

Vancouver winters: Environmental influences on inpatient adult orthopaedic trauma demographics

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Abstract

Objective: To compare the pattern of adult inpatient orthopaedic injuries admitted at three Vancouver hospitals following one of the worst winter snowstorms in the region with the preceding control winter period.

Methods: The surveillance study was conducted at the University of British Columbia, Vancouver, Canada, 2007 to 2010. Inpatient adult admissions for orthopaedic injuries at three hospitals were recorded, including age, gender, anatomic location of injury, type of fracture (open or closed), fixation method (internal versus external fixation), and length of acute care hospital stay. Comparisons between admissions during this weather pattern and admission during a previous winter with minimal snow were made. SPSS 19 was used for statistical analysis.

Results: Of the 511 patients admitted under Orthopaedic trauma service during the significant winter snowstorms of December 2008 - January 2009, 100 (19.6%) (CI: 16.2%-23.2%) were due to ice and snow, whereas in the preceding mild winter only 18 of 415 (4.3%) (CI: 2.5%-6.8%) cases were related to snow ($p < 0.05$). Ankle and wrist fractures were the most frequent injuries during the index snow storm period ($p < 0.05$). At all the three institutions, 97 (96.5%) fractures were closed during the snowstorm as opposed to 17 (95%) during the control winter period. Internal fixation in 06 (89%) fractures as opposed to external fixation in 12 (11%) patients was the predominant mode of fixation across the board during both time periods.

Conclusion: The study demonstrated a significantly higher inpatient orthopaedic trauma volume during the snowstorm. More rigorous prospective studies need to be designed to gain further insight to solving these problems from a public health perspective.

Keywords: Fracture, Trauma, Surveillance, Winter, Snowstorms. (JPMA 64: 549; 2014)

Introduction

The public health effects of low temperatures, including significant increases in mortality rates, have been well documented.^{1,2} Specifically, the increased risk of falls and specific orthopaedic injuries in cold weather and icy conditions have been documented in several studies in the United Kingdom, the United States, and elsewhere.^{1,3-10} Many of these studies have focussed on the seasonal variations in injury rates in climates with cold winters.^{8,10}

Vancouver, British Columbia, is a large urban centre on the pacific coast of Canada, known for its mild winters. In the 'lowest snowfall' category, Environment Canada has ranked Vancouver in 3rd place among 100 major Canadian cities.¹¹ As such, even small amounts of snow in the Vancouver area can cause school closures, as well as produce significant traffic problems. Furthermore, the low frequency of snowfall makes it hard to justify the extensive public works infrastructure necessary for more

effective snow removal. Because snow is so infrequent, snowfall levels considered routine or mild in other parts of Canada can be relatively catastrophic in Vancouver.

This study aimed to review the inpatient orthopaedic trauma burden in two consecutive winters in three major tertiary care hospitals of Vancouver. The objective was to evaluate the patterns of orthopaedic injury seen in 3 Vancouver hospitals during an extensive period of snow, and to compare this to those seen during a similar period in winter with more typical mild conditions.

Subjects and Methods

The surveillance study was conducted at the University of British Columbia, Vancouver, Canada, from 2007 to 2010 and comprised inpatient adult admissions for orthopaedic injuries at three hospitals.

This study was developed based on two consecutive winters in the Vancouver area. The first period of significant snow developed from several winter storms during December 13, 2008, to January 31, 2009. The most recent White Christmas occurred in Vancouver in December 2008 after weeks of record breaking cold temperatures and consecutive snow storms that left over 60cm of snow on the ground across Metro Vancouver.

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New snow also accumulated on Christmas Eve and Christmas Day, giving it the title for Canada's whitest Christmas in 2008 with 41cm on ground (48cm at one point on Christmas Eve). Secondary roads and sidewalks were all snow-covered for several weeks. The control period was the preceding winter from December 13, 2007, to January 31, 2008, when Vancouver barely received any snow.

