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RESEARCH ARTICLE

Snow Catastrophe Conditions: What is its Impact on Orthopedic Injuries?

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Abstract

Background: Iran places sixth amongst high risk natural disaster countries and Guilan province of Iran shoulders a large amount of socio-economic burden due to snow catastrophes. The more knowledge of circumstances we have, the more efficient our future encounters will be.

Methods: In this retrospective study, of all of the patients admitted to Poursina Hospital due to snow and ice related trauma in the first two weeks of February 2014, 306 cases were found eligible for entry into the present study.

Results: Of the 306 eligible patients (383 injuries), there were 175 men (57.2%) and 131 women (42.8%). Most patients suffered from orthopedic injuries (81%) and the most common fractures were distal radius fractures in the upper extremities and hip fractures in the lower extremities. Slipping was the most common and motor vehicle accidents had the rarest injury mechanisms. It was shown that the frequency of injuries were higher on icy days (67.6%) than snowy days (32.4%).

Conclusions: Snow crises may lead to increased risk of slipping and falling situations, especially on icy days. The peak of injury rates is a few days after snowfall with the most common injury being distal radius fracture. Providing essential instructions and supporting resource allocation to better handle such catastrophes may improve outcomes.

Key words: Epidemiology, Fractures, Natural crisis, Orthopedic trauma, Snow, Snow Trauma, Trauma

Introduction

Iran ranks as a high risk natural disaster country, placing sixth among other countries and the memory of recent earthquakes, sandstorms, and snow catastrophes are examples of such disasters. Supervenient events affect 150,000 individuals annually and in our country only 3% of the cities are considered to be low risk. The incidences of the three snow crises in Guilan province in recent years that hampered people's lives for weeks and left a large amount of financial and life casualties was quite considerable. Additionally, the most recent snow crisis caused more than USD 50 million to infrastructures, residential buildings, local orchards and their products.

Detailed knowledge of these crises and imparting knowledge from previous experiences will provide us with better and more cost effective approaches for future catastrophes (1). During a snow crisis, the pattern and mechanism of injuries alter due to changes in traffic patterns and this increases slipping and falling risks (2-4). Since there is no such study about the incidences of snow related trauma in our country, the present study seeks to evaluate and analyze snow injuries on February 2014 in order to implement safety measures and prevent further trauma in future catastrophes.

Materials and Methods

In this retrospective descriptive study, all of the patients who were admitted to Poursina Hospital due to snow related trauma in the first two weeks of February 2014 were evaluated for eligibility into our study. Precise registration and data recording was emphasized to the staff. Patients with incomplete medical files and/or superficial injuries (bruise, contusion, or laceration) and

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Table1. Mechanism of injuries in anatomical sites

	Mechanism of injury				
	Slipping (%)[α]	Falling (%)	MVA[β] (%)	Others (%)	Overall
Upper limb	185 (82%)	15(7%)	0(0%)	26(11%)	226
Lower limb	71 (82%)	10(11%)	0(0%)	6(7%)	87
Head & neck	26(46%)	23(42%)	8(14%)	0(0%)	57
Trunk	3(23%)	10(77%)	0(0%)	0(0%)	13

[α]. The number in parentheses are demonstrated the percentage of the injury in every anatomical site
[β]. MVA: motor-vehicle accident

dislocations were excluded from the study. Demographic characteristics such as age and gender and other findings (mechanism and anatomical site of injury) were collected from the patients' medical files. Then the patients were sub-categorized based on the day of admission (snowy day or icy day). The first three days after commencing snowfall was considered as snowy days and the fourth to seventh days after snowfall were considered as icy days. Eventually, there were 383 injuries (306 cases) that were categorized based on mechanism of injury (slipping, falling, vehicle accident, and others).

Results

Of the 306 eligible patients (383 injuries), there were 175 men (57.2%) and 131 women (42.8%). The most common anatomical sites of injury included 226 cases of upper extremities (59%), followed by 87 cases of lower (23%) extremities (23%), then the head and neck with 57 cases (15%) and lastly the trunk with 13 cases (3%).

The most common fractures among the upper extremities were 124 cases of distal radius fracture (32% of all fractures), 32 cases of forearm bone fracture (8% of all fractures) and 10 cases of humerus fracture (3% of all fractures). The ranking in lower extremity fractures included 45 cases of hip fracture (12% of all fractures), 44 cases of ankle fracture (12% of all fractures) and 11 cases of tibia fracture (3% of all fractures) (Figure 1).

