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The role of depressive symptoms in recovery from injuries to the extremities in older persons. A prospective study

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SUMMARY

Background Previous research suggested that depressive symptoms play a role in recovery after hip fracture. However none of these studies were prospective and included only patients with hip fractures.

Objective To examine the effect of depressive symptoms on the recovery of (instrumental) activities of daily living after fall-related injuries to the extremities in older persons.

Design Prospective cohort study.

Methods Data were collected from 168 older persons at baseline, prior to their injuries (hip fractures, other fractures or contortions and dislocations), and 8 weeks, 5 months and 12 months after their accident. Hierarchical multiple regression analysis was used to study the impact of depressive symptoms (as assessed with the Hospital Anxiety and Depression Scale; HADS) on disability (as assessed with the Groningen Activity Restriction Scale; GARS) after the injury while adjusting for several covariates.

Results Depressive symptoms at baseline were not predictive for disability after the injury when covariates were taken into account. However, depressive symptoms 8 weeks after the fall were significantly related to disability at 8 weeks, 5 months and even 12 months after the injury. In addition, disability levels before the injury were highly predictive for recovery later on. Severity of injury was particularly predictive for disability at 8 weeks while age (which may generally represent the amount of physiological reserve) predicted disability at 5 and 12 months after the injury. Cognitive functioning 8 weeks post-injury was, in contrast to previous research, not predictive for recovery when covariates were taken into account.

Conclusions Pre-injury levels of disability and post-injury depressive symptoms are associated with recovery and may warrant concern and special attention in clinical practice. Copyright © 2002 John Wiley & Sons, Ltd.

KEY WORDS — depressive symptoms; disability; recovery; falls; elderly; The Netherlands

INTRODUCTION

Falls in the elderly are a common problem. Community-based studies report that 23.1–59.2% of those living independently, and 20–44.9% of institutionalised elderly fall at least once a year (Ryynänen et al., 1991; Stalenhoef et al., 1997). About 5% of falls result in fractures (1% in hip fractures) and 5% in other injuries (Stalenhoef et al., 1997). Non-fatal fall injuries have substantial short and longer-term consequences for individuals’ mobility and independence in activities of daily living (ADL) and instrumental activities of daily living (IADL). Only half of hip-fracture patients, for example, regain pre-injury levels of mobility, and 33–74% regain pre-injury ADL/IADL independence (Kreutzfeldt et al., 1984; Jette et al., 1987; Cummings et al., 1988; Magaziner et al., 1990; Kitamura et al., 1998; Koval et al., 1998;
of disability and depressive symptoms and three pre-injury baseline wave including the assessment after the fall. We used a prospective design with a pre-injury baseline wave including the assessment of disability and depressive symptoms and three post-injury waves assessing disability in the year after the event. Furthermore, we adjusted for chronic medical morbidity and disability at baseline, for the severity of the injury as well as for gender and age. Cognitive dysfunctioning and post-surgical disorientation were found to be associated with poor recovery after hip fracture, too (Billig et al., 1988; Mossey et al., 1989; Magaziner et al., 1990; Mossey et al., 1990; Young et al., 1997). Therefore, we included the level of cognitive functioning 8 weeks after the injury as a covariate in our multivariate analyses.

METHODS

Data source

The persons evaluated in this study are participants in the Groningen Longitudinal Aging Study (GLAS). GLAS is a population-based prospective and longitudinal study on the determinants of health-related quality of life of elderly people living independently in the north of the Netherlands, either in the community or in sheltered accommodations. All patients aged 57 years and older from 27 general medical practices, which are linked to a local morbidity registration network (99% of non-institutionalised elderly in the Netherlands are registered with general medical practices) were eligible to participate. In 1993, 5279 subjects completed baseline assessments (62% of the eligible population) comprising an interview and a self-report questionnaire. Objectives, design and matters of representativeness of GLAS have been described earlier (Kempen et al., 1997; Ormel et al., 1998; Kempen et al., 1998a).

