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Original Article

Clinical features of winter sports injuries: A prospective single center study

Ali Gur[1*], Bahar Keskin Celik[1], Erdal Tekin[1], Emine Ozdal[1], Ibrahim Ozlu[1], Mehmet Ali Bilgili[2]

[1]Department of Emergency, School of Medicine, Ataturk University, Erzurum, Turkey
[2]Department of Emergency, Van Education and Research Hospital, Van, Turkey

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Abstract

Introduction: This study aimed to present the epidemiological and clinical effects of skiing training and use of protective equipment on skiing, sledding and snowboarding injuries.

Methods: The patients were evaluated in two groups according to both their skiing experience and use of protective equipment. The characteristics of the patients, such as age, gender, injury area, and injury type were statistically evaluated according to the groups.

Results: A total of 191 patients, 68 (35.6%) female and 123 (64.4%) male, were evaluated. There was a significant difference between the patients with and without skiing experience ($P=0.001$). When the patients were evaluated according to the presence of protective equipment, 25 (59.5%) patients who had no experience did not wear protective equipment, and this rate was statistically significant compared to the experienced group ($P=0.001$). Concerning the diagnoses of the patients according to injury areas, joint dislocation and soft tissue trauma were mostly detected in the upper extremities, bone fractures in the lower extremities and organ injury in the thorax.

Conclusion: Shoulder and wrist traumas were the most common injuries among the patients with previous skiing experience while tibial fractures were mostly seen in those without such experience. Tibia fractures were mostly observed in the patients using protective equipment, and skin incisions in those that did not use protective equipment. Therefore, in winter sports injuries, patients' skiing experience and protective equipment use should be questioned and more attention should be paid to the above-mentioned injuries.

Introduction

Winter sports are among the sport activities with increasing annual prevalence. Skiing, sledding and snowboarding are popular winter sports.[1] Winter sports are not only performed by professional athletes, and many amateurs also engage in these activities.[2] Although it is estimated that four to eight of every 1000 athletes suffer injuries that require emergency medical care each winter season, the actual number is not known due to various reasons.[3]

While winter sports offer people great fun and high adrenaline, they also pose a serious risk of injury. Although many precautions are taken on ski tracks, ski injuries cannot be prevented.[4] Many patients with or without skiing experience present to the emergency services following skiing accidents. Falls are the most common cause of skiing injuries, frequently resulting in lower extremity, upper extremity, vertebral and head traumas.[5,6] Therefore, to prevent skiing-related injuries, it is very important to have experience, familiarize with the ski track in advance, use protective equipment, and ensure the suitability of ski equipment for individuals engaging in this activity.[7]

This study aimed to present the demographic and clinical effects of skiing training and use of protective equipment on winter sports injuries.

Methods

This is a descriptive-analytical, cross-sectional study, conducted prospectively in the emergency department of a tertiary university hospital between November 1, 2020 and April 31, 2021. This wide range of dates was chosen considering that the skiing season starts early and ends late, depending on the geographical location of the province. However, since ski resorts could not be opened due to both the pandemic period and the winter season, patients presented to the emergency service with winter sports injuries from December to March. The study was started after receiving the approval of the ethics committee (approval number: B.30.2.ATA.0.01.00/418, date: 01.10.2020). Written informed consent was obtained from the volunteers participating in the study. For unconscious patients, informed consent was obtained from the relatives.

***Corresponding Author:** Ali Gur, Email: doktoraligur@gmail.com

The study included patients presenting to the emergency department after incurring injuries while skiing, snowboarding or sledding. Patients under the age of seven years, pregnant women, and patients who presented to the emergency department following trauma in a ski resort other than skiing, snowboarding, or sledding were excluded from the study. During the study period, the emergency department received a total of 61 258 patients. Among these patients, trauma was present in 12 315, of whom 198 were due to winter sports injuries. After excluding pregnant women (n = 3) and patients aged under seven years (n = 5), the final sample included 191 patients.

