



## SLIPPING ON ICE AND SNOW—ELDERLY WOMEN AND YOUNG MEN ARE TYPICAL VICTIMS

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(Received 29 December 1995; in revised form 28 July 1996)

**Abstract**—Slipping on ice or snow during winter caused 3.5 injuries per 1000 inhabitants per year in the Umeå health district; the injury rate was highest among the elderly. Most injured were elderly women, but also many young men in the age group 20–29 years were injured. Half of all injuries were fractures; for women 50 years and over two-thirds were fractures, mostly of an upper extremity. The ‘cost’ of medical care of these slipping injuries was almost the same as the ‘cost’ of all traffic injuries in the area during the same time. Injury reducing measures, such as more effective snow clearing, sand and salt spreading in strategic areas, better slip preventive aids on shoes, and ‘padding’ of older women, would reduce the injuries and their consequences. © 1997 Elsevier Science Ltd. All rights reserved

**Keywords**—Fall injuries, Slipping, Ice/snow

### INTRODUCTION

Many injuries treated at medical centers and hospitals are the results of falls. These are especially common during winter, when slippery conditions prevail (Nilsson, 1986). Snow and ice conditions are present in the northern part of Sweden during almost half the year. This type of injury event has also been reported in other Nordic and European countries, e.g. Denmark and England (Avery, 1982; Manning et al., 1982; Merrild and Bak, 1983; Ralis, 1986; Billesbolle et al., 1989; Ralis, 1981).

The aim of the present study was to analyze some epidemiological factors connected with injuries incurred by slipping on ice and snow. The consequences were also analyzed in order to compare them with the consequences of other types of injury.

### MATERIAL AND METHOD

The results are based on hospital injury data (inpatients and outpatients) collected over a 1 year period at the University Hospital of Northern Sweden in Umeå. This is the only hospital serving a well-defined area of about 60 km around Umeå. Overlap with the neighboring health district served by other hospitals is negligible due to a sparse rural popula-

tion. The general practitioners in the Umeå area have their doctor on duty in the hospital's emergency section. It is estimated that almost everybody, especially those with non-minor injuries, from the area is treated at the hospital and would thus be included in the material. The area had 118,544 inhabitants, 58,713 men and 59,831 women of whom, respectively, 16,349 and 18,569 were 50 years of age or older.

All persons injured in association with slipping on ice or snow outdoors were included in the sample. Only falls that occurred on the ‘same level’ or on steps outdoors were included in the sample. Falls from, for example, a roof or from a ladder slipping on ice were not included. The injured persons answered a questionnaire asking when, where and how the injury occurred. Further information was obtained from the hospital's patient medical records and sickness benefit records. The calculation of the use of medical care in the acute phase included both inpatient and outpatient treatment and is based on the mean operational cost for different departments in 1993. The patients were followed up until 1 year after the injury event.

The severity of the injuries was graded according to the Abbreviated Injury Scale (AIS) (Committee of Injury Scaling, 1990), where MAIS denotes Maximum AIS, i.e. the AIS-value of the most serious injury on a scale from 1 to 6.

SEK is Swedish Crowns and USD is U.S. dollars.

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## RESULTS

### *Injury rate, age and sex distribution*

A total of 415 persons were treated, equaling an injury rate of 3.5 cases per 1000 inhabitants per year. The fracture rate was 1.7 per 1000 inhabitants per year. The injury rate was highest for elderly women (see Table 1). The injury rate was on average 5 per 100 000 inhabitants per day during the 10 days with the highest injury frequency (maximal day rate 7).

The 415 injured comprised 253 (61%) women and 162 (39%) men. The age distribution is shown in Fig. 1. The injury frequency was highest in the age groups 50–79 years ( $n=143$ ; 34%) for women, and for men it was highest in the age group 20–29 years. In the age groups 50–79, more than twice as many women (143) as men (63) were injured. The injury rate for women and men was quite even under the age of 50 except for teenage girls whose rate was high (Tables 1 and 2).

### *Time distribution*

The injuries occurred rather evenly during the winter months November–April. On Sundays, an equal number of men and women were injured, while 78% more women (237) than men (133) were injured during the remaining weekdays. Most injuries occurred during leisure time; 4 women and 19 men were injured during their working hours and 13 schoolgirls and 8 boys during their school hours. During the night, between 00.00–06.00 hours, there

Table 1. Injury rate for women and men in different age groups, per 1000 inhabitants per year

Age group (years)	Women	Men	Total
0–9	0.7	0.9	0.8
10–19	4.6	1.7	3.2
20–29	2.2	3.2	2.7
30–39	2.9	2.5	2.7
40–49	2.6	2.3	2.5
50–59	8.2	2.2	5.2
60–69	9.7	5.5	7.7
70–79	9.3	6.4	8.0
80–89	3.3	4.3	3.6
Mean	4.2	2.8	3.5

were 25 (7%) persons injured, 15 of these 25 were aged between 20 and 29 years of age, and 11 of these 15 were men.

