal bars overhanging the snow (~2 to 3 feet in height) that freestylers hop onto, slide along with their skis perpendicular to the ground, and drop themselves off. Rails can be of various shapes; the most common are "flat rail" (straight), "c-rail" (c-shaped), and "s-rail" (s-shaped).

Boxes are long (~15 to 20 feet in length), wide (~15 to 18 inches in width) rectangular structures, usually made out of wood with rounded metal edges and a plastic top, placed on the snow (~1.5 to 3.5 feet in height) that users slide along with their skis either parallel or perpendicular to the ground. These features include a small ramp leading straight onto the box and

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another ramp for exiting it leading straight onto the ground. Boxes can also be of various shapes; the most common are "flat box" (straight), "c-box" (c-shaped), and "rainbow box" (∩-shaped).

Previous research comparing skiing and snowboarding injuries sustained in SPs with those sustained on traditional slopes provides evidence that injuries sustained in the former were both proportionately more frequent and far more likely to be more severe than those sustained in the latter.[2,4–9] Researchers have found that, compared with traditional slopes, skiers in SPs are significantly more likely to sustain head and neck, trunk, and severe upper extremity injuries,[4] fractures, and concussions.[7] However, it is unknown whether feature-specific skier injury types or anatomic locations of injury differ for aerial and nonaerial features.

There is a dearth of research examining the characteristics of feature-specific injuries sustained by skiers in SPs. Consequently, the objectives of this study were to identify the most common types and anatomic locations of injury resulting from skiing on aerial and nonaerial SP features, determine potential risk factors for SP injuries, and calculate the odds of injury to body regions and injury types on aerial versus nonaerial features.

Methods

This study was conducted in the SP of a winter resort located in the Spanish Pyrenees, between December 2013 and April 2014. The SP was delimited, and its design did not vary during the season. Helmets were mandatory in the SP.

Cases involved skiers injured in the SP while performing a maneuver on a feature. They were chosen after a detailed check of the resort's ski patrol accident forms and the records of the only nearby emergency, trauma, and medical hospital (ETMH). Non–feature-related injuries were excluded because these are not related to the specific risks of using freestyle elements. If a skier had a ski patrol accident form and was also examined at the ETMH, the physician's diagnosis was used.

Data collection included contact information, demographics (sex and age group), self-reported skill level, environmental circumstances (visibility and snow, weather, and wind conditions), feature used at the time of accident (aerials: halfpipe, big jump [~4 m], or jump [~1 m]; nonaerials: flat rail, c-rail, flat box, or rainbow box), type of injuries (fracture, concussion, sprain/strain/dislocation, abrasion/laceration/bruise, and pain/swelling), and injured anatomic locations, which were classified into 4 "body regions": 1) head/neck (head, face, and neck); 2) trunk (back, chest, and pelvis/hip); 3) upper extremity (shoulder, clavicle, upper arm, elbow, lower arm, wrist, and hand); and 4) lower extremity (thigh, knee, lower leg, and ankle/foot). In addition to accident forms and ETMH records, telephone interviews were conducted to collect missing data.

The total number of runs and the total number of times each feature was used were estimated to obtain denominator data on skier runs and feature use. For that purpose, 2 teams of 3 observers took turns to cover the 6 hours per day (10:00–16:00) during which the SP was open. Skier runs were counted by 1 member at the entrance to the SP, while the 2 remaining members, in the middle and at the bottom of the SP, respectively, recorded use of those features allotted to each of them.

This procedure was repeated for each and every day in the sample period. These days were chosen according to 2 sets of computer-generated random numbers: 1 set of random numbers was generated to select a subsample among the population of working days in the season, and a second set of random numbers was generated to select a subsample from among the population of public holidays (weekends, Christmas, and Easter).

The overall injury rate was calculated as injuries per 1000 runs; the numerator was the number of injured skiers over the season, and the denominator was the estimated total runs. Feature-specific injury rates were also calculated; the numerators were the number of skiers injured on each particular type of feature, and the denominators were the estimated total number of times each had been used.

The proportions of injured anatomic locations, body regions, and injury types, with 95% CIs, were calculated for aerial (halfpipe, big jump, and jump) and nonaerial (flat rail, c-rail, flat box, and rainbow box) features. Multinomial regression was used to determine the associations between aerial versus nonaerial feature exposure and injured body region.

Variables tested were sex (male or female), age group (<20, 20–40, or >40 years), self-reported skill level (novice, intermediate, advanced, or expert), snow (grippy, icy, or slushy), weather (sunny, overcast, or snowy), wind (calm [≤ 10 km/h], moderate [11–35 km/h], or strong [≥ 36 km/h]), and visibility (good, moderate, or poor), all of them multitiered except for sex. According to the information provided by the variables to generate the model, the self-rated skill had the greatest impact in the model.

A crude model was generated in which the exposure was a feature and the outcome was an injured body region, with upper extremity as the base outcome. The modeling process was repeated with injury type as the outcome and sprain/strain/dislocation as the base outcome. Analyses were conducted in SPSS 22.0. This study was conducted with the approval of the University of Zaragoza research board.