Patients who were injured while engaging in winter sports were questioned and their data were recorded in the emergency department according to the previously prepared ski fall analysis form. This form included information on the patient's age, gender, skiing experience, time of fall, month of fall, type of winter sports, type of injury, use of protective equipment, injury area, diagnosis, treatments, and inpatient clinic and length of stay if hospitalized. The patients were evaluated according to the Advanced Trauma Life Support (ATLS) guidelines. The patients with winter sports injuries were divided into two groups according to their skiing experience (experienced and non-experienced groups). While professional athletes who had taken lessons in previous seasons and had a history of skiing were considered as experienced, those that were skiing for the first time or had only started to take lessons during that season were considered non-experienced. The patients were also divided into two groups according to the use of protective equipment, such as gloves, helmets, goggles, knee pads and other clothing. As the type of winter sports, sledding, skiing and snowboarding groups were evaluated. The mechanism of injury was analyzed as falls or impaction. Injury areas were examined separately as head and neck, thorax, abdomen, pelvis, upper extremity, lower extremity, and lumbar region. The patients with injuries in more than one area were evaluated according to the severity of the injury. The general injury diagnoses of the patients were evaluated as soft tissue trauma, bone fracture, organ injury, skin laceration, and joint dislocation. Then, the diagnoses were evaluated separately for groups according to the main diagnoses included in the International Statistical Classification of Diseases and Related Health Problems (ICD) codes.

Statistical analyses

Statistical analysis was performed using IBM SPSS software, version 25.0 (IBM Corp., Armonk, New York, USA). The distribution of variables was evaluated for normality using the Kolmogorov-Smirnov test. Descriptive statistics were given as frequency (n) and percentage (%) for categorical variables. In 2×2 comparisons of categorical variables, the Pearson chi-square test was run if the expected value was >5, the Yates's chi-squared test was run if the expected value was 3-5, and Fisher's exact test was run if the expected value was <3. For the comparison of categorical variables between more than two groups, the Pearson chi-square test was used when expected value was >5 and the Fisher-Freeman-Halton test was used when the expected value was <5. The statistical significance level was taken as $P < 0.05$.

Results

The study included a total of 191 patients, 68 (35.6%) female and 123 (64.4%) male. The mean age of the patients was 25.66 ± 12.77 years. There were 129 (67.5%) with skiing experience and 62 (32.5%) without skiing experience. The number of patients using protective equipment was 149 (78%) and the number of those not using such equipment was 42 (22%).

The demographic characteristics of the patients are given in Table 1. The highest number of injuries occurred between 12:01 and 16:00 hours (42.9%). The highest rate of injuries occurred in February (48.2%), and skiing injury (89.5%) was the most common type of winter sports injury. The patients were mostly injured due to falls (95.8%). The area of injury was mostly upper extremities (31.9%), and the most common injury diagnosis was soft tissue trauma (55.0%) (Table 1).

When the patients were evaluated according to their skiing experience, a statistically significant difference was found between the time of falling between the experienced and non-experienced groups ($P = 0.044$). There was also a significant difference between the skiing styles of the patients with and without ski experience ($P = 0.001$). Fifteen (24.2%) patients with no skiing experience were injured while sledding. Six (9.7%) patients in the non-experienced group were injured as a result of impaction, and this rate was statistically significant compared to the patients with skiing experience ($P = 0.009$). Twenty (40.3%) patients without skiing experience did not use protective equipment, and this rate was also statistically significant compared to the experienced group ($P = 0.001$). There was no statistically significant difference between the experienced and non-experienced groups according to injury area or injury diagnosis. Other clinical and demographic data are detailed in Table 2.

