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INJURIES AND VIOLENCE

A small fraction of patients with repetitive injuries account for a large portion of medical costs

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Background: The phenomenon of repetitive injuries has been judged to be of limited importance in the public health context. A study was therefore initiated in order to analyse all types of single and repetitive injuries using a longitudinal approach. Methods: Hospital care, medical costs and risk factors were examined for single and repetitive severe injuries. A cross-sectional survey with a 12-year follow-up was performed. Questionnaire information from a survey of a random sample of the adult population 20–89 years old in 1984 in Stockholm County were linked to the Swedish national inpatient and cause-of-death register up to 1996, inclusive. Results: During the study period 13% of males and 15% of females were hospitalized or deceased as a result of injuries. Persons with three or more injuries comprise 19% of the injuries, but account for 63% of the total number of days of hospital care and medical costs. Injuries related to falls were most common among patients requiring hospital care. Factors such as high age, living alone, stroke earlier, and use of hypnotics and sedatives were especially associated with repetitive injuries. The risk factors for single and repetitive injuries covariate, but the size of the risk is overrepresented for stroke, drugs, self-reported injuries and living alone for two or more injuries. Conclusion: These results indicate that subjects with repetitive injuries, and with the observed risk factors for such injuries, should be given extra attention, both in policy and prevention, but also in integrated treatment programmes.

Keywords: accidents, drugs, fall injuries, health economics, pharmacoepidemiology, trend analysis

Greenwood and Woods observed many years ago (1919) that reported accidents did not follow a Poisson distribution.[1] An individual who randomly has one accident then becomes non-randomly more or less likely to incur another.[2] Individuals with physical/medical impairment (stroke, seizures), psychological (alcoholism) and personality (overactive, adventuresome) traits should be regarded as 'accident prone'.[3–7] Additionnally, individuals with repetitive injuries are more influenced by exposure to the physical and social environment. Some individuals may be at constant higher risk for socioeconomic reasons, because they may be unable to buy proper safety equipment or they may live in less safe environments. Sometimes there is a combination of these two characteristics. In summary accident proneness includes the possibility that one or several of the mentioned circumstances should be manifest as background or contributing factors in injury causation. This study questions the established notion that such groups do not contribute an appreciable proportion of injuries, and cannot be identified beforehand. The occurrence of repetitive injuries has not, however, been confirmed in modern epidemiological studies of surveillance type that cover the entire population. The phenomenon has therefore been judged to be of limited importance in the public health context. Only in exceptional cases did the same persons consult for treatment of injuries more than once. These findings are based on data from studies of injuries of different types and severity.[8–11] The study periods in these investigations have been relatively short, however, 1–2 years.

A limited number of follow-up studies of risk factors for all causes of injuries leading to hospitalization have been conducted. Most studies have focused on the combination of an acute event, usually a fall, which is the most common injury leading to hospitalization in most industrialized countries, in combination with a chronic condition such as osteoporosis.[12,13] The most common risk factors for fall injuries are high age, low body weight, low intake of calcium and dairy products, osteoporosis, high alcohol consumption, inappropriate use of medicines, and permanent disabilities such as Parkinson's disease, stroke and epilepsy.[14–26]

A few longitudinal studies have analysed different risk factors in the same model, but no epidemiological study has dealt with similarities and differences in risk factors for single and repetitive injuries. The relative burden of disease and medical costs for subjects with repetitive injuries has not been studied. Knowledge about this is vital for policy-making, prevention, and also for efficient treatment programmes. The research questions can be formulated with the help of Waller.[27] If one follows the injury experience of a population over a longer timeframe (5–15 years), are there individuals who are involved in repeated injuries, and does this exceed the proportion of individuals in a population who, purely by chance, might be expected to have two or more such events in a similar timeframe? If such individuals exist, do they account for more than a small minority of all injuries or of all severe injuries? If so, can they be identified before the occurrance of repetitive injury? Of interest for prevention is, if such a group can be identified, and if anything useful can be done to alter them or the nature of their interactions with potential hazards in the environment? A study was therefore initiated in order to analyse hospital care consumption, direct medical costs and risk factors among all types of single and repetitive injuries using a longitudinal approach.