For this cohort study, general practitioners (GPs) reported patients who had sustained injuries to the extremities according to site, as coded by the International Classification of Primary Care (ICPC; Lamberts and Wood, 1987). Patients who had completed the baseline assessment were included until 31 December 1997 if their injury fell under the ICPC-codes L72 to L80 (fractures of wrist/forearm, ankle/lower leg, hand/foot and hip, contortions of ankle, knee or other contortions and dislocations). Follow-up interviews were conducted 8 weeks after the injury (short-term impact), and 5 and 12 months after the injury (long-term impact). The interviews were held at respondents’ homes by experienced middle-aged female interviewers. The interviewers did not know the interviewees in either a clinical or an administrative aspect. At the start of the follow-up interviews a shortened version of Folstein’s Mini-Mental State Examination (MMSE; Folstein et al., 1975) was administered to evaluate respondents’ cognitive capacities for completing the assessment (threshold score = 4) (Breakhus et al., 1992). If
patients were too ill to complete the assessment at follow-up, proxy interviews regarding perceptible aspects of subjects’ physical functioning were conducted with a well-informed person nearby.

Measurement

Depressive symptoms were assessed with the depression scale of the Hospital Anxiety and Depression Scale (HADS; Alyard et al., 1987; Spinhoven et al., 1997). The HADS was originally developed to reveal possible anxiety and depressive states in a medical outpatient clinic setting. Items referring to symptoms that may have a physical cause (e.g. insomnia and weight loss) are not included in the scale. Therefore, the HADS is considered to be unbiased by coexisting general medical conditions (Spinhoven et al., 1997). Examples of the items are ‘I still enjoy the things I used to enjoy’, ‘I can laugh and see the funny side of things’, ‘I feel cheerful’ and ‘I feel as if I am slowed down’. The theoretical score range of these seven-item scales varies from 0 to 21; higher scores indicate more symptoms.

Disability in ADLs and IADLs was assessed with the Groningen Activity Restriction Scale (GARS; Kempen et al., 1996a) at baseline and at the three follow-ups. The GARS assesses disability in the domains of personal care and domestic activities, and comprises 18 items referring to both ADLs (personal care, 11 items) and IADLs (household chores, seven items), with four response options per item. Examples of items are ‘Can you, fully independently, dress yourself?’, ‘Can you, fully independently, stand up from sitting in a chair?’, ‘Can you, fully independently, get around in the house?’ and ‘Can you, fully independently, get on and off the toilet?’. Scores may range from 18 (no disability) to 72 (maximum disability). The results of previous studies showed that the 18-item GARS meets the stochastic cumulative scalability criteria of the Mokken Model, and can thus be considered one-dimensional (Kempen et al., 1996a).

Baseline levels of chronic medical morbidity, age, gender, severity of the injury and cognitive functioning 8 weeks post-injury were included as covariates because they were found in previous studies to be associated with recovery after hip fracture (see Introduction). A checklist of 19 chronic medical conditions was administered to assess chronic medical conditions at baseline (for detailed description see Kempen et al., 2001). The number of chronic medical conditions was used as an index of chronic morbidity. A three-level index of the severity of the injury was constructed incorporating the ICPC codes used by the GPs. Hip fracture was considered the most severe. The second level comprised fractures other than hip fracture (fractures of wrist/forearm, ankle/lower leg and hand/foot). The third level consisted of non-fracture injuries (contortions of ankle, knee or other contortions and dislocations). The level of cognitive functioning 8 weeks post-injury was assessed with a shortened 12-item version of Folstein’s MMSE (Breakhus et al., 1992). The scores theoretically range from 0 (severe cognitive impairment) to 12 (no cognitive impairment). The psychometric properties of the Dutch version were approved in a previous study (Kempen et al., 1995).

Participants and response

During the inclusion period, the GPs registered 287 patients who sustained injuries to the extremities. Of these, 18 did not meet the inclusion criteria, i.e. scored less than 5 (n = 2) on short version MMSE or were already enrolled in another GLAS cohort (n = 16). Four people had died in the period between registration date and date of contact and five people could not be located. This brought the number of eligible patients to 260. Another 59 patients refused to participate, 22 because they felt too ill and 37 for other reasons. Proxy interviews were conducted regarding the disability level of 10 patients who were hospitalised at the time of the assessment or felt too ill otherwise. Valid data were obtained from 201 patients (including the proxies) in the first series of interviews (8 weeks post-injury); of these, 186 participated in the second series (5 months post-injury) and 181 in the third (12 months post-injury). Ten patients, who had participated in all three follow-up assessments, appeared to have incomplete baseline data for the GARS. Only those patients with complete data for the dependent variable at all four measurements were included in the analyses (n = 171, response rate is 66% of 260 eligible patients—see above). In addition, three patients did not complete the HADS subscale for depressive symptomatology at 8 weeks post-injury, so 168 patients were included in the present study. The non-participants (including deceased and those who did not meet the inclusion criteria, n = 119) were older than the participants (72.8 and 70.2 years respectively) and more disabled at baseline (mean GARS-scores: 27.6 and 22.9). With respect to depressive symptoms, there were no significant differences between participants and non-participants at baseline (mean HADS-scores: 4.7 and 4.5 for non-participants and participants, respectively). Attrition in the present cohort study has been described.
elsewhere in detail (Kempen et al., 2001; Scaf-Klomp et al., 2001).