When the patients were evaluated according to the presence of protective equipment, 25 (59.5%) patients without skiing experience were determined to have used no protective equipment, and this rate was statistically significant compared to the experienced group ($P = 0.001$). The type of winter sports was sledding in 15 (35.7%) patients without protective equipment use, and this rate statistically significantly differed between the two groups ($P = 0.001$). When the type of injury was compared between the groups, lower extremity injuries were most common (34.2%) in those using protective equipment while head and neck injuries were mostly observed (33.3%) in those

Table 1. Demographic data of all patients

Variables		N = 191 (100%)
Age (mean ± SD) (y)	25.66 ± 12.77	
Gender	Female	68 (35.6)
	Male	123 (64.4)
Skiing experience	Present	129 (67.5)
	Absent	62 (32.5)
Time of injury	08:00-12:00 hours	28 (14.7)
	12:01-16:00 hours	82 (42.9)
	16:01-20:00 hours	77 (40.3)
	20:01-07:59 hours	4 (2.1)
Month of injury	December	22 (11.5)
	January	33 (17.3)
	February	92 (48.2)
	March	44 (23.0)
Type of winter sports	Sledding	15 (7.9)
	Skiing	171 (89.5)
	Snowboarding	5 (2.6)
Mechanism of injury	Fall	183 (95.8)
	Impact	8 (4.2)
Protective equipment use	Present	149 (78.0)
	Absent	42 (22.0)
Area of injury	Head-neck	41 (21.5)
	Thorax	15 (7.9)
	Abdomen	4 (2.1)
	Pelvis	7 (3.7)
	Upper extremity	61 (31.9)
	Lower extremity	59 (30.9)
	Lower back	4 (2.1)
Diagnosis	Soft tissue trauma	105 (55.0)
	Bone fracture	64 (33.5)
	Organ injury	5 (2.6)
	Skin laceration	8 (4.2)
	Joint dislocation	9 (4.7)
Treatment applied	Medical	77 (40.3)
	Operation	29 (15.2)
	Plaster-splint	65 (34.0)
	Binder-neck collar	3 (1.6)
	Suture	8 (4.2)
	Tube thoracostomy	1 (0.5)
	Reduction	8 (4.2)
Mortality	Yes	0 (0)
	No	191 (100)
Clinic stay	None	142 (74.3)
	Short stay unit in the emergency department	14 (7.3)
	Orthopedics	26 (13.6)
	General surgery	5 (2.6)
	Other	4 (2.1)
Length of stay/days (min-max)	0-6	

using no protective equipment, and the difference was statistically significant ($P = 0.026$). Skin lacerations were present in six (14.3%) patients without skiing experience, and there was a statistically significant difference ($P = 0.009$). Therefore, there were also differences between the groups according to the applied treatments ($P = 0.032$). Other data are demonstrated in details in Table 3.

In patients with skiing experience, soft tissue trauma was the most common diagnosis (16.3%), followed by wrist trauma (8.5%). In the non-experienced group, soft tissue trauma was observed at most (19.4%), followed by tibial fractures (11.3%). Among the patients using protective equipment, soft tissue trauma was the most common diagnosis at 14.8% while tibial fractures were detected as the second most common diagnosis at 9.4%. In the group that did not use protective equipment, the most frequent diagnosis was soft tissue trauma (26.2%), followed by skin lacerations (14.3%). Table 4 presents the other main diagnoses of the patients.

When the injury diagnoses of the patients were evaluated according to the injury area, joint dislocation and soft tissue trauma were mostly detected in the upper extremities, bone fractures in the lower extremities, and organ injury in the thorax (Figure 1).

Discussion

In this study, patients who presented to the emergency department after incurring injuries while performing winter sports were evaluated epidemiologically and clinically according to their skiing experience and use of protective equipment. In previous studies, the number of individuals using protective equipment when engaging in winter sports activities varied between 16% and 90%.[8,9] The rate of individuals performing winter sports with skiing experience is reported to be 84%.[10] In our study, the rate of patients with skiing experience was 67.5% and the rate of protective equipment use was 78%, which is similar to the existing literature.

