Chapter 3

Injury circumstances in repetitively injured patients

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Abstract

Objective Injury-related health problems tend to cluster within individuals. Since repetitively injured patients may have a certain personality make-up which makes them prone to accidents, we investigate injury circumstances such as the influence of individuals’ own behaviour on injury causation.

Methods We compared 196 repetitively injured patients (two or more separate injuries within 12 months) with 558 patients with a single injury visiting an emergency department between 1 June 1998 and 1 January 2003 (55 months). Patients completed a questionnaire eliciting injury circumstances.

Results Repetitively injured patients more often reported that their own aggressive behaviour and substance use were involved in their injuries than singly injured patients (14.9% versus 6.6%, adjusted odds ratio 2.21, 95% confidence interval 1.28 to 3.82). In both patient groups, aggressive behaviour and substance use were most often reported in the category other environments (mainly night life), with a significant difference between repetitively and singly injured patients (42% versus 12%, adjusted odds ratio 4.85, 1.57 to 14.95). In contrast, patient’s own high-risk behaviours were not involved in injuries occurring at work (0% versus 1%).

Conclusion Patients’ own high-risk behaviours were relatively often involved in injuries of repetitively injured patients. Therefore, preventive strategies should aim to change these high-risk behaviours into healthier lifestyles. In this respect, mental health workers at emergency departments could play an important role in the prevention of injury recurrence.
Introduction

Injury is one of the leading causes of disability and death in all age groups in Western societies, despite downward trends over the past decade (Krug, 1999; Morrison et al., 2000). Early in the 20th century, Greenwood and others (Greenwood and Woods, 1919; Greenwood and Yule, 1920) were the first to observe that injury-related health problems tend to cluster within persons. A decade later, Farmer and Chambers (1929) introduced the term accident proneness for this phenomenon, referring to accident proneness as a persistent and stable personality characteristic. Ever since, the concept of accident and injury proneness has been the subject of much debate and controversy (Green, 1991; McKenna, 1983; Visser et al., 2007). One of the major criticisms of the concept has been that attributing injury proneness to certain individuals would blame them for their injuries instead of shortcomings in health and safety regulations in the workplace (Green, 1991). This discussion highlights the fact that injury rates depend on both the person and their environment, which together determine the amount of risk-exposure (Haight, 2001).

Nevertheless, it remains all the more important to identify factors that contribute to injury-clustering as a starting point for preventive strategies. Person-characteristics have been investigated as potential risk factors for injuries and injury proneness. A number of studies reported that repetitively injured individuals are younger (Hedges et al., 1995; Poole et al., 1997; Smith et al., 1992) and more frequently male (Hedges et al., 1995; Madden et al., 1997; Smith et al., 1992) than non-injured or less frequently injured individuals. Other investigators found that personality features such as extraversion (Jin et al., 1991; Marusic et al., 2001), hyperactivity (in children) (Gayton et al., 1986), alcohol problems (Ponzer et al., 1999; Weisbeski Sims et al., 1989) and neuroticism (Jin et al., 1991) were positively correlated with higher injury rates. Furthermore, Lowen-
stein et al. (1998) found high rates of many injury-prone behaviours, e.g., wearing no seat belts and problem drinking, in patients who consulted emergency departments. These studies focused on person characteristics and did not take causes or environments of injuries into account. The main reason for this is that the majority of studies on injury proneness use a case-control design in which a group with multiple injuries (typically two or more in a year) is compared with a group without injuries (Visser et al., 2007). Several problems arise from these types of comparisons. First, persons may end up in the injury-prone group because of mere bad luck that caused them to have two or more injuries in the year under study. The size of this group is unknown, but it is likely that these persons will dilute the associations under study. Second, injury proneness is not only determined by person-characteristics but also by mere exposure differences. For instance, persons participating in a competitive sport are more likely to get injured than persons who spend their leisure time reading; and the number of driving days or mileage should be taken into account while studying injury rates in traffic contexts (Shaw and Sichel, 1971). Thus, it is important to distinguish injury causes and environments to overcome these problems when studying injury-clustering.

The aim of this study is to compare circumstances of injuries between singly and repetitively injured patients. First, we hypothesise that patients’ own behaviours will be more involved in injury occurrence of repetitively injured patients than in those of singly injured patients. Second, we hypothesise that differences in the prevalence of these behaviours between singly and repetitively injured patients will be particularly evident for injuries occurring in environments in which risk exposure is relatively uniform and thus mainly person-related, such as at home. In contrast, we expect limited differences in the prevalence of high-risk behaviours in the occurrence of work, traffic, and sports injuries. These environments are
likely to be associated with a large variety in risk exposure, and consequently, we expect mere risk exposure to have a relatively large influence on injury causation. In order to test these hypotheses, we compared injury characteristics of patients who visited the emergency department repeatedly with patients who visited the department only once in the study period.