**Analytical strategy**

First, descriptive statistics were computed for all variables. Second, associations between the variables were analysed by means of Pearson correlation coefficients. Third, hierarchical multiple regression analysis was conducted to study the impact of depressive symptoms on levels of disability at 8 weeks follow-up, 5 months follow-up and 12 months follow-up adjusted for baseline levels of disability, age, gender, number of chronic medical conditions at baseline, the severity of injury and cognitive functioning 8 weeks post-injury. Two equations were estimated for each of the three follow-up measurements: the first with depressive symptomatology at baseline as the predictor and the second with the addition of depressive symptoms at 8 weeks post-injury.

**RESULTS**

Table 1 presents the descriptive statistics for all variables. The majority of patients were female (81.5%; n = 137); mean age for the sample was 70.2 years (observed range 57–88 years). Nearly 20% (n = 33) of patients sustained hip fractures, nearly 60% (n = 100) other fractures, and 20% (n = 35) contortions. The level of disability was significantly higher at each of the three follow-ups (means of 33.8, 28.3 and 28.8, respectively) compared to baseline (22.9) (paired t-tests, p < 0.05).

Table 2 presents the correlation coefficients for all selected variables. Depressive symptoms at baseline were moderately associated with disability at baseline (0.472) and with disability at 8 weeks (0.353), 5 months (0.432) and 12 months (0.362) post-injury. The correlations between depressive symptomatology at 8 weeks follow-up and disability were higher: 0.417 (at 8 weeks), 0.470 (at 5 months) and 0.390 (at 12 months). Disability at baseline was strongly related to disability later on: 0.542, 0.730 and 0.670.
respectively. Cognitive functioning was significantly related to disability and depressive symptoms at the bivariate level.

Table 3 presents the outcomes of the hierarchical multiple regression analyses. Depressive symptomatology at baseline was not significantly associated with the level of disability at 8 weeks post-injury, 5 months post-injury or 12 months post-injury. However, depressive symptomatology at 8 weeks post-injury was significantly associated with disability at 8 weeks post-injury ($\beta = 0.259$), as well as disability at 5 months ($\beta = 0.203$) and 12 months post-injury ($\beta = 0.147$). Baseline disability, assessed before the injury, was a strong predictor of disability later on. Severity of injury was particularly associated with disability at 8 weeks while age significantly predicted disability at 5 and 12 months after the injury. Cognitive functioning was not an independent predictor of disability at 8 weeks, 5 months or 12 months post-injury. The variance inflation factor (VIF) was used to measure collinearity in all regression models. The highest VIF was 1.76 and therefore much lower than 10.0, and can be considered acceptable (Kleinbaum et al., 1988).

DISCUSSION

In this prospective study we analysed the impact of depressive symptomatology on recovery after injuries to the extremities in older persons. Several conclusions can be drawn. First, depressive symptoms which were already present before the injury, were bivariately associated with disability at 8 weeks, 5 months and 12 months post-injury. However, when several covariates — such as disability at baseline and depressive symptoms 8 weeks after the injury — were taken into account, the impact of depressive symptoms at baseline on disability later on disappeared. Depressive symptomatology at 8 weeks post-injury remained a significant predictor of recovery later on. In addition, pre-injury levels of disability were highly predictive for recovery later on. Severity of injury was particularly predictive for disability at 8 weeks while age (which may generally represent the amount of physiological reserve) predicted disability at 5 and 12 months after the injury. Age seemed to begin to influence recovery as the impact of severity diminished. Cognitive functioning at 8 weeks post-injury was not independently related to disability at either 8 weeks, 5 months or 12 months post-injury.

