

Analysis of Patients Coming to the Emergency Department with Snow Sports Injury

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ABSTRACT

Snow sports pose serious risks from minor soft tissue traumas to injuries of vital areas. For this reason, we think that the importance of the multidisciplinary approach of the emergency room doctors and to pay attention to the prehospital safety methods is absolutely necessary. The study included patients who applied to Erciyes University Faculty of Medicine, Department of Emergency Medicine between 01.11.2018 and 31.03.2019 with snow sports injuries. After snow sports traumas, the first application was in December and the most frequent application was in February with a rate of 37.3% (n=121). 1.06 patients applied daily and peaked with 4.32 patients daily in February. 56.2% (n=182) of the patients who presented to the emergency department with snow sports trauma were male and the mean age was 26.78 ± 10.83 (6–65) were professionals. According to the frequency of traumas of the athletes, ski, snowboard and sled use depended. The patients most frequently applied with extremity traumas, followed by head, spine, and trunk traumas. X-rays were used in extremity traumas, while CT imaging was preferred in head and trunk traumas. 93% (n=301) of the patients were discharged from the emergency department, 25.3% (n=82) were consulted, 7% (n=23) were hospitalized and surgical treatment was performed for 3.7% (n=12) of the patients.

Keywords: diagnosis methods and treatments after snow sports traumas, emergency service, snow sports in children and adolescents, snow sports, skiing accidents, sledding accidents, snowboarding accidents.

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I. INTRODUCTION AND PURPOSE

Snow sports (skiing, snowboarding, snow skiing, ice skating, ice climbing, curling, snow rafting, sledding) have become a popular means of recreation around the world and in Turkey, leading to an increase in injuries and patient admissions to the emergency department, especially in winter. (National Ski Areas Association, 2018). In children, adolescents and adults, there is a variety of trauma mechanisms and injury sites according to sport habits, education, sport equipment used and gliding style. So that patients can experience wide range of conditions from simple soft tissue injuries (STI) and extremity fractures to life-threatening internal organ damages such as subarachnoid hemorrhage (SAH), spleen injury, bowel perforation, large vessel injuries which can cause morbidity and mortality. (Ehrnthaller *et al.*, 2015, Ozen G *et al.*, 2017). Our aim in this study is to analyze patients who applied to the emergency department as a result of injuries, especially with sports such as skis, snowboards and sleds, depending on their demographic characteristics, clinical findings, imaging and laboratory examinations.

II. MATERIALS AND METHODS

A. Conducting the Study

In this retrospective and descriptive thesis, Patients who applied to Erciyes University Faculty of Medicine, Department of Emergency Medicine between 01.11.2018 and 31.03.2019 with snow sports injuries were discussed. Identification of patients was obtained using ICD diagnostic codes W02, W18, W19. The study was approved by the Erciyes University Clinical Research Ethics Committee (Date: 20.03.2019; No: 2019/188).

Patient's demographic information, sport equipment uses, injury mechanism, type of slip, person's experience, injury site, physical examination, vital signs, imaging-laboratory, diagnosis, consultation, and outcome (hospitalization/discharge/surgery) saved on the form and transferred to the computer.

B. Statistical Analysis

Descriptive statistics for data were analyzed using SPSS 25 Statistics version (IBM Corporation, New York, NY, USA) software program. After examining the distribution of the data with the Shapiro-Wilk test, the normally distributed variables were defined as the mean with the standard deviation (SD), while the median (1st Quarter–3rd Quarter) and categorical data were presented as n (%) for the non-normally distributed variables. Chi-square and t-tests were used among subgroups. A p value of <0.05 was considered significant in statistical analysis.

III. RESULTS

In our study, 324 patients who applied to Erciyes University Faculty of Medicine Emergency Service with snow sports injury between 01.11.2018-31.03.2019 were included. Although the snow sports season started in November, patients first applied to our emergency department in December and the most frequent application was in February, with a rate of 37.3% (n=121). The mean age of the patients was 26.78±10.83 (6–65). The median age was 24 (19–33) for ski users, 27 (22–35) for snowboarders, and 15.5 (13–20) for sled users. There is a significant difference between sled-ski, snowboard-sledge and equipment used in terms of average age. (p<0.05).

56.2% (n=182) of the patients were male. The sports equipment preferred by the athletes was skiing followed by 26.9% (n=87) snowboarding and 3.7% (n=12) sledding. The most common trauma in athletes is lower extremity trauma, the second is upper extremity trauma, followed by head, spine, chest, pelvis, and abdominal trauma. There was no significant relationship between the injury sites according to the sports equipment used (p>0.05) (Table I).