**Methods**

**Subjects**
The University Medical Center Groningen (UMCG) is the largest hospital of the province of Groningen in the Netherlands with a catchment area of approximately 570,000 inhabitants. Both the orthopedic and the trauma division of the emergency department of this hospital provided computerized medical records of patients who had attended the department between 1 June 1998 and 1 January 2003. These divisions cover all injuries that are presented at the emergency department. Overall, 34,355 patients, accounting for a total of 44,301 consultations, received medical care for their injuries at the emergency department during the study period. This means that a number of patients consulted the emergency department more than once during the study period, either because they suffered several injuries or because they required multiple consultations for a single injury.

The procedure to identify repetitively injured (RI) and singly injured (SI) patients is shown in Figure 1. RI patients were defined as patients who visited the emergency department for two or more unique injuries on at least two separate occasions within a time frame of 12 months over the 55-month study period. This definition is in accordance with other stud-
ies that investigated repetitively injured patients (Gauchard et al., 2006; Madden et al., 1997; Williams et al., 1997).

All consultation records were examined to check whether it concerned unique injuries and not follow-up visits for plaster or wound care. We invited 1168 randomly selected RI patients to participate in our study, aiming for a total of 200 participants. A reminder was sent when patients did not respond. We received responses from 213 patients declining to participate, 79 patients who were interested but withdrew before measurements started, and 196 RI patients who participated in our study (17%). A random sample of 2058 of 24,769 (8%) single consultation patients was also asked to participate, 691 (34%) of whom agreed. Single consultation patients who indicated they had suffered an injury requiring medical attention in the UMCG or elsewhere in the year preceding or following the index visit were excluded, leaving 558 SI patients. Patients with a single consultation more often agreed to participate than RI patients. In this respect, it should be noted that both patient groups completed a questionnaire at home, but that RI patients also were asked to visit our outpatient clinic three times for a more extensive physical and psychiatric examination. SI patients were not asked to complete the same procedures, because the target of our main study was the RI patient group.

The medical ethics committee of the UMCG approved the study and we conducted the study in accordance with the guidelines of the declaration of Helsinki. Written informed consent was obtained from all participants.
Figure 1  Inclusion of repetitively injured (RI) and singly injured (SI) patients

Study period: 1 June 1998 to 1 January 2003
34 355 patients

- multiple consultations in UMCG in study period
  6796 patients

- a single consultation in UMCG in study period
  27 559 patients

- multiple consultations within 12 months
  4824 patients

- multiple consultations not within 12 months
  1972 patients

- multiple injuries within 12 months
  1928 patients

- deliberate self harm or suicide attempt *
  29 patients

- asked to participate
  1168 patients

- asked to participate
  2058 patients

- agreed
  691 patients

- RI patients
  196

- SI patients
  558

- other consultation one year before or after UMCG consultation
  133 patients

* as assessed by a consulting psychiatrist
Chapter 3

Measurements
Gender, date of birth, and date and time of consultation were extracted from computerized medical records of the emergency department. In order to obtain more detailed information about injuries, RI patients as well as SI patients completed a questionnaire at home. These questions concerned the environment and the cause of injuries and was introduced to the participants as follows: “For our study it is important that you describe the circumstances in which your injury, for which you attended the emergency department, occurred. The questions below concern [type and location of injury] for which you attended the emergency department at [date of injury]: 1) The injury concerned: a) a home injury; b) a traffic injury; c) a sports injury; d) a work injury; e) if other, please specify; 2) According to you what caused your injury (you may mark more than one cause): a) my own clumsiness or inattention; b) someone else’s clumsiness or inattention; c) my own aggressiveness; d) someone else’s aggressiveness; e) my own alcohol consumption; f) someone else’s alcohol consumption; g) my own medication or drug use; h) someone else’s medication or drug use; i) mere bad luck.” Patients were allowed to mark more than one cause. We categorised these causes into two groups, based on the relative contribution of patient’s own behaviour on injury causation:

a) Low-risk behaviour causes: injury causes include the patient’s own clumsiness or inattention, someone else’s clumsiness or inattention, aggressiveness, or substance use, or mere bad luck;

b) High-risk behaviour causes: injury causes include the patient’s own aggressiveness or substance use.