The frequency of injury on snowy days was 124 cases (32.4%), while for icy days there were 259 injuries (67.6%); icy days significantly resulted in more injuries than snowy days (P<0.001). The mean fracture rate per day was 54.7 cases which was 4.5 times more than a similar time two years ago (11.6 fractures per day). Once again, mean fractures per icy days (64.6 fractures per day) was more than snowy days (41.3 fractures per day) (P<0.001).

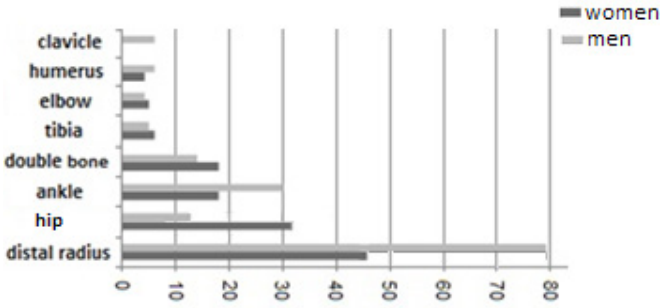

Figure 1. Anatomical sites of injury in male/female cases.

The frequency of mechanism of injury related to the snow crisis is shown in Table 1. The mean age of lower and upper extremity fracture was 47.7±17.9 and 44.4±20.6 respectively (P>0.05). Frequency of lower limb fractures was more than upper limb fractures among those patients over 65 years.

The incidence of all fractures in men was significantly more than women (P<0.0001). In the lower limb sub-category there still was significant difference (P=0.002); however, the incidence of upper limb fractures was similar between male and female patients (P>0.05). The most common mechanism of injury was slipping and the rarest was motor vehicle accidents.

Discussion

Increased rate of falling and slipping after a snow crisis was evaluated in several European studies. Ralis et al. reported an increase of 2.58 times in fracture rate in a four-day period after snowfall in Cardiff (5). The elderly, especially older women, are the main victims because they had a higher percentage of these types of fractures. Upper limb fractures were reported in 59% of cases with the most common ones being distal radius fractures, which is comparable to our findings. Ralis et al. gathered the results of six similar studies and they concluded that there was an increase (4.5 times more than usual) in fracture rates, which is consistent with our results (6). In a study in Norway the higher frequency of fractures unrelated to motor-vehicle accidents on snowy winter days were documented (7). Thirty-nine percent of fractures were due to slipping on the ice or snow and 45% of those cases suffered from upper extremity fractures. In a review by St. Lewis, the frequency of slipping and falling cases on icy and snowy days were 79% and 53% respectively. Elbow or lower limb fractures were observed in 53% of cases and lower limb fracture rates were documented to be 31% during icy days (8).

In addition to freezing temperature, which may increase risk of injuries, there are other hypothetical mechanisms that facilitate fracture occurrence in cold seasons, such as reduced exposure to sunlight leading to reduced synthesis of vitamin D and subsequent osteomalacia and

decreased activity and concomitant increased bone loss (9, 10).

During the first stage of ice formation, the surface of ice is uneven due to subsiding snowflakes and subsequent decrease in temperature at night prevents the snow from defrosting. With an increase in temperature the next day, the ice surface thaws and again it becomes frozen at night. This mechanism forms a smooth and plain layer of ice that increases the rate of slipping and falling. On the first day of a snow crisis, a large percentage of people may stay at home; however, as time passes, people start to come out onto the icy walkways and streets and according to Lewis et al.'s study in 1994, the peak days of trauma may occur on the sixth day after snowfall (4, 8, 11).

Slipping fractures are more common during the icy rather than snowy days, so one may conclude that every maneuver that could increase the coefficient for friction (such as sand spreading on icy surfaces and wearing suitable shoes with ankle protection) may result in lower fracture rates (12, 13).

Conclusion

Improving friction on icy by wearing appropriate shoes and boots with better outsoles or the spread of sand may efficiently reduce the slipping risk. In order to decrease the frequency rates of injuries on peak days (icy days: 3-6 days after snow), it is recommended to empower the public, especially the elderly, by providing them with essential instructions so that they can avoid such catastrophes, which may lead to improved outcomes.

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