Diferencias en el patrón de las lesiones de surf de nieve y de esquí: Análisis de 9.147 víctimas durante cinco temporadas

Differences in the Pattern of Injuries Between Snowboarding and Alpine Skiing: An Analysis of 9,147 Casualties During Five Seasons

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RESUMEN

Objeto: El objeto de este estudio es evaluar si la práctica del surf de nieve está asociada con un patrón diferente de lesiones, en comparación con la práctica del esquí alpino.

Métodos: Fueron analizadas todas las fichas de asistencia médica de los accidentados atendidos en el Centro Médico de la estación de esquí de Masella, durante cinco temporadas (2003-2008). Los grupos de surf de nieve y esquí alpino se compararon utilizando la prueba de chi-cuadrado o el test de Fischer para las variables categóricas y la prueba de t de Student o la prueba de Mann-Whitney para variables continuas. El análisis de varianza (ANOVA) se utilizó para la comparación de más de dos grupos. Cuando las variables no cumplían los supuestos de normalidad, se aplicó la prueba de Kruskal-Wallis se aplicó. La significación estadística se fijó en P <0,05.

Resultados: Durante este período, fueron atendidas 9.147 víctimas (6.101 fueron esquiadores y 2.789 eran practicantes de surf de nieve). En comparación con los practicantes de esquí alpino, entre los accidentados durante la práctica de surf de nieve se observó que había un mayor número de principiantes (49.5 vs 41.5%), el uso del casco protector era menor (37.8% vs 44.9%), tenían menos heridas incisas y contusas (5.8% vs 8.5%), menos lesiones de las extremidades inferiores (21.2% vs 47.4%), menos lesiones del dedo pulgar (3.2% vs 7.8%), y menos esguinces de rodilla (2.8% vs 14.7%). Por otra parte, presentaban un mayor porcentaje de fracturas óseas (18.6% vs 6.7%), de lesiones de extremidades superiores (57% vs 29.2%), de lesiones de muñeca en general (16.8% vs 2.5%), de fracturas distales de radio (12.3% vs 1.6%), de luxaciones de hombro (2.9% vs 1.6%), de fracturas de clavícula (2.4% vs 1.4%), y de lesiones del tronco (2.8% vs 2%). Todas estas comparaciones fueron estadísticamente significativas (P <0.05).

Conclusión: Los resultados de este trabajo demuestran que el surf de nieve tiene un patrón de lesiones distinto del que se observa en la práctica del esquí alpino, el conocimiento de las cuales puede influir en la prevención de accidentes de surf de nieve. Las estrategias propuestas para reducir las lesiones consisten en una revisión de la metodología de aprendizaje y entrenamiento, el uso rutinario del casco y la evaluación de los protectores de espalda para adaptarlos a los deportes de nieve.

Palabras clave: (MeSH terms): Lesiones de esquí. Deportes de nieve. Heridas y lesiones.

SUMMARY

Purpose: The purpose of this study was to assess whether the practice of snowboarding is associated with a different pattern of injuries as compared with alpine skiing.

Methods: All consecutive patients with snow sports injuries attended at the Medical Center of Masella ski resort, during five ski seasons (2003–2008) were analyzed. A comparison was made of the groups of alpine skiers and snowboarders, using the chi-square (χ²) test or the Fisher’s exact test for categorical variables, and the Student’s t test or the Mann-Whitney U test for continuous variables. The analysis of variance (ANOVA) was used for the comparison of more than two groups. When variables did not fulfill assumptions of normality, the Kruskal-Wallis test was applied. Statistical significance was set at P < 0.05.

Results: During this period, a total of 9,147 accident victims were attended (6,101 were alpine skiers and 2,789 were snowboarders). When injured snowboarders were compared with injured alpine skiers, it was noted that the percentage of beginners was larger (49.5% vs 41.5%) and snowboarders were less likely to use helmet (37.8% vs 44.9%), to have lacerations (5.8% vs 8.5%), to have lower extremity injuries (21.2% vs 47.4%), to have thumb lesions (3.2% vs 7.8%), and to have knee sprains (2.8% vs 14.7%). In addition snowboarding was associated with higher percentages of bone fractures (18.6% vs 6.7%), upper extremity injuries (57% vs 29.2 %), wrist injuries in general (16.8% vs 2.5%), distal radius fractures (12.3% vs 1.6%), shoulder dislocations (2.9% vs 1.6%), clavicle fractures (2.4% vs 1.4%), and trunk injuries (2.8% vs 2%). All these comparisons were statistically significant (P < 0.05).