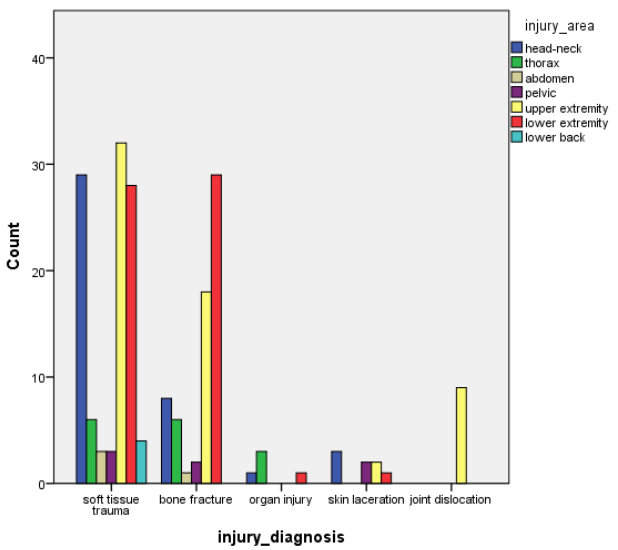

Figure 1. Diagnoses According to the Area of Injury.

Table 2. Comparison of the patients according to skiing experience

Variables		Experienced (n = 129, 100%)	Non-experienced (n = 62, 100%)	*P* value
Age (mean ± SD) (y)		25.6 (12.1)	25.6 (12.6)	0.979[a]
Gender	Female	50 (38.8)	18 (29.0)	0.249[b]
	Male	79 (61.2)	44 (71.0)	
Time of injury (h)	08:00-12:00	17 (13.2)	11 (17.7)	0.044[b]
	12:01-16:00	63 (48.8)	19 (30.6)	
	16:01-20:00	48 (37.2)	29 (46.8)	
	20:01-07:59	1 (0.8)	3 (4.8)	
Month of injury	December	15 (11.6)	7 (11.3)	0.080[b]
	January	16 (12.4)	17 (27.4)	
	February	66 (51.2)	26 (41.9)	
	March	32 (24.8)	12 (19.4)	
Type of winter sports	Sledding	0 (0)	15 (24.2)	0.001[b]
	Skiing	124 (96.1)	47 (75.8)	
	Snowboarding	4 (3.9)	0 (0)	
Mechanism of injury	Fall	127 (98.4)	56 (90.3)	0.009[b]
	Impact	2 (1.6)	6 (9.7)	
Protective equipment use	Present	112 (86.8)	37 (59.7)	0.001[b]
	Absent	17 (13.2)	25 (40.3)	
Area of injury	Head-neck	28 (21.7)	13 (21.0)	0.836[b]
	Thorax	10 (7.8)	5 (8.1)	
	Abdomen	2 (1.6)	2 (3.2)	
	Pelvis	4 (3.1)	3 (4.8)	
	Upper extremity	45 (34.9)	16 (25.8)	
	Lower extremity	38 (29.5)	21 (33.9)	
	Lower back	2 (1.6)	2 (3.2)	
Diagnosis	Soft tissue trauma	76 (58.9)	29 (46.8)	0.403[b]
	Bone fracture	39 (30.2)	25 (40.3)	
	Organ injury	3 (2.3)	2 (3.2)	
	Skin laceration	4 (3.1)	4 (6.5)	
	Joint dislocation	7 (5.4)	2 (3.2)	
Treatment applied	Medical	54 (41.9)	23 (37.1)	0.533[b]
	Operation	18 (14.0)	11 (17.7)	
	Plaster-splint	43 (33.3)	22 (35.5)	
	Binder-neck collar	3 (2.3)	0 (0)	
	Suture	4 (3.1)	4 (6.5)	
	Tube thoracostomy	1 (0.8)	0 (0)	
	Reduction	6 (4.7)	2 (3.2)	
Mortality	Yes	0 (0)	0 (0)	-
	No	129 (100)	62 (100)	
Clinic stay	None	97 (75.2)	45 (72.6)	0.941[b]
	Short stay unit in the emergency department	10 (7.8)	4 (6.5)	
	Orthopedics	16 (12.4)	10 (16.1)	
	General surgery	3 (2.3)	2 (3.2)	
	Other	3 (2.3)	1 (1.6)	
Length of stay/days (min-max)		0-6	0-6	0.328[a]

[a] Independent samples t test; [b] Pearson chi-square test.