Our results with respect to depressive symptomatology and recovery are consistent with previous research in hip-fracture patients (e.g. Mossey et al., 1989; Magaziner et al., 1990; Mossey et al., 1990; Mutran et al., 1995). Mossey et al. (1990), for example, reported that persons reporting fewer depressive symptoms were three times more likely than those with elevated depression scores to achieve independence in walking and nine times more likely to return to pre-fracture levels on at least five of seven physical function measures after their hip fracture. Magaziner et al. (1990) reported a standardised beta coefficient of 0.13 ($p < 0.01$) between initial depression scores and physical dependence in hip-fracture patients one-year after hospital discharge while adjusting for several covariates. Our study indicates that depressive symptoms 8 weeks post-injury are not only predictive for recovery after hip fracture, but also for recovery from fall-related injuries in general. In contrast, baseline (pre-fracture) levels of depressive symptoms (not included in previous studies) did not predict recovery in our multivariate models. This may particularly be due to the strong association between depressive symptoms at baseline and depressive symptoms 8 weeks post-injury ($r = 0.587$, see Table 2). On average, depressive symptomatology did not change significantly between baseline and 8 weeks post-injury in the total sample. However, 36 patients improved by at least three points on the HADS during this period, while another 30 patients deteriorated by at least three points. The impact of the injury may have induced or reduced depressive symptoms in specific groups of patients, which in turn may have affected their recovery. There is evidence that health behaviour is influenced by depressive symptoms, which may be induced by health problems. Depressed patients are more likely to not comply with medical recommendations and procedures, to not seek medical treatment when necessary and to be less physically active independent of levels of physical, cognitive and sensory functioning (e.g. Carney et al., 1995; Kempen et al., 1998b; Slymen et al., 1996). This may affect recovery from health events such as fall-related injuries. In addition, we found strong associations between pre-injury levels of disability and recovery later on, which is consistent with the hip-fracture studies by Kitamura et al. (1998), Mossey et al. (1989) and Magaziner et al. (1990).

With respect to cognitive functioning our results are less consistent with previous research. Although several researchers reported a significant impact of cognitive dysfunctioning on recovery in (hospitalised) hip-fracture patients (e.g. Mossey et al., 1989; Magaziner et al., 1990; Mossey et al., 1990), we only found bivariate associations between cognitive functioning and recovery. When covariates (such as depressive
Table 3. Hierarchical multiple regression analyses: disability at baseline, depressive symptoms at baseline, age, gender, chronic medical morbidity, level of injury, cognitive functioning 8 weeks post-injury and depressive symptoms 8 weeks post-injury on disability at 8 weeks, 5 months and 12 months post-injury

<table>
<thead>
<tr>
<th></th>
<th>8 weeks post-injury</th>
<th>5 months post-injury</th>
<th>12 months post-injury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$p$-value</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Disability at baseline</td>
<td>0.509</td>
<td>0.000</td>
<td>0.479</td>
</tr>
<tr>
<td>Depressive symptoms at baseline</td>
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<td>0.076</td>
<td>0.001</td>
</tr>
<tr>
<td>Age</td>
<td>-0.004</td>
<td>0.955</td>
<td>0.004</td>
</tr>
<tr>
<td>Gender (1 = male, 2 = female)</td>
<td>0.042</td>
<td>0.507</td>
<td>0.030</td>
</tr>
<tr>
<td>Number of chronic medical conditions</td>
<td>-0.305</td>
<td>0.000</td>
<td>-0.311</td>
</tr>
<tr>
<td>Level of injury</td>
<td>-0.049</td>
<td>0.481</td>
<td>-0.034</td>
</tr>
<tr>
<td>Cognitive functioning 8 weeks post-injury</td>
<td>-0.049</td>
<td>0.481</td>
<td>-0.034</td>
</tr>
<tr>
<td>Depressive symptoms 8 weeks post-injury</td>
<td>0.259</td>
<td>0.004</td>
<td>0.203</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.400</td>
<td>0.442</td>
<td>0.595</td>
</tr>
<tr>
<td>$F$-value</td>
<td>15.3</td>
<td>0.000</td>
<td>15.8</td>
</tr>
<tr>
<td>$R^2$ change</td>
<td>0.042</td>
<td>0.004</td>
<td>0.026</td>
</tr>
<tr>
<td>$F$-change</td>
<td>11.9</td>
<td>0.001</td>
<td>10.7</td>
</tr>
</tbody>
</table>

$\beta$, Standardised regression coefficient; $R^2$, Amount of variance explained.