TABLE I: AGE/SEX/TRAUMA AREA/SLIP TYPE ACCORDING TO THE SPORTS EQUIPMENT USED

	Ski	Snowboard	Sled
Average age (1st Quarter-3rd Quarter)	24 (19–33)	27 (22–35)	15.5 (13–20)
Gender n(%);			
Male	125 (38.7)	52 (16)	5 (1.5)
Woman	100 (30.8)	35 (10.8)	7 (2.2)
Trauma area n(%);			
Head trauma	43 (13.3)	15 (4.6)	4 (1.2)
Spine trauma	22 (6.8)	9 (2.8)	1 (0.3)
Chest trauma	23 (7.1)	14 (4.3)	1 (0.3)
Abdominal trauma	6 (100)	0	0
Pelvic trauma	18 (5.6)	8 (2.5)	2 (0.6)
Upper extremity T.	70 (21.6)	29 (9)	2 (0.6)
Lower extremity T.	103 (31.8)	36 (11.1)	5 (1.5)
Slip type n(%);			
Alpine type	137 (42.3)	0	0
Slalom	3 (0.9)	64 (19.8)	0
Free style	32 (9.9)	15 (4.6)	0
Carving	53 (16.4)	8 (2.5)	0
Skid strap	0	0	12 (3.7)
Injury mech. n(%);			
Fall	173 (53.4)	68 (21)	8 (2.5)
Sprain	31 (9.6)	16 (4.9)	0
Collision	21 (6.5)	3 (0.9)	4 (1.2)

Data are expressed as n (%).

The athletes applied to the emergency service most commonly with a fall. Most of the athletes were doing alpine type skiing followed by slalom, freestyle, carving and sledding. There was a significant relationship between the type of slip and the sports equipment used (p<0.05) (Table I). Athletes with extremity injuries had 97.5% (n=239) STI/Joint dislocation. Most of them were amateur male athletes using ski. In athletes who presented with upper extremity traumas; radius fracture was the most common (14.85%(n=15)), followed by humerus, hand, and shoulder. In athletes with lower extremity traumas, tibia fracture was the most common (12.5%(n=18)), followed foot-ankle, knee and femur fractures. (Table II).

14.2%(n=4) of the athletes who presented with pelvic trauma had fractures. There were no cervical and thoracic vertebral fractures in athletes with spinal trauma, 3% (n=1) had lumbar vertebral fractures. Athletes with head-facial traumas were presented with 25.8% (n=16) cephalohematoma, there were 5.4% (n=4) facial bone fractures and 8% (n=5) intracranial pathologies. Athletes with thoracic trauma had 18.5% (n=7) bone fractures, 10.6% (n=4) lung injuries and there were no mediastinal or cardiac injuries. There was no

mediastinal or cardiac injury. No organ pathology was detected in 6 athletes with abdominal trauma. (Table II).

TABLE II: GENDER/SPORTS EQUIPMENT/EXPERIENCE INJURY RELATIONSHIP

	Male n (%)	Woman n (%)	Ski n (%)	Snowboard n (%)	Sled n (%)	Amateur n (%)	Professional n (%)
STI/Joint dislocation	136 (57)	103 (43)	164 (69)	65 (27)	10 (4)	216 (90.5)	23 (9.5)
U. extremity frac.	24 (54.5)	20 (45.5)					
Scapula	1 (0.99)	0					
Clavicle	4 (3.96)	2 (1.98)					
Humerus	4 (3.96)	6 (5.94)					
Radius	5 (4.95)	10 (9.9)	34 (77)	9 (20.5)	1 (2.5)	35 (79.5)	9 (32.5)
Ulna	3 (2.97)	1 (0.99)					
Carpal	2 (1.98)	0					
Metacarpal	3 (2.97)	0					
Phalanx	2 (1.98)	1 (0.99)					
L. extremity frac.;	17 (65)	9 (35)					
Femur	1 (0.7)	0					
Patella	1 (0.7)	0					
Tibia	11 (7.65)	7 (4.85)	21(80.5)	4 (15.5)	1 (4)	25 (96)	1 (4)
Fibula	1 (0.7)	2 (1.4)					
Metatarsal/phalanx	3 (2)	0					
Pelvis/sacrum frac.	1 (25)	3 (75)	2 (50)	2 (50)	0	4 (100)	0
Vertebral fracture	1 (100)	0	1 (100)	0	0	1 (100)	0
Cranium injury.	10 (38.5)	16 (61.5)					
Cephal hematoma	7 (11.2)	9 (14.6)					
Head bone fracture	0	1 (1.6)	19 (73)	6 (23)	1 (4)	25 (96)	1 (4)
Intracranial bleeding	2 (3.2)	3 (4.8)					
Facial bone fracture	1 (1.6)	3 (4.8)					
Thoracic injury.	8 (88.8)	1 (11.2)					
Sternum fracture	1 (2.6)	0	4 (44.4)	5 (55.6)	0	8 (88.8)	1 (11.2)
Rib fracture	5 (13.25)	1 (2.65)					
Pneumo/hemothorax	2 (5.3)	0					
Abdominal injury	3 (50)	3 (50)	6 (100)	0	0	5 (83.3)	1 (26.7)