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MATERIAL AND METHODS

Design and definitions

The study uses information from a questionnaire survey in 1984, with a follow-up study of inpatient care and mortality during the 12-year period 1984–1996. The term 'repetitive injuries' refers to admissions where one person is treated in hospital for intentional or unintentional injuries on two or more new occasions during the study period.

Stockholm Health of the Population Study

The study area is a Swedish metropolitan district with 25 municipalities and a total population of 1.8 million inhabitants. The 1984–85 Stockholm Health of the Population Study (SHPS) was used as baseline data and included a questionnaire survey. The study was carried out in 14 of the 42 primary health care districts in Stockholm County, and was roughly representative for the whole county regarding principal socio-demographic conditions.[28]

Analyses are based on a net sample of 6,217 subjects (with due corrections for deaths, moves, etc.) aged 18 years and over. Excluded from the analysis are the few subjects under 20 years and over 90 years of age. A questionnaire was sent to all individuals in each sample (n=450) from the 14 districts, in total 6,217 subjects after considering moves or deaths between the date of sampling and the date of the questionnaire. Of them 4,094 persons answered the questionnaire, 1,856 men and 2,238 women. The non-participation amounted to 38% for men and 32% for women.

We selected a variety of factors which had been shown or which were hypothesized to increase the risk of injuries.[12,17] As the survey was not primarily intended for research on injuries, some potential risk factors were not included, e.g. measures of risk behaviour. The following risk factors were included (exposed/unexposed): age (continuous in ten-year groups), sex (male/female), cohabited (unmarried, single/married) divorced (yes/no), occupation (unemployment/employment), state of health (very bad, rather bad, neither good nor bad/good, very good). The items and categories for variables about health, socio-economic factors and alcohol and substance misuse were: dizziness (sometimes or often/never, occasionally), muscular tension (sometimes or often/never, occasionally), stroke (yes/no) previous injury (yes/no), alcohol (1–100 g/month/0; 100–500 g/month/0; 500–1000 g/month/0; >1000 g/month/0) (240 g 100% ethanol per month is compatible with 70 cl of strong spirits). We also analysed questions on the use of sedatives and hypnotics during the past two weeks: use of hypnotics or sedatives (sometimes/no, daily/no), use of hypnotics (sometimes/no, daily/no). We lack information about (direct) trigger factors, i.e. factors closely related to the accident sequence of events such as slipping, acute dizziness or intoxication.[8]

Follow-up data in-patient care and mortality

After obtaining permission from the Ethics Committee at the Karolinska Institutet, information about hospitalization and mortality from all hospitals in Sweden was linked to the survey data, using the Swedish personal identification number. A complete personal identification number was missing in three cases. Only injuries necessitating hospital treatment or leading to death are included in the analysis. Based on hospital records, information on the three outcomes (dependent variables), reported as one, two and three or more injuries leading to hospital admissions or death for injuries including the E codes (ICD-8 and ICD-9), were collected from the national register. All injury diagnoses were collected for each individual. The follow-up period is from the date of response to the questionnaire by each person up to and including 31 December, 1996. Information about deaths was taken from the Swedish cause-of-death register, which has a coverage of over 99% of all deaths. The number of deaths due to injuries were few, 24 persons, of which nine died at the scene, and among the hospitalized, 15 died later from injuries during the follow-up period. The cumulative incidence for different types of injuries was calculated. Relative risks (with 95% confidence intervals) for various presumed risk factors for single and repetitive injuries during the follow-up period were also calculated.

Statistical methods

Relative risks were calculated using logistic regression. The relative risk, based on cumulative incidence, is the ratio between the incidence figures for the exposed group and the reference group. We first conducted bivariate analyses of the relative risk for the two levels of intake of sedatives and/or hypnotics. Variables in the questionnaire that were correlated to intake of sedatives and/or hypnotics and to the outcome variables in the bivariate analyses were included in the multivariate logistic regression models. The reason was that intake of sedatives and/or hypnotics was considered an important risk factor *a priori*.[17] Calculated odds ratios were transformed to relative risks. When calculating relative risks in bivariate and multivariate analysis, three outcome variables were used; one, two and three or more injury cases. A trend test was conducted for the number of days per individual and per event of inpatient care in relation to the number of injury events for in-patient care and mortality.