Table 3. Comparison of the patients according to protective equipment use

Variables		Using protective equipment (n=149, 100%)	Not using protective equipment (n=42, 100%)	*P* value
Age (mean±SD)		26.1 (12.5)	23.8 (11.0)	0.283[b]
Gender	Female	55 (36.9)	13 (31.0)	0.476[b]
	Male	94 (63.1)	29 (69.0)	
Time of injury (h)	08:00-12:00	21 (14.1)	7 (16.7)	0.490[b]
	12:01-16:00	67 (45.0)	15 (35.7)	
	16:01-20:00	59 (39.6)	18 (42.9)	
	20:01-07:59	2 (1.3)	2 (4.8)	
Month of injury	December	11 (7.4)	11 (26.2)	0.005[b]
	January	28 (18.8)	5 (11.9)	
	February	77 (51.7)	15 (35.7)	
	March	33 (22.1)	11 (26.2)	
Skiing experience	Present	112 (75.2)	17 (40.5)	0.001[b]
	Absent	37 (24.8)	25 (59.5)	
Type of winter sports	Sledding	0 (0)	15 (35.7)	0.001[b]
	Skiing	145 (97.3)	26 (61.9)	
	Snowboarding	4 (2.7)	1 (2.4)	
Mechanism of injury	Fall	145 (97.3)	38 (90.5)	0.051[b]
	Impact	4 (2.7)	4 (9.5)	
Area of injury	Head-neck	27 (18.1)	14 (33.3)	0.026[b]
	Thorax	14 (9.4)	1 (2.4)	
	Abdomen	3 (2.0)	1 (2.4)	
	Pelvis	3 (2.0)	4 (9.5)	
	Upper extremity	49 (32.9)	12 (28.6)	
	Lower extremity	51 (34.2)	8 (19.0)	
	Lower back	2 (1.3)	4 (4.8)	
Diagnosis	Soft tissue trauma	83 (55.7)	22 (52.4)	0.009[b]
	Bone fracture	51 (34.2)	13 (31.0)	
	Organ injury	5 (3.4)	0 (0)	
	Skin laceration	2 (1.3)	6 (14.3)	
	Joint dislocation	8 (5.4)	1 (2.4)	
Treatment applied	Medical	59 (39.6)	18 (42.9)	0.032[b]
	Operation	23 (15.4)	6 (14.3)	
	Plaster-splint	54 (36.2)	11 (26.2)	
	Binder-neck collar	3 (2.0)	0 (0)	
	Suture	2 (1.3)	6 (14.3)	
	Tube thoracostomy	1 (0.7)	0 (0)	
	Reduction	7 (4.7)	1 (2.4)	
Mortality	Yes	0 (0)	0 (0)	-
	No	149 (100)	42 (100)	
Clinic stay	None	111 (74.5)	31 (73.8)	0.544[b]
	Short stay unit in the emergency department	9 (6.0)	5 (11.9)	
	Orthopedics	21 (14.1)	5 (11.9)	
	General surgery	5 (3.4)	0 (0)	
	Other	3 (2.0)	1 (2.4)	
Length of stay/days (min-max)		0-6	0-6	0.862[a]

[a] Independent samples *t* test; [b] Pearson chi-square test.