Data are expressed as n (%).

In children and adolescents, boys were admitted most commonly falling after using alpine skiing, and there was a statistically significant difference in gliding styles when comparing children and adolescents with adults ($p < 0.05$). All of them were amateur athletes. In 60 patients who applied, the most common injury was lower extremity trauma followed by upper extremity, head-face, pelvis, spine, abdomen, and thorax traumas respectively. There was no statistically significant difference between the adults and the injury site ($p > 0.05$) (Table III).

TABLE III: DEMOGRAPHICS OF CHILD AND ADOLESCENT ATHLETES

	N (%)
Gender.	
Male	39(65)
Woman	21(35)
Sports equipment.	
Ski	51 (85)
Snowboard	3 (5)
Sled	6 (10)
Injury mech.	
Fall	48 (80)
Sprain	4 (7)
Collision	8 (13)
Extremity.	
STI	42 (70)
Joint dislocation	0
Slip type.	
Alpine type	41 (68)
Slalom	4 (7)
Free style	0
Carving	9 (15)
Skid strap	6 (10)
U. extremity trauma.	15 (25)
Radius frac.	2 (3.3)
Humerus frac.	3 (5)
Clavicle frac.	1 (1.7)
L. extremity trauma.	32(53,3)
Tibia frac.	8 (13.3)
Spine trauma	5 (8,3)
Chest/Abdominal/Pelvis Trauma	10 (16.5)
Head-Face	12 (20)
Cephal hematoma	1 (1.6)
Subdural bleeding	1 (.6)

Data are expressed as n (%).

After snow sports traumas in children and adolescents, 70% (n=42) of patients had STI, 10% (n=6) had upper extremity fracture, 13.3% (n=8) had lower extremity fractures, 3.3% (n=2) had pathologies due to head-facial trauma. There was a statistically significant difference in favor of children and adolescents compared to adults in lower extremity fractures. ($p<0.05$). There was no pathology in chest, abdomen, and spine trauma (Table III).

X-rays were the most common radiological imaging method for athletes who came with snow sports traumas, CT imaging was the second most frequent and USG imaging was less preferred. Laboratory tests were performed on 6.7% (n=22) of the athletes. (Table IV).

TABLE IV: IMAGING AND LABORATORY

	N (%)
Graph	
Head x-ray	11 (3.4)
Lung X-ray	13 (4)
Abdominal X-ray	5 (1.5)
Spinal X-ray	9 (2.7)
Pelvis X-ray	21 (6.4)
Joint X-ray	241 (74.3)
Computer tomography	
Brain CT	56 (17.2)
Thorax CT	30 (9.2)
Abdominal CT	11 (3.4)
Spinal CT	49 (15.1)
Pelvis CT	7 (2.1)
Extremity CT	42 (12.9)
Abdominal USG	5 (1.5)
laboratuvar	22 (6.7)

Data are expressed as n (%).

25.3% (n=82) of the athletes who applied with snow sports injury were consulted. Hospitalization was planned for 7% (n=23) of the patients and surgical treatment was done for 3.7% (n=12). 75.4% (n=244) of the discharged patients were adults and 17.6% (n=57) were children and adolescents. No statistically significant relationship was found between children and adolescents when comparing to adults at consultation, surgery, discharge, and hospitalization ($p>0.05$) (Table V).

TABLE V: CONSULTATION AND OUTCOME OF THE PATIENTS

	Child/Adolescent n (%)	Adult n (%)	Total n (%)	P value
Consultation	16 (4.9)	66 (20.4)	82 (25.3)	$p>0.05$
Surgical	1 (0.3)	7 (2.2)	8 (2.5)	
Urgent	1 (0.3)	3 (0.9)	4 (1.2)	
Elective				
Conclusion	3 (0.9)	20 (6.1)	23 (7)	
Admission	57 (17.6)	244 (75.4)	301 (93)	
Discharge				

Data are expressed as n (%).