RESULTS

External causes

Altogether 565 (14%) of patients (218 men and 323 women) had such severe injuries that they were hospitalized. Another 24 persons died from injuries (4.2% of all deceased), 12 males and 12 females. Nine died at the scene, and among the hospitalized, 15 died later from injuries during the follow-up period. When controlling for overall mortality the relative risk increased by 10–20% for the variables in the bivariate analysis and with a diminishing change in the multivariate analysis.

The cumulative incidence was 12.9% for men and 15.4% for women. The most frequent external causes among those with repetitive injuries were falls from the same or a higher level (E880–888), attempted suicide (E950–959), unclear cases (E980–989), assaults (E960–969) and injuries during transports (E807–848).

The group 'other external causes' is larger among those who had only one injury event during the period (*table 1*). In this group, a difference between the sexes was also observed, 46 males and 73 females. The most common 'other' external cause among those with two injuries or more is complication due to surgical operation (E878) with 59 admissions and later effects of accidental injury (E929) with 21 events. Common risk factors among patients with one or two complications in relation to a surgical operation were high age, back pain, dizziness and stroke (RR 6.20, 1.08–35.55). Also E947 (other and unspecified drugs and medications causing adverse effects in therapeutic use) is mentioned (10 patients/admissions) among those with repetitive injuries. The distribution of external cause changes when the number of injury cases per individual increases. Falls dominated among repetitive injuries during the study period.

Consumption of hospital care

The number of hospital-treated cases relates to all types of causes, i.e. both intentional and unintentional injuries. The majority (61%; 64% of men and 60% of women) had only one period of hospital stay during the period. The total consumption of inpatient care amounted to 17,420 days. The total distribution of hospital admissions for injuries during the period is shown in *table 1*. Among those with two or more admissions to hospital, 68% of injuries were due to falls (p<0.001), 5% due to attempted suicide, 5% due to transport, 1% due to assault and 21% due to all other external causes.

As shown in *table 2*, women had both more injuries and more days in hospital than men. Persons with two or more hospital admissions, accounted for a relatively large part of the total consumption of inpatient care, 6,166 days or 84% of the men's consumption and 8,247 days or 82% of the women's total consumption. Persons with three or more admissions account for 19% of all admissions but 63% of the total number of days of

hospital care, 66% in men and 60% in women. The total number of days in hospital per individual increases significantly with the number of injuries. The average number of days per admission period differ between single and repetitive injuries from 8.7 days for single injuries to 15.7 days for two admissions, and 23.0 days for three admissions, range 13.8–42.6 days for all repetitive injuries (*table 2*). We did find a significant increase in the number of inpatient days per admission when we analysed all injuries for both sexes together (p=0.03) and for women separately (p=0.012) but not for men (p=0.218). However, the mean duration of hospital stay per admission for fall injuries does not increase with increase in the number of fall injuries. As could be expected, the trend was similar for fall injuries, the dominating injury category. Patients with repetitive injuries as a group are more impaired than patients with only a single injury. Furthermore, patients with repetitive injuries are significantly older than those with just one injury (mean age = 61.0 among those with repetitive injuries and 51.7 among those with one injury).

A limited number of the N codes 905–909 'late effects', in total 36 cases (of 1044), were observed in the material. In 137 of 479 cases (29%) irrespective of time between admissions, the same N and E codes were registered. (The 479 admissions derive from 218 patients being hospitalized for two or more injuries.) Since 137 out of 479 cases were followed by a new case (irrespective of time) with the same N code and E code and if it is estimated that about 50% of the new injury cases were misclassified as new cases, then about 70 cases were wrongly classified as new cases. Since 218 persons had two or more injuries one could estimate that about 30–35 persons were wrongly classified as repeaters or 5–6% of the persons with injuries. We do not know if these patients had a re-operation or were hospitalized again because of a deterioration due to the initial injury. The best method would be to scrutinize the medical records. However, scrutinization of