The majority ( $n=314$ ; 76%) of the injured sought medical attention within the first 24 hours after the injury, 91 (22%) 1–4 days after the injury, and 10 (2%) after 5 days or more.

### *Place of incident*

Table 2 shows the places where the various incidents occurred. For persons under 50 years of age, there was no particular difference between women and men regarding the place of accident. In the age group 50–59 years, approximately five times more women than men were injured on a pavement, street or road. Most of the injury events occurred when the

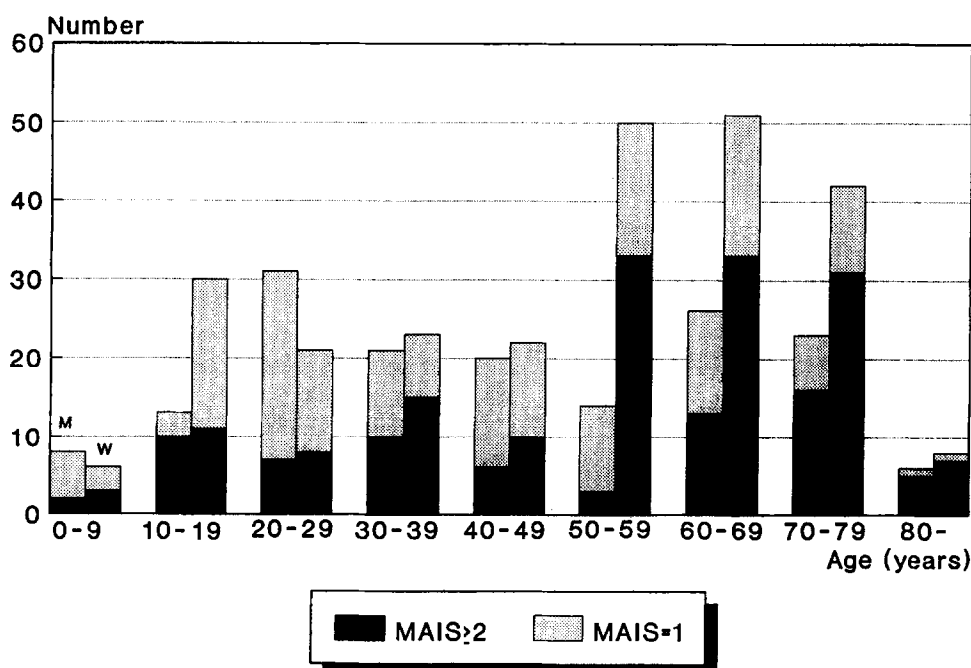


Fig. 1. Distribution by age, sex and injury severity.

Table 2. Place of injury events and injury rates for women and men over and under 50 years of age

Place	Age < 50 years		Age ≥ 50 years		Sub-total		Total
	Women	Men	Women	Men	Women	Men	
Pavement, street, road	42	36	82	36	124	72	196 (47%)
Yard	16	20	37	10	53	30	83 (20%)
Parking, business area	12	14	15	3	27	17	44 (11%)
Outdoor stairs	10	3	6	5	16	8	24 (6%)
Field, forest, path, slope	8	5	3	4	11	9	20 (5%)
Working place area	—	9	—	3	—	12	12 (3%)
School yard, day care center	6	4	—	—	6	4	10 (2%)
Unknown place	11	2	5	8	16	10	26 (6%)
Total	105 (25%)	93 (22%)	148 (36%)	69 (17%)	253 (61%)	162 (39%)	415 (100%)
Injury rate per 1000 inhabitants per year	2.5	2.2	8.0	4.0	4.2	2.8	3.5

person was walking (354; 85%). Fifteen persons (3.5%) slipped while 'standing still' doing something like clearing snow, while 13 persons (3%) fell while running and 13 persons while they were pulling or pushing something, e.g. a car.

#### Distribution of injuries

The majority (151; 59%) of the injured women had moderate or serious injuries (MAIS=2 or 3), while the majority (90; 56%) of the men had minor injuries. Thirty-seven of the men (52%) with moderate or serious injuries were 50 years of age or more, while the corresponding figure for the women was 101 (65%) (Fig. 1).