Table 4. Main diagnoses according to groups

Main diagnosis	Experienced (n = 129, 100%)	Non-experienced \ (n = 62, 100%)	Using protective equipment (n = 149, 100%)	Not using protective equipment (n = 42, 100%)
Subgaleal hematoma	6 (4.7)	1 (1.6)	6 (4.0)	1 (2.4)
Shoulder tissue trauma	11 (8.5)	1 (1.6)	12 (8.1)	0 (0)
Radius fracture	9 (7.0)	1 (1.6)	8 (5.4)	2 (4.8)
Nasal fracture	4 (3.1)	3 (4.8)	5 (3.4)	2 (4.8)
Ankle tissue trauma	5 (3.9)	1 (1.6)	6 (4.0)	0 (0)
Pneumothorax	2 (1.6)	1 (1.6)	3 (2.0)	0 (0)
Tibia-fibula fracture	4 (3.1)	5 (8.1)	7 (4.7)	2 (4.8)
Soft tissue trauma	21 (16.3)	12 (19.4)	22 (14.8)	11 (26.2)
Tibial fracture	9 (7.0)	7 (11.3)	14 (9.4)	2 (4.8)
Clavicular fracture	2 (1.6)	4 (6.5)	4 (2.7)	2 (4.8)
Elbow tissue trauma	11 (8.5)	2 (3.2)	12 (8.1)	1 (2.4)
Other diagnosis[a]	7 (5.4)	3 (4.8)	6 (4.0)	4 (9.5)
Skin laceration	4 (3.1)	4 (6.5)	2 (1.3)	6 (14.3)
Rib fracture	3 (2.3)	2 (3.2)	5 (3.4)	0 (0)
Vertebral fracture	3 (2.3)	0 (0)	3 (2.0)	0 (0)
Leg tissue trauma	7 (5.4)	1 (1.6)	6 (4.0)	2 (4.8)
Knee tissue trauma	4 (3.1)	5 (8.1)	8 (5.4)	1 (2.4)
Wrist tissue trauma	6 (4.7)	3 (4.8)	7 (4.7)	2 (4.8)
Olecranon dislocation	1 (0.8)	1 (1.6)	1 (0.7)	1 (2.4)
Shoulder dislocation	5 (3.9)	1 (1.6)	6 (4.0)	0 (0)
Patellar fracture	1 (0.8)	1 (1.6)	1 (0.7)	1 (2.4)
Pelvic fracture	1 (0.8)	1 (1.6)	1 (0.7)	1 (2.4)
Femoral fracture	3 (2.3)	0 (0)	3 (2.0)	0 (0)
Humeral fracture	0 (0)	2 (3.2)	1 (0.7)	1 (2.4)

[a] Mandibular fracture, spleen laceration, liver laceration, scapular fracture, maxillary fracture.

It is reported that the rate of skiing injuries is higher in males than in females, but there is no significant difference between the genders in relation to type of injuries.[11,12] In a study conducted in Finland, it was found that 35 (57.4%) cases with skiing injuries were male and 25 (42.6%) cases were female.[11] Similarly, in our study, there was no significant difference between the experienced and non-experienced groups or between the patients with and without protective equipment use according to gender, and the rate of injuries was more common in males.

Falls are the most common cause of injury when skiing due to uneven ground, melted or icy snow, and speed among many other reasons. In the existing literature, the most common cause of injury in skiing is reported as falling.[13,14] In our study, the most common mechanism of injury was a fall in both patients with and those without skiing experience. However, in patients without skiing experience, the incidence of impaction was higher than the experienced group. This may be due to personal factors, such as lack of attention and experience or environmental factors, such as type of the snow in the ski resort, obstacles in the track (e.g., trees and rocks, width of the track) and number of skiers.