Table 1 Number of hospital admissions for injuries distributed by external cause (E code), Stockholm Health of the Population Study, age groups 20–89 years, 1984–1996

Admissions per individual	Transport[a]		Fall[b]		Suicide and unclear[c]		Violence[d]		All others		Total	
	N	%	N	%	N	%	N	%	N	%	Admissions	Patients
1	19	5	161	46	19	5	10	3	138	40	347	347[e]
2	5	2	143	64	14	6	6	3	54	24	222	111
3	2	1	80	61	18	14	–	–	32	24	132	44
4	3	3	81	72	1	1	1	1	26	23	112	28
5	5	8	43	66	4	6	–	–	13	20	65	13
6	6	11	48	89	–	–	–	–	–	–	54	9
7	–	–	27	77	–	–	–	–	8	23	35	5
8	–	–	32	80	–	–	–	–	8	20	40	5
9	–	–	9	100	–	–	–	–	–	–	9	1
10	–	–	10	100	–	–	–	–	–	–	10	1
18	11	61	–	–	–	–	–	–	7	39	18	1
Total	51	–	634	–	56	–	17	–	286	–	1044	565

a: E807–848
b: E880–888
c: E950–959 and E980–989
d: E960–969
e: Fatal injuries not included.

Table 2 Number of patients, ages 20–89 years and days in hospital, all external causes, (E codes), Stockholm Health of the Population Study, 1984–1996 (n=565)

Admissions per individual	Number of males in each group	Inpatient care, males Number of days	Number of females in each group	Inpatient care, females Number of days	Total number of cases and percentage of total		Total number of days and percentage of total		Average number of days per admission
1	147	1212	200	1795	347[a]	49.7	3007	17.3	8.7
2	40	1284	71	2206	222	21.3	3490	20.0	15.7
3	20	1568	24	1470	132	12.6	3038	17.4	23.0
4	2	399	16	1228	112	10.7	1627	9.3	14.5
5	4	1304	9	738	65	6.2	2042	11.7	31.4
6	1	216	8	1130	54	5.2	1346	7.7	24.9
7	3	771	2	217	35	3.4	988	5.7	28.2
8	3	624	2	202	40	3.8	826	4.7	20.7
9	–	–	1	151	9	0.9	151	0.9	16.8
10	–	–	1	138	10	1.0	138	0.8	13.8
18	–	–	1	767	18	1.7	767	4.4	42.6
Total	230	7378	335	10042	1044	100.0	17420	100.0	16.7

a: Fatal injuries not included.

each admission for misclassified late effects is recommended as a separate study.

Persons with repetitive injuries have a significantly higher total mortality (34.4%) during follow-up compared to persons with single injuries (18.7%) and others (10.3%). A significant difference for injury mortality was observed between those hospitalized for injury and others ($p<0.001$), as could be expected. However, injury mortality among persons with repetitive injuries (2.8%) were comparable to those with single injuries (2.6%).

An interesting finding is that injuries due to falls from the same or a higher level also account for 74% of all days of hospital care (12,814/17,420). Here, too, a difference between men and women was observed for both number of (fall) injuries and days in hospital. Men with three or more fall injuries account for 23% of all fall injuries among men but for 69% (3,702 days) of all men's days of hospital care. The corresponding figures for women are 19% of fall injuries and 55% of days in hospital (4,149 days).

Costs for hospital treatment and care

Altogether 17,420 days of hospital care covering 565 hospitalizations are included in the cost calculation (*table 3*). The average cost of treatment and care per day amounted in 1996 to 5,181 SEK (USD 575; exchange rate USD 1 and Euro 1 = 9.00 SEK) at a department of orthopaedics at a public hospital in Stockholm (Södersjukhuset).

A small group of persons account for more than 4/5 of the total consumption of hospital care (*table 2*). It was therefore interesting to analyse the group repetitive injuries in more detail with respect to main risk factors.

