Depression in older people after fall-related injuries: a prospective study

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Abstract

Background: objectives of the study were i) to describe changes in depression in independently living people aged 57 or older with fall-related injuries, and ii) to examine the effect of incomplete recovery of physical functions on depression one year post-injury.

Method: prospective cohort-study, including a pre-injury baseline and post-injury assessments at 8 weeks, 5 months and one year. The sample consisted of 159 patients who sustained various kinds of fall-related injuries to the limbs. Physical functioning was measured by the Groningen Activity Restriction Scale, depression by the Hospital Anxiety and Depression Scale. Additional variables in the study were age, gender, chronic medical conditions and severity of the injury (three level-groups). Pre- and post-injury levels of depression were compared by using Student’s t-test and effect size indices. Hierarchical multivariate regression analysis was used to examine the contribution of change in physical functioning between baseline and one year post-injury to depression one year post-injury.

Results: severity of the injury was not associated with depression. Mean depression levels of all patients remained stable until 5 months post-injury but increased between 5 months and one year. Physical functioning decreased between baseline and 8 weeks post-injury, increased between 8 weeks and 5 months but did not change after 5 months. One year post-injury, both disability and depression were higher than at baseline. Change in physical functioning between baseline and one year post-injury accounted for 19% of the variance in depression explained by the regression model.

Conclusions: depressive reactions did not occur as long as patients experienced improvement in physical functioning but became manifest as recovery appeared to stagnate. No significant differences in this respect were found between hip fracture patients and patients with other injuries.

Keywords: depression, falls, injuries, recovery

Introduction

The consequences of falls are a major health problem in older populations. Older people who sustain fall-related injuries do not generally regain their pre-injury levels of physical functioning. Not only is this shown for hip fractures [1, 2], but also for other injuries [3, 4]. Poor recovery of physical functions, specifically those needed to carry out activities of daily living (ADLs), may lead to loss of independence and, consequently, to depressive feelings. Conversely, depressive feelings may hinder the process of recovery. Several studies approached the relationship between depressive symptomatology and physical disability in older people, although in different settings and from different points of view. Community-based studies that focused on the association of depression with physical functioning in general, found a positive relation between both subsyndromal and clinical depressive symptomatology and disability, independent of other relevant factors such as age and comorbidity [2, 5, 6]. In another study, changes for the worse in physical functioning were related to increase of depressive symptoms [7]. A comprehensive review of the literature on the association of late-life depression and
physical disability has been published recently [8]. To the extent that depression was studied in the context of falls and fall-related injuries, research mainly focused on two subjects, namely: depression as a risk factor for falling and depression as a predictor for recovery.

With respect to the latter subject, data indicate that patients with persisting elevated levels of depression do not recover as well as patients with lower or 'normal' levels [1, 8–10]. However, in these studies, depression was assessed after the fall and depressive history, if incorporated, was diagnosed by asking patients about their pre-injury symptoms [9]. Furthermore, the samples consisted of hip fracture patients only. Consequently, the results do not reveal whether the reported depressive feelings were increased or triggered by the fall or were symptoms of pre-existing mood disorders, nor whether the associations that were found between depression and recovery hold true for injuries other than hip fractures. For psychological interventions, aimed at reducing negative influences on recovery, it makes a great difference if the diagnosed depression is a continuation or worsening of a chronic condition, or specifically associated with the fall and the resulting disability. Up till now, data do not give information about these matters. The present, prospective, study aims at filling some of the lacunae in the knowledge about depressive reactions of older people who are confronted with a sudden and sometimes steep increase in disability caused by a fall.

In this article, we describe changes in depression in a cohort of independently living older people who sustained fall-related injuries, up to one year after the fall. Post-injury depression levels are compared with pre-injury levels that were assessed in the baseline wave of a longitudinal study of older people's health-related quality of life. Subsequently, we examine the effect of changes in physical functioning on post-injury depression. We were particularly interested in the patients’ situation after one year, a time when the medical treatment of the injury and subsequent rehabilitation programmes most likely would be completed and fall-related disability might be more or less irreversible. In a previous study we demonstrated that, besides hip fractures, other fall-related injuries might lead to lasting impairments endangering people’s independence [4]. For this reason, patients with various kinds of injuries (fractures and serious sprains or dislocations) are included in the analyses.

Methods

Procedures

The patients in this study participated in the Groningen Longitudinal Ageing Study (GLAS). GLAS is a population-based prospective and longitudinal study on the determinants of health-related quality of life of people aged 57 years and older who are living independently in the north of the Netherlands. In 1993, 5,279 subjects completed baseline assessments (62% of the eligible population). Participants were asked to give informed consent to be approached for follow-up studies focusing on different health problems. Details of GLAS have been described elsewhere [11].

For the present cohort study, local general practitioners (GPs) reported patients who sustained fall-related limb injuries that needed medical treatment, according to site as coded by the International Classification of Primary Care (ICPC) [12]. The codes used are fractures of wrist/forearm (L72), ankle/lower leg (L73), hand/foot-bones (L74), hip (L75), ‘other fractures’ (L76), sprains of ankle (L77), knee (L78) and ‘other sprains and dislocations’ (L80).