IV. DISCUSSION

Every year during the winter months, due to snow sport injuries patients are restricted from their daily activities and their health is affected in the long run.

In a study by Westin *et al.* (2012), between 2006 and 2011, injuries were reported between 1.7–3.11 per skier day. In this study, although similar results are seen, especially in February, with the effect of the semester break of the education period; there was an increase in the injury rate.

In a study in literature, the mean age for the whole population was 36 ± 16 , the mean age for snowboarders was 23 ± 8 , for skiers the mean age was 41 ± 16 (Wasden, C *et al.*, 2009), while the mean age for sled users in the study of Heim *et al.* (2014) was 22 (14–38). In this study, Although the mean age of snowboarding athletes was similar to other studies, ski and sled users were younger, which can indicate that skiing and sledding are more frequently preferred in children, adolescents and young people.

In the study conducted by Basques *et al.* (2018), the rate of total male athletes was reported as 74.4%. In this study, the fact that there are close ratios in gender and sports equipment preference reveals that women's interest in snow sports has increased and they are gradually adopting it.

In the literature, while injuries as a result of falling on amateur or professional athletes are very common in ski, snowboard and sled use, sprains and collisions have been reported as other causes of injury. (Hagel,

B. *et al.*,2004). Although we have obtained similar results in this study, we think that the reliability and validity of the results we obtained decrease as the skill level changes relatively from person to person.

It has been reported that lower extremity injuries are more common in skiers, while upper extremity injuries are more common in snowboarders (Coury, T. *et al.*,2013). In the study of Nakaghuci *et al.* (1999) it was reported that head trauma was more common in snowboarders, and in another study abdominal trauma was more common (Wasden, C. *et al.*, 2009). Prall *et al.* (1995) suggested that thoracic injuries are more common in skiers than snowboarders. In the study of Ogawa *et al.* (2010), fractures in the pelvic and sacrum region were observed more frequently especially in snowboard users. Although the frequency of injury sites was similar in this study, no specific injury site difference was found according to the experience of the athletes, gender, and type of sport equipment used. The recent increase in the use of snowboards in our country and the popularity of skiing is still higher than snowboarding, and the fact that novices prefer skiing more and ski more cautiously while using snowboard may have caused no difference in injury areas.

In the study of Idzikowski *et al.* (2000), while wrist fractures were the first among upper extremity injuries in snowboarding athletes, it was followed by shoulder and clavicle. In another study, clavicle fractures were frequently observed in men skiers, while humerus fractures were the second most common (Dohjima, T. *et al.*, 2001). In this study, we found that humerus and clavicle fractures due to shoulder traumas were more common in skiers compared to snowboarders, and we detected radius fractures were more common in skiers than in snowboarders. However, it can be thought that the widespread use of skiing compared to snowboarding in our country has a share in this. It may be related to the fact that men continue to use the ski pole while falling, and women receive the blow on their wrists and shoulders as a result of leaving the pole.

Tibia fractures still account for the majority of all ski-related injuries. Sulheim *et al.* (2011) reported that beginners, children, or adolescents are at higher risk than older skiers. Patton *et al.* (2010) found that tibia and fibula fractures were more common in snowboarders than skiers. In this study, we detected lower extremity traumas more in skiers; While tibia fractures took the first place, it was followed by foot and ankle fractures. While in children and adolescent's tibia fractures observed more frequently due to falling while skiing, injuries related to traumas in the knee area were more common in women. Contrary to the rest of the world, we think that the reasons for the frequent occurrence of lower extremity injuries in snow sports injuries in our country are the equipment or ski training is not given enough attention and the appropriate track selection is not made according to the experience.

In the study of DeFroda *et al.* (2016) they found that pelvic and sacrococcygeal region injuries were more common in snowboard users compared to skiers. In this study, although most of those with pelvic trauma were caused by ski use, sacrococcygeal fractures were found to be more common in novice female athletes due to snowboard use, which is consistent with the literature. We think that women who use snowboards are more susceptible to fractures in injuries of this region due to reasons such as direct blow to the sacrococcygeal region, weak ligamentous and muscle structures compared to men, and the difference in the shape of the pelvis.

Studies have reported that repetitive injuries are an important problem for spinal trauma in alpine-style skiers who are novices and who have not received a course training (Haaland, B. *et al.*, 2016). In this study, parallel results were obtained with these findings.