Conclusion: This study show that snowboarding has a different pattern of injuries seen in alpine skiing, the knowledge of which could influence snowboarder accident prevention. Strategies for prevention consist of training courses, the routine use of helmets, and the evaluation of back protectors in order to adapt to snow sports.

Key words: (MeSH terms): Skiing/injuries. Snow Sports. Wounds and Injuries.

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INTRODUCTION

Snowboarding continues to gain in popularity with an increasing number of participants of varying ages and ski levels. Despite common resorts are being used, snowboarding and alpine skiing use distinctive equipment and techniques to descend down slopes. Snowboarders use their arms to balance and the shifts in weight cause the board to turn, slow down or stop; moreover, the majority of snowboards do not have a releasable binding system and both feet are fixed. Although there is a great deal of information describing ski injuries, data assessing snowboarding injuries as compared with skiing injuries in large study populations are limited1,7,9,10,16,20,23.

Therefore, to further provide epidemiological data, injury pattern and clinical features of injuries related to alpine skiing and snowboarding, the database of all casualties treated at the Masella ski resort medical center in the Spanish Pyrenees over a 5-year winter season was reviewed. The aim of this retrospective study was to assess whether snowboarding is associated with a different pattern of injuries as compared with alpine skiing. The knowledge gained through the study could influence snowboarder education, equipment design and accident prevention.

MATERIAL AND METHODS

The Alp 2500 (Masella-La Molina) ski resort is located in the Spanish Autonomous Community of Catalonia in the Oriental Pyrenean Mountains (altitude 1,600–2,535), this being the second biggest ski resort in the Spanish Pyrenees. The resort is immediately to the south east of Andorra and 175 kilometres from Barcelona. The skiable area includes 115 slopes (133 km), with 33 lifts (with a capacity to transport 40,880 skiers per hour), and more than 500 snow cannons. The Medical Service of the ski resort assists all skiers and snowboarders injured in its domains. This service consists of a general doctor trained in traumatology and vital support, a nurse and a team of first aid qualified pisters-lifeguards.

Data on each casualty are entered in a database, which includes the following salient items: demographics (age, gender), perceived ski level (classified as beginner, intermediate and expert), history of skiing accidents, type of skiing (alpine or downhill, snowboarding, snowblading), circumstances and time of the accident, hours spent skiing, mechanism of injury, site and severity of injury, use of helmet, use of renal equipment, and discharge destination.

For the purpose of this study, data from 2003–2004 to 2007–2008 winter seasons were collected. Because many injured patients attended firstly at medical center of the ski resort are transferred and treated at the Hospital of Puigcerdà (an acute-care 30-bed community hospital belonging to the Catalan Health System, with a reference population of approximately 30,000 inhabitants), which is the closest hospital to the ski station, the hospital database for these years was also reviewed. The Institutional Review Board approved the study. This study has been performed in accordance with the ethical standards13.

Statistical analysis: A comparison was made of the groups of alpine skiers and snowboarders, using the chi-square ($\chi^2$) test or the Fisher’s exact test for categorical variables, and the Student’s $t$ test or the Mann-Whitney U test for continuous variables. The analysis of variance (ANOVA) was used for the comparison of more than two groups. When variables did not fulfill assumptions of normality, the Kruskal-Wallis test was applied. Statistical significance was set at $P < 0.05$.

Institutional Review Board approval and written consent were obtained in June 5, 2002.

RESULTS

During these five seasons, 9,147 accident victims were attended (41% women, median age 21.3 years [range 5–79]), which accounted for 4.6 injuries for every 1000 skiers per day, based on all purchased lift tickets. A total of 3,364 subjects (36.8%) were evacuated by ski-patrols, which
accounted for 1.76 evacuated accidents per 1000 skiers per day. The remaining 5,783 injured skiers reached the medical center by their own means. Accidents involved alpine ski in 6,101 cases (66.7%), snowboarding in 2,789 (30.5%), snow-blading in 219 (2.4%) and telemark skiing or wading in 38 (0.4%). Forty-four percent of skiers were beginners, 49.6% rented ski equipment and 39.3% wore a helmet. The most common diagnoses were contusions (54.5%) followed by sprains (21%), fractures (7.8%), lacerations (7.8%) and dislocations (3.1%). The lower extremities were involved in 37.6% of the accidents (n = 3,439) and the upper extremities in 36.6% (n = 3,347). The most frequent injuries in the lower and upper extremities were knee injuries and the skier’s thumb, respectively.

