

## ORIGINAL RESEARCH

# Hospital-Treated Snow Sport Injury in Victoria, Australia: A Summary of 2003–2012

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**Introduction**—To determine the incidence rate and changes over time for ice and snow sports injury in Victoria, Australia, from 2003 to 2012 and describe the most common types and causes of these injuries.

**Methods**—Retrospective data from the Victorian Injury Surveillance Unit describing hospital admissions and emergency department presentations were extracted for the 10-year period of 2003 to 2012 for all ice- and snow-related injury. Descriptive injury data and participation-adjusted trend analyses using log-linear regression modelling of data (statistical significance,  $P < 0.05$ ) from the Exercise, Recreation and Sport Survey 2003 to 2010 are presented.

**Results**—Overall, there were 7387 ice- and snow-related injuries, with a significant increase in hospital-treated snowboard injuries and a (nonsignificant) decline in hospital-treated ski injuries over the 10 years. Skiing (39%) and snowboarding (37%) had the highest incidence of hospital-treated injury, with males aged 15 to 24 years injured most frequently in both sports. Falls were the most common cause of injury in both skiing (68%) and snowboarding (78%).

**Conclusions**—Patterns of snow sports injury in Australia during 2003 to 2012 remain similar to findings of national studies conducted decades earlier. More importantly, however, Australian injury patterns are comparable to international statistics and thus may be generalizable internationally. Head injuries, although infrequent, are associated with great injury severity due to a high frequency of hospitalization. Furthermore, research into the use of personal protective equipment and other injury prevention measures among Australian participants, particularly by young, male snowboarders, is required. Given the similar injury patterns, injury prevention measures implemented internationally could reasonably translate to an Australian setting.

*Keywords:* recreation, sports medicine, epidemiology

## Introduction

Snow sports, including skiing (eg, alpine and Nordic), snowboarding, and recreational snow play, are popular winter activities, with 70 million people participating worldwide.<sup>1</sup> Australian snow resorts, which are predominantly located in the southeastern states of New South Wales and Victoria, record an estimated 3

million visitor-days per year. Approximately 2 million of these visits involve resort-lifted activities, such as downhill skiing and snowboarding.<sup>2</sup> The Australian ski industry attracts a large number of national and international visitors and makes a significant economic contribution to Australian tourism each year.<sup>2</sup> Given the popularity of snow sports, obtaining an understanding of the injury risks involved in these activities and developing strategies to minimize them would have benefits for the individual and for the broader snow sports industry.

Although published studies describing snow sports injury are common in other regions, such as the United States,<sup>3</sup> Canada,<sup>4</sup> Japan,<sup>5</sup> and Europe,<sup>6,7</sup> these studies may be unlikely to be generalizable to Australia because of the less challenging skiable environments in Australia,

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Submitted for publication June 2017.

Accepted for publication January 2018.

Presented in part at the Asics Conference of Science and Medicine, October 22–25, 2013, Phuket, Thailand.

which are predominantly beginner and intermediate level, as well as the difference in Australian population snow sports exposure and skill level in comparison to North American or European countries.<sup>1</sup> Few Australians live near ski resorts; thus, recreational, weekend, and day-pass visitation is common.<sup>8</sup> Previous evidence suggests that less experienced skiers and snowboarders have a higher risk of injury,<sup>9</sup> so it is possible that the sporadic nature of Australian snow sport participation could have a greater risk of injury and thus could be a target group for injury prevention strategies.

Generally, skiing is the most common snow activity worldwide, although snowboarding has grown in popularity, particularly among younger participants.<sup>10</sup> Internationally, these 2 sports are associated with relatively high injury incidences.<sup>11</sup> In Australia, there has been little research examining injury from snow sports, with some previous studies only targeted to 1 specific group (eg, risk in children,<sup>12</sup> Nordic skiing injury,<sup>13</sup> and ski-related deaths<sup>14</sup>), and results are now quite dated. More recent studies have investigated injuries sustained during snowboarding and ski-based snow sports, more specifically, providing greater depth of knowledge of injury occurrence, including common types of injuries sustained for each activity, body regions injured, and severe snow sports-related injuries.<sup>15,16</sup> However, despite the detail provided in these studies, the data are dated and may not accurately reflect injury occurrence in the past 10 to 20 years when considering possible changes over time in factors such as participant numbers, protective equipment use (eg, helmets), style of riding (eg, freestyle [involving tricks] vs free ride [involving backcountry]), and terrain/conditions encountered (eg, groomed runs, terrain parks, off-piste).<sup>11</sup>

An understanding of the common types of injuries sustained in the unique setting of Australian snow resorts will help to determine the types of injury prevention initiatives that are required. Comparing these injury findings with those of global studies may also inform the translation of international prevention measures for implementation in an Australian setting, if injury patterns can be generalized. Furthermore, an evaluation of injury trends can provide insight into possible factors affecting injury occurrence and how these factors can be addressed in future prevention strategies. Therefore, the purpose of this research was to investigate snow sports injury over a 10-year period (2003–2012) for the Victorian region, where 5 skiable mountains and at least 3 of Australia's larger ski resorts are located. The specific aims were to determine the incidence rate of snow sports injury in Victoria, consider changes in

incidence rate over time, and determine the most common types and causes of snow sports injury.

## Methods

Retrospective data were obtained from the Victorian Injury Surveillance Unit (VISU) covering hospital admissions (Victorian Admitted Episodes Dataset [VAED]) and emergency department presentations (Victorian Emergency Minimum Dataset [VEMD]) in the 10-year period of January 1, 2003 to December 31, 2012. The Victorian Department of Health and Human Services supplies the VISU with a deidentified subset of injury admissions and emergency department presentations annually for the purposes of injury surveillance and injury-related research. Research using data collected by VISU has approval from the Human Research Ethics Committee at the Victorian Department of Health and Human Services.

## INJURY DATA

The VAED is a statewide collection of data on all admissions to Victorian hospitals (public and private) and was established in July 1987. Data are coded to the International Classification of Diseases, Australian Modification (ICD-10-AM).<sup>17</sup> For the main analysis, cases recorded in the VAED were extracted if they had a principal diagnosis recorded as an injury (ICD-10-AM code in the range S00–T98) and an activity code as an ice or snow sport (U550–U559). These codes include snow skiing, snowboarding, bobsledding, ice skating, ice dancing, snowmobiling, speed skating, tobogganing, curling, and other specified and unspecified ice or snow sport. Transfers within and between hospitals were excluded to avoid double counting in the estimation of the incidence of cases.

The VEMD, which commenced in October 1995, is an ongoing surveillance dataset of injury presentations to Victorian public hospitals that have a designated emergency department service. Cases recorded in the VEMD were extracted using text narratives that indicated that a person was injured while engaging in an ice or snow sport (activities searched were the same as those listed for VAED cases). Emergency department cases that were subsequently admitted to hospital were excluded in the VEMD dataset to avoid double counting with the VAED cases.

For both the VEMD and VAED, data are presented for body region, injury type, and cause of injury, based on the first occurring injury diagnosis recorded (ie, the number of injuries is equal to the number of injured persons).

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