RISK FACTORS

Bivariate analysis

There are ten factors that carry a significantly higher risk for one, two and three or more injury events compared to no injury leading to hospitalization or death. These are: high age, single or not cohabiting, living alone, state of health, back pain, sleeping problems, earlier self-reported stroke, high alcohol consumption, daily or temporary use of hypnotics and sedatives and daily or occasional use of both hypnotics and sedatives and (self-reported) previous injury. The results of the bivariate analysis for those with one, two and three or more injury events are shown in *table 4*. Testing for gender differences among the group with repetitive injuries, there is no significant difference between men and women in the proportion of persons with repetitive injuries among all persons with injuries. Single or not cohabiting (RR 6.34, 95% CI: 3.78–10.65), earlier self-reported stroke (RR 6.08, 95% CI: 1.71–21.61), daily use of hypnotics (RR 8.84, 95% CI: 5.41–12.34) and sedatives (RR 6.43, 95% CI: 3.38–12.25) or if combined (RR 7.55, 95% CI: 4.62–12.34) carried the largest excess risk.

When analysing risk factor distribution in relation to different external causes (fall, suicide, violence and others) the three most often observed risk factors were: *fall* injuries among men (single or not cohabiting, daily use of hypnotics and/or sedatives and permanent impairment) and for women (stroke, single or not cohabiting and daily use of hypnotics and/or sedatives); *suicides* for men (stroke, use of hypnotics and/or sedatives and dizziness) and among women (daily use of sedatives, sleeping difficulties and permanent impairment); *intentional violence* among men (self-reported previous injury, occupation and back pain), no significant risk factors were observed for women; and among all *other causes* for men (daily use of hypnotics and/or sedatives and previous injury) and among women (single or not cohabiting, back pain and permanent impairment). Additionnally, stroke was overrepresented among women in fall injuries (RR 9.62, CI: 2.39–38.74) and among men in suicides (RR 13.75, CI: 1.61–117.29). Finally, self-reported previous injury was overrepresented among men in intentional violence (RR 4.89, CI: 1.63–14.66). When controlling for overall mortality the relative risk increased by 10–20% for the variables in the bivariate analysis and with a diminishing change in the multivariate analysis.

Multivariate analysis

Those factors which showed a significantly increased risk for one, two or more injuries in the bivariate analyses were selected for the multivariate analyses. The initial model was based on risk factors reported in the literature.[12,17]

Factors that remain significant for three or more outcomes after the multivariate analysis are high age, stroke, high alcohol consumption, daily use of hypnotics and sedatives, and previous injury. The multivariate analysis (*table 5*) shows the risk factors that are significant among those with two cases. High age, living alone, stroke, high alcohol consumption, daily use of hypnotics and sedatives and self-reported previous injury carry a significantly increased risk in both sexes together as well as in each sex separately.

Risk factors that are significantly overrepresented in the group with three or more admissions are high age, stroke, daily use of sedatives and hypnotics and self-reported previous injury.

Table 3 Direct costs of hospital care due to repetitive injuries in relation to all types of external causes, males and females, age groups 20–89 years in the Stockholm Health of the Population Study, 1984–1996

Injuries per individual	Medical costs males, SEK[a]	Medical costs females, SEK	Average costs males SEK	Average costs females SEK	Total medical costs SEK	Cumulative percentage
1	6,279,372	9,299,895	42,717	46,499	15,579,267	17
2	6,652,404	11,429,286	166,310	160,976	18,083,690	37
3	8,123,808	7,616,070	406,190	317,336	15,739,878	54
4	2,067,219	6,362,268	122,268	397,641	8,429,487	63
5	6,756,024	3,823,578	1,689,006	424,842	10,579,602	75
6	1,119,096	5,854,530	1,119,096	731,816	6,973,626	83
7	3,994,551	1,124,277	1,331,517	562,138	5,118,828	89
8	3,222,944	1,046,562	1,077,648	523,281	4,269,506	94
9	–	782,331	–	782,331	782,331	95
10	–	714,978	–	714,978	714,987	96
18	–	3,973,827	–	3,973,827	3,973,827	100
Total	38,225,418	52,027,602			90,253,020	

a: The exchange currency rate is for USD 1 = 7.44 and Euro 1 = 9.19 SEK (5 April 2004).