Orthopaedic inpatients admitted to three hospitals in Vancouver, including Vancouver General Hospital (VGH), Lions Gate (LG) and Richmond hospital (RH), were included in the study using the Ministry of Health database. Patients were included if a fall on ice and snow was indicated as the chief complaint at registration, in the nursing note, or in the patient database. Patients were excluded if they had fallen but with no indication that it had been on ice or snow. Approval for the study was obtained from the institutional ethics review board governing the three hospitals prior to the start of the study.

Data including age, gender, anatomic location of injury, type of fracture (open or closed), fixation method (internal versus external fixation) and length of stay (LOS) were tabulated. Differences between the groups were assessed by Chi square test, t test, Wilcoxon rank sum test or Fisher's exact test depending on the type of variables. All statistical analyses were performed using SPSS 19.0. Statistical significance was set at $p < 0.05$.

Results

Of the 511 patients admitted under orthopaedic trauma service during the winter snowstorms of December 2008 - January 2009, 100 (19.6%) (CI: 16.2%-23.2%) were due to ice and snow whereas in the preceding winter only 18 of 415 (4.3%) (CI: 2.5%-6.8%) cases were related to snow ($p < 0.05$) (Table-1). All the three institutions, 97 (96.5%) of the fractures were closed during the snowstorm as opposed to 17 (95%) during the control winter period. The number of cases admitted separately at the three individual hospitals during the two study periods were also tabulated separately (Tables-1 & 2). Lower limb fractures were more common at VGH and LG hospital, whereas there was a slight preponderance of upper limb fractures at RH during both winters (Table-2). Ankle and wrist fractures were the most frequent injuries during the index snow storm period. This data has not been shown separately to avoid redundancy. However, there were 3 wrist fractures in 2008 vs 14 wrist fractures in 2009, and 4 ankle fractures in 2008 vs 36 ankle fractures in 2009 at all the 3 hospitals combined ($p < 0.05$).

The mean LOS for these orthopaedic inpatients was the shortest at RH for both time periods and most patients at VGH and RH were discharged to home, since inpatient rehabilitation facilities were available at these centres. The increase in mean LOS at LGH was multifactorial. Delays in transfer to rehab facilities were partly responsible for this.

Table-1: Details of cases presenting in mild versus heavy snowstorm winters in three Vancouver hospitals.

	Light snow storms (Dec 2007 - Jan 2008)			Heavy snow storms (Dec 2008 - Jan 2009)		
	Vancouver General	Lions Gate	Richmond	Vancouver General	Lions Gate	Richmond
Total trauma cases	89	185	141	119	204	188
Number snow related trauma cases	9	6	3	52	17	31
% of snow-related trauma cases *	10.1	3.2	2.1	43.7	8.3	16.5
Male:Female	1 : 0.8	1 : 1	3 : 0	1 : 1.6	1 : 2.4	1 : 1.4
Mean (\pm SD) age of snow-related trauma cases	58.0 \pm 13.9	54.8 \pm 18.6	41.3 \pm 11.9	56.6 \pm 14.7	57.8 \pm 20.4	57.7 \pm 16.5
Age range	41-81	35-72	28-51	39-80	41-87	16-87
Mean Length of stay of snow-related trauma cases	4.2 \pm 2.6	3.0 \pm 1.4	1.3 \pm 0.6	3.7 \pm 3.3	6.2 \pm 7.4	3.1 \pm 4.0
Discharged to home: discharged to rehab facility	1: 0.12	1: 0.2	1:0	1: 0.16	1: 0.13	1: 0.11

* $p < 0.05$.

Table-2: The number of snow-related trauma cases and their anatomic localisation in mild versus heavy snowstorm winters in three Vancouver hospitals.

	Light snow storms (Dec 2007 - Jan 2008)			Heavy snow storms (Dec 2008 - Jan 2009)		
	Vancouver General	Lions Gate	Richmond	Vancouver General	Lions Gate	Richmond
Upper limb fractures, n (%)	4 (44.4)	2 (33.3)	2 (66.7)	17 (32.7)	4 (23.5)	17 (54.8)
Lower limb fractures, n (%)	5 (55.6)	4 (66.7)	1 (33.3)	35 (67.3)	13 (76.5)	14 (45.2)
Total fractures, n (%) *	9 (100)	6 (100)	3 (100)	52 (100)	17 (100)	31 (100)

* $p < 0.05$.