Potentially severe injuries occurred in 12.9% of victims, involving the head in 3.7% of the cases, spine in 3.8%, thorax in 2.3% and abdomen in 0.8%. Urgent hospitalization was required in 1.7% of the casualties (surgical operation in 0.9%). One alpine skier and one snowboarder with blunt head trauma died, with an overall mortality rate of 0.02%. None of these skiers wore a helmet.

Snowboarders as compared with alpine skiers were more frequently men (74.3% vs 51.6%, P < 0.01) and beginners (49.5% vs 41.5%, P < 0.01) and used a helmet less frequently (37.8% vs 44.9%, P < 0.01). The median age, however, was similar 21.7 vs 20.3 years. On the other hand, as shown in Table 1, snowboarders had a smaller number of lacerations and smaller number of injuries of lower extremities (P < 0.05), although the number of fractures was greater (P < 0.05). In addition, a greater number of upper extremities injuries (wrist injuries, shoulder dislocations and clavicle fractures) in snowboarders was found (P < 0.05), but the skier’s thumb was more common in alpine skiers (P < 0.01). Regarding potentially severe injuries, similar percentages of head, spine and abdominal injuries were observed in both study groups, but thorax injuries were significantly more frequent among snowboarders.

**TABLE 1. Differences in the distribution of injuries in alpine skiers and snowboarders**

<table>
<thead>
<tr>
<th></th>
<th>Alpine skiers (n = 6,101)</th>
<th>Snowboarders (n = 2,789)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacerations</td>
<td>518 (8.5)</td>
<td>162 (5.8)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Fractures</td>
<td>409 (6.7)</td>
<td>519 (18.6)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>2892 (47.4)</td>
<td>591 (21.2)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Ankle injuries</td>
<td>134 (2.2)</td>
<td>61 (2.2)</td>
<td>NS</td>
</tr>
<tr>
<td>Knee injuries</td>
<td>897 (14.7)</td>
<td>78 (2.8)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Femoral or hip fracture</td>
<td>18 (0.3)</td>
<td>6 (0.2)</td>
<td>NS</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>1781 (29.2)</td>
<td>1590 (57)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Skier’s thumb</td>
<td>476 (7.8)</td>
<td>89 (3.2)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Wrist sprain</td>
<td>55 (0.9)</td>
<td>125 (4.5)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Wrist fracture</td>
<td>98 (1.6)</td>
<td>343 (12.3)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Shoulder dislocation</td>
<td>98 (1.6)</td>
<td>81 (2.9)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Other sites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>244 (4)</td>
<td>95 (3.4)</td>
<td>NS</td>
</tr>
<tr>
<td>Spine</td>
<td>214 (3.5)</td>
<td>112 (4)</td>
<td>NS</td>
</tr>
<tr>
<td>Thorax</td>
<td>122 (2)</td>
<td>78 (2.8)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Abdominal</td>
<td>43 (0.7)</td>
<td>28 (1)</td>
<td>NS</td>
</tr>
<tr>
<td>Potentially severe injuries</td>
<td>781 (12.8)</td>
<td>388 (13.9)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Percentages in parenthesis.
DISCUSSION

To our knowledge, the present study reports the largest series addressing the different injury pattern between snowboarding and alpine skiing in one single large resort. In this study, the injury rate per 1000 skier-days was 4.6 and remained constant during the five winter seasons. Other authors have found injury rates of 2 to 10 injuries per 1000 skier-days for alpine skiing, 1 to 6 injuries per 1000 snowboarding days, and 10.7 injuries per 1000 skier days for telemark skiing²¹,²⁴. The sale of lift passes was used to calculate injuries per skiers days, although it has been recognized that is difficult to estimate the real use of each pass. The characteristic profile of snowboarders, --young men and beginners--, was also found in our series (74.3% were men, with a median age of 21.7 years, and 49.5% were beginners). In other studies, about 50% and 58% of the injured snowboarders are beginners³,¹⁷. Beginner snowboarders are at the highest risk group especially those trying snowboarding for the very first time.