Most studies suggest that among individuals engaging in winter sports, skiing injuries mostly result in fractures, followed by sprains.[15,16] In a study conducted in Antarctica, Cattermole reported that the most common type of injury was sprains at a rate of 62.7% while the rate of fractures was lower at 15%.[17] In our study, soft tissue trauma was the most common type of injury in not only the patients with and without skiing experience but also those with and without protective equipment use, and the frequency of fractures ranked second. Bone fractures were seen at a higher rate in those who did not have skiing experience than those with skiing experience. In a previous study, it was shown that as the skill level of individuals engaging in winter sports increased, the severity of injury also increased.[18] At the same time, in the current study, the rate of bone fractures was higher in those using protective equipment than in those without protective equipment use. We consider that the reason for this is that individuals who do not have skiing experience try to be more careful when performing winter sports. On the other hand, the rate of bone fractures was found to be higher in those using protective equipment, which can be attributed to this equipment increasing the confidence and courage of skiers.

Studies have reported that more than 50% of winter

sport injuries occur in the lower extremities, followed by the upper extremities.[11-13,19] This is because the lower extremities, which are under the control of the ski, board or sled, are exposed to more physical stress while skiing, resulting in a higher rate of injury in this area.[14] In another study, the rate of upper extremity injuries was found to be higher at 54.3%.[20] In the current study, upper extremity injuries were more common than lower extremity injuries among the patients with skiing experience. At the same time, upper extremity injuries were detected more frequently in the group that did not use protective equipment. This may be because most of the injured patients presented to the emergency department due to falling when skiing, and therefore they tried to get support from their upper extremities to protect themselves during the fall. This was proven by joint dislocations mostly being seen in the upper extremities.

Our study has some limitations. First, this is a single-center study. Our second limitation was that patients with full protective equipment were evaluated in this study. The partial does not contain any data on the use of protective equipment.

Conclusion

The use of protective equipment and receiving training are among the measures to be taken to minimize winter sports injuries. However, we determined that both the patients with skiing experience and protective equipment use were mostly exposed to soft tissue traumas. Shoulder and wrist traumas were the most common types of injuries in those with skiing experience while tibial fractures were mostly seen in the non-experienced group. Tibial fractures were most common in those using protective equipment and skin lacerations in those that did not use such equipment. Therefore, in the presence of winter sports injuries, the patient's skiing experiences and protective equipment use should be questioned and more attention should be paid to the above-mentioned injuries.

Conflict of Interest

The authors have no conflict of interest to declare.

Study Highlights

What is current knowledge?

- Falls are the most common cause of skiing injuries, frequently resulting in lower extremity, upper extremity, vertebral and head traumas.

What is new here?

- Joint dislocation and soft tissue trauma are mostly detected in the upper extremities, bone fractures in the lower extremities, and organ injury in the thorax.

Ethic Approval

The study was approved by local ethics committee (approval number: B.30.2.ATA.0.01.00/418, date: 01.10.2020)

Authors' contribution

AG contributed to Conceptualization, data curation, formal analysis, investigation, methodology, supervision, writing-original draft and writing-review & editing. BKC contributed to data curation, methodology and software. ET contributed to formal analysis, supervision and writing-original draft. EO contributed to Conceptualization, data curation and resources. IO contributed to resources, validation and visualization. MAB contributed to resources, writing-original draft and writing- review & editing.