Discussion

The winter of 2009 in Vancouver was known to be one of the most significant ones that the province has seen to date in the last 30 years in terms of the amount of snow that it received. For a realistic assessment of the increase in orthopaedic trauma during the snowstorms, we selected a similar time period during winter of the preceding year since the flow of patients during different months is specific particularly around New Year.

Overall, the number of fractures sustained during the winter 2009 snowstorms was significantly higher than those sustained during the control periods. The increase in certain specific fractures was particularly dramatic, including ankle fractures. The sheer number of orthopaedic injuries became overwhelming during the inclement weather. Ralis⁵ studied two winter periods as in our study, and reported two-and-a-half times increase in the number of fractures during the winter epidemic in Cardiff when compared with a control time period. One of the limitations of this study is that we only analysed inpatient data to look at the operative burden. However, the total of all snow injuries was much higher, since a substantial number of people who were treated in emergency and outpatient visits for sprains, bruises, contusions, lacerations and joint injuries were not included in this study. This data includes cases that occurred due to a fall on snow or ice and does not include injuries due to motorbike or vehicle skidding or failure of brakes due to slippery surfaces or poor visibility which may underestimate the true impact. Also potential confounding factors such as type of activity, footwear, and physical fitness could not be assessed due to the retrospective nature of the study. Furthermore, this study does not take into account long-term rehabilitation issues and treatment of complications as a result of the snowstorm.

The structure and financing of the healthcare system is of paramount consideration when planning for the future. In the new millennium, society faces difficult choices in terms of allocation of scarce resources for different facets of medical care. In a country with universal access to healthcare, there may be a tendency to focus more on cure because of its immediate benefits. The hospital arrival of casualties on a large scale within a short period has the character of a "major accident" - except that the injuries can be predicted and are spread over several days. In Vancouver, we had to deal with these sudden, yet predictable epidemics of snow-and-ice casualties. To decrease the burden of injuries from a public health preventive perspective pedestrians need to pay more

attention to weather forecasts during such times. Our objective is to draw attention to this epidemic increase in the number of orthopaedic injuries in the part of the country not used to snow and the preventability of this potentially disastrous event.

With respect to the management of these injuries, because they are predictable based on weather forecasts, the health authorities can plan strategies to ensure smooth operations.⁵ Moreover, as the arrival of patients is spread through days rather than hours or minutes, one can easily chalk out effective operative measures including staff and materials/facilities management. Unlike in other types of a major accident, one does not usually have to arrange a rescue operation for the "disaster site", nevertheless many patients would require professional first aid at the site of injury. These patients represent an increased burden for the ambulance and transport services, medical staff especially those in emergency, surgery, radiology, anaesthesia, orthopaedic wards, fracture clinics and operating rooms. Being proactive therefore would be of paramount importance to streamline patient flow, rather than to react to the ground realities once we are face to face with such a hazardous situation.

Our data represents the first analysis of inpatient orthopaedic fractures related to snowfall in western Canada using a dataset of inpatient orthopaedic admissions. Compared with dry days, snow days are associated with an increased number of fractures. In one study,¹² 258 patients came to one of four participating hospitals in St. Louis, Missouri, during the snow period with a snow-related injury, while patients were seen for ice-related injuries at the same hospital during the ice period ($p < 0.05$). These results suggest that the population need to make appropriate modifications in their indoor and outdoor activities to mitigate the number of injuries. Because of the small sample size it was not possible to calculate the fracture rate in different age groups. However, the data shows a trend of fractures more in the age groups over 50. One of the potential for changes in the injury panorama around the age of 50 is the development of osteoporosis. Interestingly, a study reported a significant effect of winter on propensity of hip fractures in Taiwan.¹³ For this elderly age group, organizing assistance with shopping, snow clearing and sanding for older persons, as well as organising a transport service for them would decrease their risk of slipping and potential fractures. With the large number of fractures, orthopaedic surgeons should plan a standby disaster-type call schedule during predictions of extensive snowfalls.

Conclusion

More rigorous prospective studies need to be designed to gain further insight to solving problems of orthopaedic nature during natural calamities from a public health perspective.

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