Women over 50 years old had the highest proportion of fractures (101; 68%), 67% of the 137 fractures

in women involved the upper extremities (Fig. 2). The corresponding figure for men was 38% of 58 fractures. For men, however, a fracture of a lower extremity (22; 38%) was just as common as a fracture of an upper extremity (see also Table 3). The ankle, wrist, and knee were common sites for sprain injuries. This type of injury was just as common for men as for women.

#### Medical care

In all, there were 769 out-patient visits i.e. 1.8 visits per injured. The orthopedic clinic had 561 (73%) visits, the general practitioner had 106 (14%), the surgical clinic had 73 (9%) and other clinics had 29 (4%) visits. The 'cost' of out-patient care was SEK

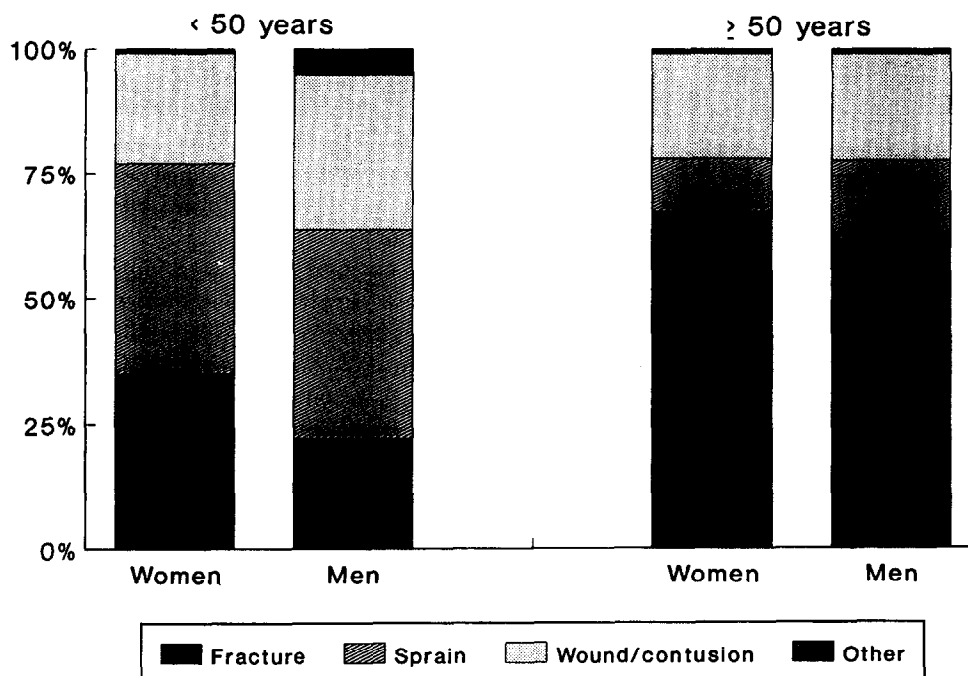


Fig. 2. Types of injuries for women and men in various age groups.

Table 3. Type of injury and localization

	Head/neck	Trunk	Upper extremity	Lower extremity	Total
Fracture	1	26	124	56	207 (48%)
Sprain	—	4	39	74	117 (27%)
Wound/contusion	25	13	33	31	102 (23%)
Other injury	9	—	—	—	9 (2%)
Total	35 (8%)	43 (10%)	196 (45%)	161 (37%)	435 (100%)

0.8 million (USD 120,000), or an average of SEK 1900 (USD 290) per injured.

Seventy-five persons (18%) were admitted to inpatient care for a total of 772 days, on average 10 days/person. The orthopedic clinic received most of the cases with 721 (93%) days of care. The 'cost' of inpatient care was SEK 2.9 million (USD 0.45 million) or an average of SEK 39,000 (USD 6000) per person.

The most expensive injuries were fractures of a lower limb, where the 'care cost' was SEK 2.4 million (USD 370,000; on average USD 6600 per person), while the same cost for fractures of an upper limb was SEK 0.6 million (USD 92,000; on average USD 740 per person).

In total, 145 (55%) of the 266 persons entitled to sickness benefit (16–64 years of age), were on sick leave for an average 41 days per person. The cost of the benefit was SEK 2.5 million (USD 0.4 million), based on the monetary value of 1993; an average of SEK 17,000 (USD 2600) per patient on sickness benefit.