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References

1. Kim S, Endres NK, Johnson RJ, Ettlinger CF, Shealy JE. Snowboarding injuries: trends over time and comparisons with alpine skiing injuries. Am J Sports Med. 2012;40(4):770-6. doi: 10.1177/0363546511433279.
2. Allen JB. From Skisport to Skiing: One Hundred years of an American Sport, 1840-1940. Amherst: University of Massachusetts Press; 1996.
3. Ruedl G, Philippe M, Sommersacher R, Dünnwald T, Kopp M, Burtscher M. [Current incidence of accidents on Austrian ski slopes]. Sportverletz Sportschaden. 2014;28(4):183-7. doi: 10.1055/s-0034-1385244.
4. Price R. The Ultimate Guide to Weight Training for Skiing. Chicago: Price World Enterprises; 2008.
5. Deady LH, Salonen D. Skiing and snowboarding injuries: a review with a focus on mechanism of injury. Radiol Clin North Am. 2010;48(6):1113-24. doi: 10.1016/j.rcl.2010.07.005.
6. Hunter RE. Skiing injuries. Am J Sports Med. 1999;27(3):381-9. doi: 10.1177/0363546599027003
7. Hagel BE, Goulet C, Platt RW, Pless IB. Injuries among skiers and snowboarders in Quebec. Epidemiology. 2004;15(3):279-86. doi: 10.1097/01.ede.0000120044.62029.b4.
8. Brügger O, Bianchi G, Schulz D, Kisser R, Rogmans W. Snow-sport helmets: injury prevention, rate of wearers and recommendations. Bfu-Swiss Council for Accident prevention; 2010. Available from: http://www.bfu.ch/PDFLib/1383_74.pdf. Accessed September 23, 2013.
9. Ruedl G, Sommersacher R, Woldrich T, Pocecco E, Hotter B, Nachbauer W, et al. Who is wearing a ski helmet? helmet use on Austrian ski slopes depending on various factors. Sportverletz Sportschaden. 2010;24(1):27-30. doi: 10.1055/s-0028-1110011.
10. Coury T, Napoli AM, Wilson M, Daniels J, Murray R, Milzman D. Injury patterns in recreational alpine skiing and snowboarding at a mountainside clinic. Wilderness Environ Med. 2013;24(4):417-21. doi: 10.1016/j.wem.2013.07.002.
11. Shea KG, Archibald-Seiffer N, Murdock E, Grimm NL, Jacobs JC Jr, Willick S, et al. Knee injuries in downhill skiers: a 6-year survey study. Orthop J Sports Med. 2014;2(1):2325967113519741. doi: 10.1177/2325967113519741.
12. Stenroos AJ, Handolin LE. Alpine skiing injuries in Finland - a two-year retrospective study based on a questionnaire among Ski racers. BMC Sports Sci Med Rehabil. 2014;6(1):9. doi: 10.1186/2052-1847-6-9.
13. Çevik Y, Kavalci C, Ülke E. Retrospective analysis of skiing

injuries. Eurasian J Emerg Med. 2010;9(1):45-8. doi: 10.4170/jaem.2009.63626.
14. Aslan Ş, Aydınlı B, Uzkeser M, Öztürk G, Kandiş H, Yıldırımm ÖS, et al. Skiing injuries in Palandöken Ski Center: 156 cases. Eur J Gen Med. 2007;4(1):1-4. doi: 10.29333/ejgm/82412.
15. Costa-Scorse B, Hopkins WG, Cronin J, Bressel E. The utility of two national injury databases to evaluate snow-sports injuries in New Zealand. In: Scher IS, Greenwald RM, Petrone N, eds. Snow Sports Trauma and Safety. Champaign: Springer; 2017.
16. Mirhadi S, Ashwood N, Karagkevrekis B. Review of snowboarding injuries. Trauma. 2015;17(3):175-80. doi: 10.1177/1460408614543509.
17. Cattermole TJ. The epidemiology of skiing injuries in Antarctica. Injury. 1999;30(7):491-5. doi: doi: 10.1016/S0020-1383(99)00139-4.
18. Ogawa H, Sumi H, Sumi Y, Shimizu K. Skill level-specific differences in snowboarding-related injuries. Am J Sports Med. 2010;38(3):532-7. doi: 10.1177/0363546509348763.
19. Asikainen P, Lüthje P, Järvinen M, Avikainen V, Koskinen I. Downhill skiing injuries and their cost at a Finnish skiing area. Scand J Med Sci Sports. 1991;1(4):228-31. doi: 10.1111/j.1600-0838.1991.tb00301.x.
20. Chen N, Yang Y, Jiang Y, Ao Y. Injury patterns in a large-scale ski resort in the host city of 2022 Winter Olympic Games: a retrospective cross-sectional study. BMJ Open. 2020;10(11):e037834. doi: 10.1136/bmjopen-2020-037834.