In another study it's mentioned that the adolescent and young population's tendency to take risks such as speed and acrobatics is an important factor for head trauma (Ruedl, G. *et al.*, 2010). In the study of Fukuda *et al.* (2001), they mentioned that head traumas in skiers are related to collisions, and therefore, facial trauma is more common. In the present study, it was observed that the most frequent victims of head and facial trauma were novice skiers presenting with a fall; It can be thought that the reason for this is that the use of snowboard is less, and the athletes try to be more careful because they are just starting out, and they avoid risky movements in the use of snowboards. It was observed that the use of helmets was not sufficient in athletes presenting with head trauma. TBI and facial trauma were found to be serious in these patients.

It is reported in literature that although thoracic traumas are rare, they take the second place in fatal ski accidents (Lochner SJ. *et al.*, 2015). It is also reported that falls and thoracic trauma were observed in young inexperienced snowboarders after jumping (Machida, T. *et al.*, 1999). Similar to the literature, thoracic traumas were less common in this study. However, thoracic traumas were mostly encountered in novice male skiers, which may have been due to trying to throw themselves on the ground instead of colliding.

According to a study in a literature, abdominal traumas as a result of falling after jumping are more common in novice, young and newly started snowboarders compared to skiers, and it is mentioned that abdominal traumas are seen with falling forward in skiers (Yamakawa, H *et al.*, 2001, Sutherland, A. *et al.*, 1996). In this study, all patients with abdominal trauma were young skiers, and no gender differences were found. We think that the reason for the lower incidence of abdominal trauma in athletes may be due to the fact that the extremities are used for protection during falls and the athletes do not pay much attention to these injuries.

Similar studies reported that sled traumas constitute 2–25% of snow sports traumas and that extremity injuries followed by head and spine especially in children are the most common (Heim, D. *et al.*, 2014). Grober *et al.* (1998), contrary to popular belief, mentioned that adults were injured significantly in sled traumas. This study showed parallelism with these findings. It is seen that the use of helmets in children is low and head traumas in sled accidents have an important place in our patients.

It has been shown that most of the snow sports traumas in children are the result of falls and collisions in novice skiers (Chaze, B., & McDonald, P., 2009). Although injuries related to lower extremity traumas in skiers have decreased in adults in recent years, this was not observed in children and adolescents in the studies of Johnson *et al.* (2009). In this study, similar to the literature, since ski use is more common in children and adolescents than snowboarding and the musculoskeletal system has not reached full maturity, lower extremity injuries were more common as we expected. The decreased use of helmets in adolescents due to cost, friend acceptance or as risk taking is seen as fun may have caused the frequent incidence of head-facial trauma.

Wick *et al.* (2010) reported that the use of low-dose CT has increased against X-rays, especially in recent years. In studies in the literature, it has been emphasized that the use of whole-body CT has increased and its importance in diagnosing especially in disorganized patients due to head trauma and athletes with multiple traumas, although conventional imaging and ultrasound are the primary choices in emergency services in patients with snow sports traumas (Wick, M. C. *et al.*, 2009, Rozycki, G. S. *et al.*, 1993). In this study, while the use of conventional X-rays in extremity traumas is common; CT is mostly preferred in head, thorax, and abdominal traumas. Today, with the development of imaging devices and the emergence of defensive medicine due to legal processes, we can say that physicians have turned to CT examination especially in head, face, and trunk traumas.

There is very little data in the literature about the necessity of consultation in the relevant branch of the patients who come to the Emergency Department with snow sports traumas and the rates of surgery / hospitalization. Ehrnthaller *et al.* (2015) conducted a study on treatment, complications and requirement of reoperation in patients presenting with snowboard injuries. In this study, the majority of fractures due to extremity traumas and those with imaging findings and high-energy trauma in head-face, spine, pelvis, thorax and abdomen injuries were consulted to the relevant branch, and only a few patients required hospitalization and surgery. It was observed that all those who needed surgery had extreme injuries.

V. CONCLUSION

Snow sports attract millions of people every year by increasing their popularity and pose serious risks ranging from simple STI to vital organ damage. Although it is important to bring new standards to equipment, to increase track safety measures and to start giving the necessary attention to the training of athletes, it is also necessary for the athletes to comply with these. Although the single-center and retrospective nature of our study limits us, the data we obtained are largely consistent with the literature. We emphasize the importance of multidisciplinary approach of emergency room physicians in patients who admitted with trauma after sporting entertainment, which may have high mortality and morbidity and also it is absolutely necessary to pay attention to prehospital safety methods.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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