The total amount for emergency care and sickness benefit during one season was SEK 6.2 million (USD 1 million); an average of SEK 15,000 (USD 2300) per injured.

## DISCUSSION

The injury and fracture rate is probably representative for a medium sized city in northern Sweden. Nilsson (1986) shows figures indicating a slightly lower frequency of slipping injuries in the middle part of Sweden. A report from England based on injuries occurring during a couple of days, when 70% of walking surfaces were covered by ice and snow, showed 9–16 injuries per 100,000 people per day (Ralis et al., 1988) which is a little higher than our peak rate of 7. A report from Odense in Denmark (Merrild and Bak, 1983) showed that the risk was 14 times higher during snowfall than during 'normal' winter weather. There seems to be a greater risk for injuries on icy surfaces, where the injury and fracture frequencies are reported to be 6–9 times higher than on snow surfaces (Lewis and Lasater, 1994). It is

quite evident, therefore, that clearing of snow, and spreading of sand and salt should take place immediately after a snow fall or ice formation.

Half of the injuries occurred on a pavement, street or road, while 1/5 occurred in a yard or near dwellings. Nilsson (1986) presented similar results and pointed out that the risk was greatest in the downtown area. This indicates where snow clearing and sanding seems to have best injury reducing potential. A couple of injured persons suggested that snow ploughs should be fitted with serrated blades and not smooth shiny blades which leave a hard slippery flat surface. Snow clearing and spreading of sand and salt should also primarily be carried out where there are many elderly people, e.g. in business areas, bus stops and near medical centers (Merrild and Bak, 1983; Ralis et al., 1988).

Most injuries occurred during leisure time and only every thirteenth case was injured during working hours. This indicates that these injuries seem to be a limited workplace problem. Among the persons injured at night, the majority were young men. Probably young men use their slippery 'dancing-shoes' when walking home, while young women change from indoor shoes to outdoor shoes or boots? Using sensible shoes would prevent slipping and falling. Tisserand (1985) considers that a sole with average friction in regard to winter conditions is better than a sole optimized for a certain ground friction.

The injury rate was highest in the age groups over 50. Fractures dominated for both women and men in these age groups, and constituted for women almost 2/3 of all injuries. The reason for the great changes in the injury panorama around the age of 50 is the development of osteoporosis (Cummings et al., 1985; Riggs and Melton, 1986). The use of estrogen by women of menopause or post-menopause age seems to lessen the risk of fractures (Paganini-Hill et al., 1981). Organizing assistance with shopping, snow clearing and sanding for older persons, as well as organizing a transport service for them would decrease the exposition for the risk of slipping. However, restricted physical activity on the other hand negatively affects the bone structure (Cummings

et al., 1990). The fact that Umeå is a university city with many young people contributed to the high injury frequency among young men.

There are many different models of anti-slipping devices available on the market, but most of them are too complex and impractical (Arvén, 1993). Strandberg (1983) carried out tests with middle-aged persons which showed that when walking straight forwards, slipping occurred when 60% of the body weight was transferred to the heel and the angle between the sole and surface was 6°. In view of this, the slipping protection should be placed on the back of the heel and not under the front part of the shoe, which is common for the present anti-slipping devices (Arvén, 1993; Lundberg and Gard, 1993). However, older and younger persons may walk differently and, therefore, further studies regarding anti-slip devices would be of value. Good devices must not cause slipping on paved floors or damage indoor floors (Lundberg and Gard, 1993). Campaigning for the use of slip protection should primarily be directed to Pensioner Associations etc. (Lewis and Lasater, 1994; Sjögren and Björnstig, 1991a,b).

An alternative to prevent hip fractures is to use personal protection devices. So called 'padding' for the hips has been shown to reduce the number of femur fractures by over 50% in older women (Lauritzen et al., 1993). Wrist protection has also been discussed but mostly in the sporting area such as in skateboarding. Sometimes it is considered that warnings should be issued, mainly to older people, during very slippery conditions. However an older person with experience from life certainly knows that it is slippery during snowy weather! Despite this, medical emergency wards can vouch for a great number of injuries especially in the elderly, when slippery conditions prevail. This indicates that factors other than the 'insight factor' play a role in injuries in the elderly (Robertsson, 1983).

The cost of out- and inpatient care was almost equivalent (90%) to the cost of all traffic injuries during the same time period (data from the Umeå Accident Analysis Group). This would give an indication of the importance of these injuries from a medical and social point of view. Injury prevention measures would, therefore, be at least as motivated against these injuries as against vehicle-related injuries.

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