A significantly lower rate of helmet use was observed in the victims of snowboarding accidents as compared with alpine skiers. Moreover, no helmets were worn in the two cases of fatality. In the study of Sacco, et al⁵ that included 25 ski-related deaths over a 6.5 year period in Vermont, USA, helmets were not worn by those sustaining head injuries or fatalities. In a case-control study at 8 major Norwegian alpine resorts during the 2002 winter season, involving 3,277 injured skiers and snowboarders and 2,992 non-injured controls, using a helmet was associated with 60% reduction in the risk for head injury²³. In our study, like others², there were no differences in the rate of head injury between snowboarding and alpine skiing, although injuries to the thorax were more frequent in snowboarders.

Injury patterns in snowboarding and alpine ski were significantly different. Upper extremity injuries were more frequent in snowboarders (57% vs 29%), whereas lower extremity injuries were more common in skiers (47% vs 21%). The incidence of fractures in snowboarders was 18.6% compared with 6.7% to skiers. The reasons for these differences can be explained by the design of the equipment and the way it is used. In other studies, the incidence of fractures in snowboarders is higher, ranging between 28% and 56%³,⁴,⁸. The lack of areas dedicated to acrobatic jumps in our ski resort may be one of the reasons for a lower incidence of snowboarding-associated fractures in our series.

The percentages of injuries in snowboarding reported in different studies published in the literature are summarized in Table 2. In our experien-

<table>
<thead>
<tr>
<th>First author (reference)</th>
<th>No. cases</th>
<th>Fractures</th>
<th>Lower extremity</th>
<th>Ankle</th>
<th>Knee</th>
<th>Upper extremity</th>
<th>Skier's thumb</th>
<th>Wrist fracture</th>
<th>Wrist injury</th>
<th>Shoulder dislocation</th>
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</thead>
<tbody>
<tr>
<td>Machold (16)</td>
<td>152</td>
<td>32</td>
<td>24</td>
<td>16</td>
<td>51</td>
<td>10.5</td>
<td>27</td>
<td>1</td>
<td>10.5</td>
<td>27</td>
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<tr>
<td>Sacco (5)</td>
<td>40</td>
<td>38</td>
<td>24</td>
<td>16</td>
<td>51</td>
<td>10.5</td>
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<td>1</td>
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<td>27</td>
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<td>Pigozzi (17)</td>
<td>106</td>
<td>45</td>
<td>24</td>
<td>16</td>
<td>51</td>
<td>10.5</td>
<td>27</td>
<td>1</td>
<td>10.5</td>
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<tr>
<td>Oberthaler (18)</td>
<td>437</td>
<td>31</td>
<td>34</td>
<td>34</td>
<td>16</td>
<td>51</td>
<td>10.5</td>
<td>27</td>
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<tr>
<td>Abu-Laban (7)</td>
<td>132</td>
<td>49</td>
<td>20</td>
<td>14</td>
<td>32</td>
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<td>10</td>
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<td>Chow (19)</td>
<td>355</td>
<td>16</td>
<td>3.1</td>
<td>2.8</td>
<td>58</td>
<td>20.3</td>
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<td>Davidson (14)</td>
<td>931</td>
<td>38</td>
<td>16</td>
<td>17</td>
<td>40</td>
<td>19.9</td>
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<tr>
<td>Made (20)</td>
<td>568</td>
<td>54</td>
<td>20</td>
<td>35</td>
<td>20.3</td>
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<tr>
<td>Pino (21)</td>
<td>110</td>
<td>52.7</td>
<td>26.4</td>
<td>11.8</td>
<td>29.1</td>
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<td>Ganong (22)</td>
<td>415</td>
<td>43</td>
<td>16.9</td>
<td>18.1</td>
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<td>Bladin (11)</td>
<td>276</td>
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<td>23</td>
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<td>Calle (23)</td>
<td>487</td>
<td>34.1</td>
<td>12.5</td>
<td>25</td>
<td>38</td>
<td>19.9</td>
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</tr>
<tr>
<td>Warne (8)</td>
<td>47</td>
<td>21</td>
<td>17</td>
<td>21.2</td>
<td>2.2</td>
<td>2.8</td>
<td>57</td>
<td>3.2</td>
<td>12.3</td>
<td>16.8</td>
</tr>
</tbody>
</table>