Statistical analyses
We compared age (Student’s T-test), gender (Chi-square test), and number of injuries (Mann-Whitney test) of responding and non-responding patients within the RI and SI patient groups. Differences in injury charac-
teristics between RI and SI patients who participated in our study were quantified by odds ratios with 95% confidence intervals in logistic regression. RI patients were significantly younger than SI patients and therefore, we adjusted these odds ratios for age. Since a patient was the unit of generalization and analysis, we included only the first injury of RI-patients in the analyses. Because subsequent injuries may have a different basis, we repeated the analyses for the second injury of RI patients. This revealed essentially the same results. We used SPSS12 for all statistical analyses.

Results

During the 55-month study period, RI patients (n=1928) attended the emergency department 7065 times. Although they accounted for less than 6% of the total number of patients, they accounted for 16% (7065/44301) of the total number of consultations. Excluding multiple consultations for the same injury (1659), RI patients had 5406 injuries in total during the study period (mean number of injuries per RI patient 2.8, 2.74 to 2.86). Most RI patients (56%, n=1077) had two injuries, 26% (n=502) had three, and 18% (n=349) were injured more than three times, with a maximum of 15 injuries in 55 months.

We compared patient characteristics of responding and non-responding patients within the RI and SI patient groups. Responders in both groups were significantly older (RI patients, mean age 38 years (35.9 to 40.2) versus 35 (33.5 to 35.7), P<0.001; SI patients, mean age 43 (41.6 to 44.3) versus 37 (36.0 to 37.8), P<0.001) and less frequently male (RI patients 61.2% (120/196) versus 71.7% (697/972), P=0.003; SI patients 55.6% (310/558) versus 60.7% (911/1500), P=0.034) than non-responders. The number of injuries did not differ between responding and non-responding RI pa-
patients (median 2.0, interquartile range 2.0 to 3.0 versus median 2.0, 2.0 to 3.0, \( P=0.242 \)).

Patient and injury characteristics of participating RI and SI patients are presented in Table 1. RI patients were significantly younger and visited the emergency department more frequently on weekends and during night time hours than SI patients. The proportion of injuries in different injury environments revealed no significant differences between RI and SI patients. In RI patients, 48% (14/29) of injuries in other environments occurred during night leisure time activities (e.g., at parties, in bars, etc.) as compared to 16% (14/90) in SI patients.

We first hypothesised that patients’ own high-risk behaviours were more often involved in injury occurrence in RI patients compared to SI patients. Indeed, Table 1 shows that RI patients significantly more often reported that aggressive behaviour or substance use were involved in injury occurrence than SI patients. Elaborating on this finding, we compared RI patients who indicated that at least one of their injuries involved their own aggression or substance use (29%, 56/192) with RI patients who indicated such behaviours for none of their injuries. The former had significantly more injuries (median 3.0, interquartile range 3.0 to 4.0, \( P=0.004 \) versus median 2.0, interquartile range 2.0 to 3.0). They were also younger (mean 34 years \((30.9\text{ to }37.6)\) versus mean 40 \((36.9\text{ to }42.4)\), \( P=0.026 \)) and more frequently male (78.6% \((44/56)\) versus 53.7% \((73/136)\), \( P=0.001 \)).
Table 1 Patient and injury characteristics of repetitively injured (RI) and singly injured (SI) patients