DISCUSSION

It has been observed that a small group of patients (18% of all injury patients) account for more than 4/5 of the total consumption and related costs of hospital care for injuries. Patients with three or more admissions for care accounted for 63% of all medical costs in the study group. The average length of hospital care for injuries increased in women when the number of fall injuries increased. However, the average length of hospital care in fall-related injuries did not increase per admission when the number of fall injuries increased. Other cohort studies have found that people who fell at least once in the year prior to baseline survey had about a 50% greater risk of a subsequent hip fracture than people who had not fallen.[22,26] Among patients with multiple health problems including balance disorders fall

Table 4 Number of injuries, all external causes (E codes), bivariate analyses and relative risks (RR) with 95% CI, Stockholm Health of the Population Study, 1984–1996, aged 20–89 years

Risk factors (exposed/unexposed)	One injury[a] (n=347) RR (95% CI)	Two injuries[a] (n=119) RR (95% CI)	Three injuries[a] (n=108) RR (95% CI)
Sex (male/female)	0.86 (0.70–1.05)	0.74 (0.52–1.06)	0.78 (0.53–1.14)
Occupation (unemployment/employment)	1.13 (0.91–1.40)	1.38 (0.93–2.05)	1.12 (0.71–1.77)
Divorced (yes/no)	1.36 (1.06–1.75)	1.49 (0.93–2.05)	1.23 (0.75–2.02)
Widow(er) (yes/no)	1.46 (2.09–3.99)	1.83 (0.99–3.35)	1.47 (0.75–2.86)
Unmarried, single (single/cohabiting)	2.89 (2.09–3.99)	5.19 (3.03–8.87)	6.34 (3.78–10.65)
Living alone (yes/no)	1.37 (1.11–1.70)	2.24 (1.57–3.19)	3.08 (2.13–4.46)
State of health (very bad, rather bad, neither good nor bad/good)	2.46 (1.87–3.24)	3.00 (1.85–4.86)	3.50 (2.18–5.63)
Back pain (never, occasionally/sometimes or often)	1.70 (1.37–2.10)	2.00 (1.38–2.90)	2.62 (1.76–3.92)
Muscular tension (never, occasionally/sometimes or often)	0.65 (0.48–0.88)	0.53 (0.32–0.89)	0.72 (0.39–1.32)
Depression (never, occasionally/sometimes or often)	0.71 (0.57–0.89)	0.76 (0.51–1.13)	0.63 (0.40–0.99)
Sleeping problems (never, occasionally/sometimes or often)	1.41 (1.09–1.82)	3.30 (2.26–4.82)	3.61 (2.41–5.42)
Dizziness (sometimes or often/never, occasionally)	1.29 (0.81–2.08)	1.38 (0.93–2.05)	1.90 (0.84–4.27)
Stroke (yes/no)	1.99 (0.57–7.02)	7.66 (2.83–20.75)	6.08 (1.71–21.61)
Alcohol 1–100 g/m (1–100g/0)	1.57 (0.83–2.97)	0.92 (0.23–3.71)	1.73 (0.64–4.68)
Alcohol 100–500 g/m (100–500g/0)	0.94 (0.73–1.19)	0.74 (0.49–1.12)	0.61 (0.39–0.93)
Alcohol 500–1000 g/m (500–1000g/0)	1.13 (0.81–1.56)	0.85 (0.47–1.53)	0.88 (0.50–1.57)
Alcohol >1000 g/m (>1000g/0)	1.59 (1.10–2.30)	1.48 (0.79–2.79)	0.50 (0.18–1.39)
Hypnotics, temporary (sometimes/no)	1.54 (1.14–2.10)	2.41 (1.48–3.94)	3.41 (2.10–5.53)
Hypnotics, daily (daily/no)	2.42 (1.62–3.62)	5.56 (3.26–9.50)	8.84 (5.41–14.45)
Sedatives, temporary (sometimes/no)	1.72 (1.19–2.48)	1.89 (0.97–3.69)	2.51 (1.32–4.78)
Sedatives, daily (daily/no)	1.62 (0.84–3.12)	5.36 (2.84–10.14)	6.43 (3.38–12.25)
Hypnotics/Sedatives, temporary[b] (sometimes/no)	1.54 (1.16–2.05)	2.26 (1.40–3.63)	3.54 (2.25–5.58)
Hypnotics/Sedatives, daily[c] (daily/no)	2.28 (1.57–3.32)	5.34 (3.24–8.80)	7.55 (4.62–12.34)
Self-reported previous injury (yes/no)	1.38 (1.05–1.80)	2.76 (1.86–4.09)	1.76 (1.10–2.81)