$^a$Higher scores indicate poorer function.

$^b$1 = hip fracture, 2 = other fracture, 3 = non-fracture.

$^c$Higher scores indicate better function.
Symptoms, age and disability which are related to cognitive functioning—see Table 2)—were taken into account in the multivariate regression models, the significant association between cognitive functioning and post-injury disability disappeared. In addition, the participants in our study were relatively young, were living in the community, and experienced not only hip fracture as injury, which may have weakened the association between cognitive functioning and recovery. Jelicic et al. (1998) reported no decline in cognitive functioning in older patients two months after a fracture of the extremities compared to their pre-fracture status. They concluded that impaired cognition in older patients admitted to hospital for injury to the extremities is caused by factors related to hospitalisation and may therefore be temporary. Stress and anxiety, sleep disturbances and/or psychotropic drugs seem to be responsible for the high prevalence of cognitive dysfunctioning in this patient group. Less than 25% of the patients in our sample were hospitalised after their injury, which could explain the contradictory results.

We have only included self-reported measures for disability in our study. Previous research showed that self-reported levels of functioning are more strongly influenced by affective functioning (i.e. depressive symptomatology) compared to more objectively assessed, performance-based levels of functioning (Kempen et al., 1996b; Kempen et al., 1996c; Kempen et al., 1999). However, our study was primarily focussed on the impact of depressive symptomatology on changes of disability (i.e. the impact of depressive symptoms on disability after injury while adjusted for initial levels of disability). This may have weakened the perception bias with respect to depressive symptoms in its impact on self-reported disability.

Our prospective study included patients with fall-related injuries to the extremities, which occurred after the GLAS baseline assessment in 1993. The strength of this approach is that we assessed depressive symptoms, disability and chronic medical morbidity at baseline before the injury took place. However, this approach also has its limitations. The time interval between the start of the study and the fall-related injuries varied from immediately after the baseline to 57 months (mean: 23.9 months; standard deviation: 16.1). Health status, depressive symptomatology and disability may have changed during the interval. However, the outcomes in Table 3 hardly changed when the baseline to accident time interval was included as a covariate in the multivariate models; the interval variable was not a significant predictor. The correlation coefficients between the length of the time interval and the change in disability and depressive symptoms were —0.05 and 0.04, respectively (not significant). We therefore assume that variation in this interval did not substantially affect the outcomes of the study. Another limitation of the present study was the considerable attrition. The non-participants were older than the participants and more disabled at baseline. With respect to depressive symptoms, there were no significant differences between participants and non-participants at baseline. However, Kempen et al. (2002) recently demonstrated that attrition’s effect is more disturbing for descriptive results than for measures of (longitudinal) association. And finally, in a previous study, social support was found to be related with recovery after fall-related injuries (Kempen et al., 2001). However, including social support in our multivariate models hardly changed the outcomes of Table 3.

In conclusion, we found that depressive symptoms 8 weeks after the fall as well as pre-injury levels of disability were significantly related to disability at 8 weeks, 5 months and even 12 months after the injury. We conclude that both are predictive for recovery after fall-related injury and may warrant concern and special attention in the rehabilitation process of older persons who experience fall-related injuries.

**Acknowledgments**

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**KEY POINTS**

- Depressive symptoms as assessed before fall-related injuries in older persons were not predictive for functional recovery later on when covariates were taken into account. However, depressive symptomatology 8 weeks after the injury was predictive for functional recovery.
- Disability levels before the injury were highly predictive for recovery later on.
- Severity of the injury is particularly predictive for short-term recovery while age predicted disability at 5 and 12 months after the injury.
- Cognitive functioning 8 weeks post-injury was, in contrast to previous research, not predictive for recovery when covariates were taken into account.
Public Health and Health Psychology, Family Medicine, Psychiatry, Sociology (ICS) and Human Movement Sciences. GLAS and its substudies are financially supported by the Dutch government (through NESTOR), The University of Groningen, Faculty of Medical Sciences, The Dutch Cancer Foundation (NKB/KWF), and The Netherlands Organization for Scientific Research (NWO). Preparation of this paper was supported by a grant from NWO, grant 904-54-562. The central office of GLAS is located at the NCH, PO Box 196, 9700 AD Groningen, The Netherlands.

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