<table>
<thead>
<tr>
<th></th>
<th>RI patients 1) n=196</th>
<th>SI patients n=558</th>
<th>OR (95% CI) 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>38.0 (15.3)</td>
<td>42.9 (16.1)</td>
<td>0.98 (0.97-0.99) *</td>
</tr>
<tr>
<td>Males, % (n)</td>
<td>61.2 (120)</td>
<td>55.6 (310)</td>
<td>1.17 (0.83-1.64)</td>
</tr>
<tr>
<td>Weekend consultation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Fri,Sat,Sun), % (n)</td>
<td>50.0 (98)</td>
<td>40.5 (226)</td>
<td>1.38 (0.99-1.92)</td>
</tr>
<tr>
<td>Night consultation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8 pm to 8 am), % (n)</td>
<td>29.1 (57)</td>
<td>20.1 (112)</td>
<td>1.52 (1.04-2.21) *</td>
</tr>
<tr>
<td>Injury environments, % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>home</td>
<td>21.3 (37)</td>
<td>22.9 (127)</td>
<td>0.94 (0.62-1.43)</td>
</tr>
<tr>
<td>traffic</td>
<td>24.7 (43)</td>
<td>28.3 (157)</td>
<td>0.81 (0.55-1.20)</td>
</tr>
<tr>
<td>sports</td>
<td>17.8 (31)</td>
<td>17.3 (96)</td>
<td>0.84 (0.53-1.31)</td>
</tr>
<tr>
<td>work</td>
<td>19.5 (34)</td>
<td>17.8 (99)</td>
<td>0.98 (0.64-1.52)</td>
</tr>
<tr>
<td>other</td>
<td>16.7 (29)</td>
<td>13.7 (76)</td>
<td>1.17 (0.73-1.88)</td>
</tr>
<tr>
<td>Injury causes, % (n) 3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-risk behaviour</td>
<td>96.6 (168)</td>
<td>98.9 (522)</td>
<td>0.38 (0.12-1.19)</td>
</tr>
<tr>
<td>clumsiness patient</td>
<td>51.1 (89)</td>
<td>48.5 (256)</td>
<td>1.14 (0.81-1.61)</td>
</tr>
<tr>
<td>clumsiness others</td>
<td>16.1 (28)</td>
<td>20.5 (108)</td>
<td>0.74 (0.47-1.17)</td>
</tr>
<tr>
<td>aggressiveness others</td>
<td>8.6 (15)</td>
<td>4.7 (25)</td>
<td>1.68 (0.85-3.25)</td>
</tr>
<tr>
<td>alcohol others</td>
<td>2.3 (4)</td>
<td>2.3 (12)</td>
<td>0.86 (0.27-2.73)</td>
</tr>
<tr>
<td>medication others</td>
<td>0.0 (0)</td>
<td>0.4 (2)</td>
<td>-</td>
</tr>
<tr>
<td>mere bad luck</td>
<td>47.1 (82)</td>
<td>51.0 (269)</td>
<td>0.90 (0.64-1.27)</td>
</tr>
<tr>
<td>High-risk behaviour</td>
<td>14.9 (26)</td>
<td>6.6 (35)</td>
<td>2.21 (1.28-3.82) *</td>
</tr>
<tr>
<td>aggressiveness patient</td>
<td>8.1 (14)</td>
<td>1.9 (10)</td>
<td>3.98 (1.72-9.20) *</td>
</tr>
<tr>
<td>alcohol patient</td>
<td>9.8 (17)</td>
<td>4.9 (26)</td>
<td>1.83 (0.96-3.50)</td>
</tr>
<tr>
<td>medication patient</td>
<td>2.3 (4)</td>
<td>0.8 (4)</td>
<td>3.30 (0.81-13.50)</td>
</tr>
</tbody>
</table>

1) injury characteristics of RI patients were based on their first injury
2) SI patients were the reference group and odds ratios were adjusted for age, except for age
3) patients could mark more than one cause (mean number of causes per injury was 1.4 in both RI and SI patients) and therefore these columns add up to more than 100 percent
* P-value < 0.050

Our second hypothesis was that differences in the prevalence of high-risk behaviours between RI and SI patients would be particularly evident for home injuries as opposed to work, traffic, and sports injuries, since in the former environment we expected risk exposure to be relatively uniform and thus mainly person-related, whereas in the latter environments we
expected mere risk exposure to have a large influence in injury occurrence. Table 2 shows that as compared to the other environment categories, both patient groups reported aggressiveness and substance use predominantly in the category other environment followed by home, traffic, sports, and finally work environments. The same order was found in the adjusted odds ratios which quantified the difference between RI and SI patients. Thus, differences in injury causation between RI and SI patients were particularly evident in environments in which high-risk behaviours play a relatively prominent role, as illustrated by the significant difference for injuries occurring in other environments. Exploration of those injuries in other environments that were caused by patients’ own high-risk behaviours revealed that all except one injury of a SI patient occurred during night leisure time activities.

Table 2  High-risk behaviour in different injury environments for repetitively injured (RI) and singly injured (SI) patients

<table>
<thead>
<tr>
<th>High-risk behaviour</th>
<th>RI patients</th>
<th>SI patients</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=170</td>
<td>n=525</td>
<td></td>
</tr>
<tr>
<td>Injury environments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>16.7 (6)</td>
<td>8.1 (10)</td>
<td>2.11 (0.69-6.40)</td>
</tr>
<tr>
<td>Traffic</td>
<td>14.3 (6)</td>
<td>7.9 (12)</td>
<td>1.81 (0.62-5.27)</td>
</tr>
<tr>
<td>Sports</td>
<td>6.5 (2)</td>
<td>4.7 (4)</td>
<td>1.48 (0.25-8.56)</td>
</tr>
<tr>
<td>Work</td>
<td>0.0 (0)</td>
<td>1.1 (1)</td>
<td>-</td>
</tr>
<tr>
<td>Other environments</td>
<td>40.7 (11)</td>
<td>11.8 (8)</td>
<td>4.85 (1.57-14.95) *</td>
</tr>
</tbody>
</table>