a: One, two, and three or more injury cases are compared with the group not reported to have had any injury during the study period.
b: Hypnotics and/or sedatives temporarily (and not daily). c: Hypnotics and/or sedatives daily.

Table 5 Number of injuries by all external causes (E codes) both sexes, age groups 20–89 years, multivariate analyses[a] by relative risks (RR) with 95% CI, Stockholm Health of the Population Study, 1984–1996

Risk factors	One injury RR (95% CI)	Two injuries RR (95% CI)	Three injuries[b] RR (95% CI)
Sex	1.28 (0.99–1.65)	1.29 (0.80–2.09)	0.89 (0.52–1.50)
Age[c]	1.02 (1.01–1.03)	1.04 (1.02–1.05)	1.04 (1.03–1.06)
Living alone	1.48 (0.30–6.68)	4.58 (1.01–20.37)	3.34 (0.61–18.03)
Back pain	1.43 (1.08–1.88)	1.29 (0.79–2.10)	1.41 (0.83–2.38)
Muscle strain	1.15 (0.76–1.74)	1.32 (0.68–2.54)	1.15 (0.55–2.44)
Stroke	1.11 (0.85–1.45)	1.49 (0.95–2.36)	2.14 (1.31–3.50)
Dizziness	0.95 (0.55–1.64)	1.78 (0.88–3.59)	0.67 (0.26–1.75)
Alcohol (0–100 g/m)	1.80 (0.83–3.82)	1.54 (0.34–6.99)	1.63 (0.44–5.97)
Alcohol (100–500 g/m)	1.27 (0.94–1.71)	1.42 (0.82–2.46)	1.01 (0.58–1.76)
Alcohol (>500 g/m)	1.95 (1.36–2.78)	2.17 (1.13–4.17)	1.09 (0.53–2.24)
Hypnotics/sedatives[d]	1.18 (0.86–1.62)	1.50 (0.90–2.48)	1.95 (1.15–3.29)
Self-reported previous injury	1.34 (0.97–1.86)	3.42 (2.16–5.42)	1.83 (1.03–3.27)

a: We have included variables from the model in the bivariate analysis. The reference categories for the variables are shown in *table 4*.
b: One, two, and three or more injury cases are compared with the group not reported to have had any injury during the study period.
c: Age is categorized in ten-year intervals.
d: Hypnotics and/or sedatives temporarily or daily.

accidents occur relatively often. In *tables 4* and 5 'self-reported previous injury' is significant for both two and two or more injury admissions. However, not all fall accidents need hospital care. But during a longer follow-up period, e.g. 12 year, we assume, based on the literature, that such a vulnerable risk group reflected in the bi- and multivariate analyses, could have been hospitalized for the typical injuries connected to fall injuries on several new occassions, late effects excluded. Altogether, injuries related to falls, suicide attempts and transport were overrepresented among patients with repetitive trauma requiring hospital care.

In this study, costs are calculated as the average for a public orthopaedic department, and both care and treatment are included. However, there are differences between different types of department, e.g. neurosurgery, intensive care, burns units and orthopaedic surgery. No information was available in the inpatient register on the involvement of different departments in the cases analysed. Therefore we used the average costs for the department responsible for the major part of the emergency cases due to fall injuries, the orthopaedic units in the region, SEK 5 181 (USD 575) per treated patient. A more informed calculation would probably increase the costs, owing to the involvement of neurosurgery, especially for severe injuries from transport accidents. Besides these direct medical costs there are non-medical costs, e.g. costs related to transportation and social services and loss of production. We lack information about these costs. This means that the total costs show a skew distribution with number of hospitalizations (one, two, three or more).