TABLE 2. Percentages of injuries in snowboarding reported in different published series
ce, the rate of ankle and knee injuries of 2.2% and 2.8%, respectively, are consistent with the study of Chow, et al. but lower than rates reported in most studies ranging between 12.5% and 26.4% for ankle injuries and between 11.8% and 25% for knee injuries. Because both feet are fixed in non-releasable bindings, knees are not as frequently or as severely injured in snowboarding than in alpine skiing. The fixed binding of both feet to a snowboard probably decreases the possibility of valgus stress on the knee, a common cause of medial collateral ligament injury in alpine skiing. The total proportion of injuries of lower extremities in our series was 21.2%, which is somewhat lower than ranges between 34% and 57% found in other studies, but higher than 16% reported by Chow, et al.

In agreement with different studies we have shown that snowboarding has a distinctly different pattern of injuries to alpine skiing. Compared to skiers, snowboarders are far more likely to sustain an injury to the upper limb and less likely to injure the lower limb. In our study we found 57% of the injuries were of the upper extremities, which is similar to percentages between 51% and 58% reported in other series in which a large number of snowboarders were evaluated. Snowboarders do frequently fall on to the outstretched hand after being catapulted forward or falling backwards while both legs are fixed to the board. This results in a high proportion of injuries to the upper extremities. We found a 12.3% rate of wrist fractures and 16.8% of wrist sprains, which are consistent with data reported in other studies. Wearing wrist guards reduces the risk of wrist injury and may be recommended as part of a standard equipment, particularly for a beginner snowboard. A matched case-control study conducted at 19 ski areas in Quebec, Canada (1,066 cases and 970 controls) demonstrated that the use of wrist guards reduced the risk of hand, wrist, and forearm injuries by 85% (adjusted odds ratio = 0.15, 95% confidence interval 0.05–0.45). As can be expected because snowboarders do not use poles, injury to the ulnar collateral ligament (skier’s thumb) was significantly more frequent among alpine skiers.

In our series, 13% of alpine skiers and 14% snowboarders presented potentially severe injuries, a percentage to the 15% found in the study of by Oberthaler, et al. In addition, the frequency of spine injuries in our series (3.5% and 4% in alpine skiers and snowboarders, respectively) is consistent with previously reported data.

This study has shown that the fast-growing sport of snowboarding has a notable different injury pattern from that in alpine skiing, including higher rates of upper extremities injuries, particularly, wrist fractures and a lower incidence of thumb injury. It was somewhat surprising to find a lower rate of ankle injury given that non-release bindings and soft boots have been shown to contribute to the higher incidence of ankle injuries in snowboarding. The present results should be interpreted taking into account some limitations of the study, including the retrospective design and the lack of a control group. However, descriptive statistics based on a large population of alpine skiers and snowboarders, to our knowledge the largest reported so far, adds evidence of a different set of injuries that the sport of snowboarding brings as compared with alpine skiing.

Pattern of injuries from skiing and snowboarding accidents in the Spanish Pyrenees resemble those reported in other ski resorts of the world. Emphasis on training courses from a certified instructor for those who are considering taking up the sport of snowboarding could significantly lower their risk of trauma. Proper physical training as appropriate exercises for the upper body, stationary and dynamic balance training drills and incorporate jump exercises with plyometric boxes can strengthen joints, improve balance, and better prepare the body for the physical demands of this sport. Certain changes that could affect the reduction of injuries in the snowboard training and learning process are: proper warm up before exercise, slow first descent, resting regularly, eating frequently to avoid hypoglycemia, stretching at the end of activity and, in case of fall, learning how to roll forward as you fall, as done in judo.
Nevertheless, other strategies for prevention are also needed. The routine use of helmets is associated with up to a 60% reduction in the risk of head injuries and\(^2^8\), and the use of back protectors may reduce spinal injuries\(^2^9\), although there is a mismatch between the capabilities of current back protectors to prevent spinal injury in snowboarding and the expectations users have of these protectors\(^3^0\).

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