1) patient’s own aggressiveness or substance use
2) injury characteristics of RI patients were based on their first injury
3) SI patients were the reference group and odds ratios were adjusted for age
* P-value < 0.050
Discussion

Injuries of RI patients were more often the result of their own aggressiveness than injuries of SI patients. This difference in injury circumstances between RI and SI patients was most evident in environments in which patients’ high-risk behaviours were an important cause of the injury. These findings lend support to the idea that injuries are not just a matter of misfortune, but a product of high-risk behaviour as well. Although earlier studies focusing on personality characteristics of injury repeaters suggested that high-risk behaviours are associated with injury proneness, this study was the first to take injury circumstances into account.

There are some limitations of this study that should be discussed. First, an overlap exists between RI and SI patients. Not only RI patients but also SI patients were injury-prone to some degree, because the latter needed a consultation for an injury as well. The finding that less than half of SI patients reported mere bad luck and/or behaviours of others as the sole cause of their injury illustrates this. In addition, a substantial proportion of RI patients also reported that only mere bad luck and/or behaviours of others were involved in injury occurrence. This underlines the heterogeneity within the group of RI patients. The overlap between RI and SI patients is likely to have resulted in an underestimation of the risk estimates.

Second, the results of this study may be influenced by response bias. Non-responding patients were younger and more frequently male than responders in RI patients as well as in patients with a single injury. Since RI patients who indicated at least once that their own high-risk behaviours were involved in injury occurrence also had a younger age and were more frequently male, this subgroup may be underrepresented in the total
group of RI patients. As a consequence, this may also have resulted in an underestimation of the risk estimates.

Finally, injury circumstances were self-reported, which may have led to an underestimation of the influence of patient’s own behaviour in injuries of RI patients as well as injuries of SI patients. When Marusic et al. (2001) studied injury proneness and personality, they found that introverted subjects felt more responsible for their injuries than extraverted subjects. Since extraversion may have been more present in the group of RI patients as earlier studies concerning injury proneness have suggested (Jin et al., 1991; Marusic et al., 2001), these patients probably underreported their own behaviour as a cause of their injuries. However, it should be mentioned that injury causes were patient’s reported perceptions of causes and that denying one’s own role in injury causation may be easier after a single injury, but harder to maintain after multiple injuries.

The association of injury recurrence with high-risk behaviour suggests a possible link with psychiatric comorbidity. Earlier studies already found that unintentional injuries are associated with a higher incidence of (pre-injury) psychopathology such as antisocial personality disorders and substance use (Malt et al., 1987; Poole et al., 1997; Whetsell et al., 1989). Ponzer et al. (1999) also reported that injury recurrence was associated with alcohol abuse, psychopathology, and violent behaviour. These studies compared repetitively injured patients with hospital-based controls or less frequently injured patients. Since these controls were injury-prone to some degree as well, we suggest that future research should compare psychopathology of repetitively injured patients with a sample of the general population using standardized methods for the diagnosis of psychopathology. The heterogeneity within the group of RI patients should be taken into account when examining psychopathology further.
Injury causes were differently distributed among the injury environments. High risk behaviour causes were more prevalent in night leisure time activities and home environments as compared to work and sports environments. This indicates that causes of work and sports injuries may be less person-related than in the other environment categories and this also explains why we found very small differences between RI and SI patients in injury causation in work and sports environments. The observation that the fraction of sports and work injuries is relatively equal in RI and SI patients suggests that clustering of these injuries is merely due to risk exposure differences between individuals.

This study illustrates how the collection and analysis of injury data, as suggested by the World Health Organization (WHO, 2004), can help to identify injury patients that are at risk of having another injury in the future due to their high-risk behaviour as opposed to due to their environment, both in clinical and research settings. The finding that injury recurrence is correlated with high-risk behaviours can be used as a starting point for preventive strategies. It might be argued that RI patients are reluctant to change their risk-taking behaviour and thus may be less susceptible to law enforcement activities or media prevention campaigns. However, high-risk behaviours often are the result of underlying treatable psychiatric illnesses. Mental health workers could extend their services at the emergency department from patients with deliberate self-harm and suicide attempts to patients with repetitive injuries. Our study suggests such interventions might prevent home and traffic injuries more than injuries occurring in work and sports environments.
Acknowledgements
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