A general problem in questionnaire surveys is the increasing non-participation rates. However, the non-response rate of the data collection in this survey has been scrutinized separately.[28] For example, a higher percentage of inpatients with alcohol-related disease was observed among the non-participants. We have no information indicating that the association between risk factors and hospitalization for injury is similar among the non-participants in our study.[8,9] There may be an overrepresentation of persons with repetitive injuries among non-participants, for example, the proportion of subjects hospitalized with a diagnosis of alcoholism, alcohol intoxication or alcohol psychosis was higher among non-participants. This would result in underestimation of the occurrence of the phenomenon in the population and the consequent cost of hospital treatment and care. Another problem is recall error when reporting the use of drugs and the amount of alcohol consumption, usually leading to an underestimation of relative risk. However, self-reported sleeping and depressive disorders were significantly correlated to severe repetitive injuries. Quality studies of Swedish inpatient registers and the cause-of-death register state that 99% of the patients are found in both registers.[29] So, it is concluded that matching is close to 100%.

Using registry inpatient data should be regarded as routine in clinics searching for patients with multi-level problems, e.g. repetitive injuries divided into age and socioeconomic status. We lacked resources to search for information in the medical records and to scrutinize each admission. Additionnally, the problem of late effect misclassifications should be given extra attention in clinical reporting systems. However, the scrutinization of each admission for misclassified late effects is recommended to be carried out in a separate study.

The same risk factors were found for one, two, and for three or more hospitalizations for injury (*tables 4* and 5). These were high age, stroke, back pain, daily use of hypnotics and sedatives and high alcohol consumption. In this group, self-reported treatment for injuries was also a risk factor. The relative risks changed slightly between the bivariate and multivariate analyses, indicating limited confounding. However, the risks were higher for the different levels of alcohol consumption in the multivariate analyses than in the bivariate analyses, which may be due to confounding between intake of sedatives and/or hypnotics and alcohol consumption.

It was observed that daily use of hypnotics and sedatives carry a significantly increased risk in both sexes together, as well as in each sex separately. Use of certain psychotropic drugs such as tricyclic antidepressants and selective serotonin re-uptake inhibitators has been suggested as risk factor for falling and hip fractures.[30,31] The role of benzodiazepines is more disputed. Some studies have found a positive relationship between benzodiazepines, especially the longer acting ones, and hip fracture.[32,33] Other studies have not found any association between sedative-hypnotic drugs and hip fracture.[34,35] In a study recently published based on information from questionnaires, medical records and plasma samples no association was found between the use of benzodiazepines and hip fracture. However, hip fracture was associated with the use of two or more benzodiazepines, as determined from questionnaires or medical records but not from plasma samples.[36] Does the mental state which led to prescription/use of bensodiazepines include reduced awareness, decreased balance, etc. increasing the risk of falls and other injury?

Sedatives and hypnotics have been reported by the manufacturers to influence balance, judgement and physical ability, which may explain the increased risk of injury and repeated injuries among those using these drugs. We do not know how many of those reporting use of sedatives and hypnotics at the baseline examination really used these drugs in connection with the injury. Although this is a longitudinal study we could not decide whether the identified factors function also as triggering besides being contributing.

One advantage of the study is the large cohort of over 4000 people surveyed about potential risk factors and followed over a 12-year period using logistic regression. Only a few longitudinal studies have been done in the field of injury epidemiology.[17] Also, the possibility to link survey data to the national inpatient and cause-of-death registers is not easy in many other countries. Finally, costs of injuries are seldom calculated in epidemiological studies of injuries.

Contributors

Bjarne Jansson directed the study, contributed to the interpretation of the results, and wrote the paper. Anders Leifman and Marlene Stenbacka analysed the data and contributed to the writing of the paper. Anders Romelsjö participated in the planning of the study, interpretation of the results and contributed to the writing of the paper.

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