Patients who had completed the GLAS-baseline (T0) were included until 31 December 1997. The study consisted of three assessments, comprising semi-structured interviews and self-report questionnaires, administered at approximately 8 weeks (T1) and 5 (T2) and 12 months (T3) after the injury date. The interviews were conducted at the respondents’ homes by experienced female interviewers. At the start of the interview, a shortened version of Folstein’s Mini-Mental State Examination (MMSE) was administered to evaluate the respondents’ cognitive capacity to complete the assessment. A cut-off score of ≥ 5 was used to exclude people with serious cognitive impairment [13, 14].

Measures

Depression was assessed by the corresponding subscale of the Hospital Anxiety and Depression Scale (HADS) (7 items, scoring scale 0–21). An advantage of this instrument is that it specifically excludes items referring to somatic symptoms that might be attributable to physical illness. The HADS appears also insensitive to age differences. For diagnostic purposes the HADS distinguishes between ‘non-cases’ (threshold score 0–7), ‘doubtful cases’ (8–10) and ‘definite cases’ (11–21) [15, 16].

Physical functioning was assessed by the Groningen Activity Restriction Scale (GARS). The GARS is a one-dimensional, hierarchical scale measuring grades of difficulties a person may experience when carrying out ADLs without help. The scale comprises 18 items referring to activities in the domains of personal and domestic care. Response choices range from ‘yes, I can do it fully and independently without any difficulty’ (1) to ‘no I cannot do it without someone’s help’ (4). The GARS has been used in several studies in the Netherlands and in a multicentre, longitudinal European study on incapacitating diseases ‘EURIDISS’ [17, 18].

Comorbidity as well as severity of the injury may influence the association of depression and recovery. As an indicator of comorbidity we used the number of chronic medical conditions assessed at baseline. A checklist was administered, comprising 19 chronic medical conditions. Participants were asked whether they suffered from one
of more of these conditions in the 12 months prior to the baseline date (for detailed description see: [19]). Severity of the injury was included by constructing a three-level index based on the ICPC-codes that were reported by the GPs. Hip fracture was considered the highest level, all other fractures as second level and non-fracture injuries, such as sprains and dislocations, as the lowest level. Additionally, age, gender and baseline depression were included for their potential effect on the outcome variable depression, one year post-injury.

**Sample**

During the inclusion period, the GPs registered 287 patients who sustained limb injuries. Of these, 18 did not meet the inclusion criteria: a score of ≥5 on the shortened version of the MMSE (n=2) or enrolment in another GLAS cohort (n=16); 4 died in the period between registration date and date of contact and 5 people could not be located. Another 59 people refused to participate, 22 because they felt too ill and 37 for other reasons.

Valid data were obtained from 201 patients participating in the first series of interviews; of these, 186 participated in the second series and 181 in the third. Attrition after the first series was caused by refusals to continue (n=9), institutionalisation (n=1) and patients’ death before assessment (n=2); attrition of 3 people was not well documented. Attrition after the second assessment was caused by refusal (n=1), poor health (n=1) and patients’ death before assessment (n=3). Ten patients who participated in three follow-up assessments had incomplete baseline data on the GARS, 12 other patients on depression at T3. Data of 159 patients were included in the analyses (response = 61% of 259 eligible patients).

Of the 128 patients not in the study (including deceased and those who did not meet the inclusion criteria), 41 (32%) sustained hip fractures, 58 (45%) other fractures and 29 (23%) various sprains and dislocations and, in this respect, they differed significantly from the participants (proportions: 20%, 60% and 20%, respectively). Furthermore, the non-participants were older than the participants were (73.0 and 69.8 years respectively) and more disabled at baseline (mean GARS-scores: 27.5 and 22.7). With respect to the dependent variable depression, there were no significant differences between participants and non-participants at baseline (mean HADS-scores: 5.0 and 4.2 for non-participants and participants respectively), nor between the eligible patients and the remaining participants of the baseline sample (mean HADS-score of the latter: 4.3). Table 1 summarises personal characteristics of the patients in the study.

**Table 1. Baseline characteristics of sample (n=159)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td>69.8</td>
<td>7.6</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>19.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>80.5</td>
<td></td>
</tr>
<tr>
<td>Marital status (%)</td>
<td>Married</td>
<td>59.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Never married</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Widowed</td>
<td>35.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Divorced</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Living alone (%)</td>
<td></td>
<td>39.6</td>
<td></td>
</tr>
<tr>
<td>Educational level (%)</td>
<td>Elementary</td>
<td>71.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>College, university and advanced professional</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>Type of injury (%)</td>
<td>Hip fracture</td>
<td>20.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other fractures</td>
<td>59.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sprains and dislocations</td>
<td>20.1</td>
<td></td>
</tr>
<tr>
<td>Interval between baseline and injury date (years)</td>
<td>Mean</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.3</td>
<td></td>
</tr>
</tbody>
</table>

*Including life companionship, not married.

**Statistical analyses**

First, one-way ANOVA was used to test differences in mean levels of depression between the three injury groups at T0, T1, T2 and T3. Then, for the total sample, we used paired Student’s t-tests to test changes in depression and physical functioning in the periods between the assessments. Effect sizes (ES) were calculated to evaluate the magnitude of observed differences, using Cohen’s d, which is a measure for the distance of group means expressed in pooled standard deviations and can be utilised both for differences between two independent groups and for differences between two observations of the same group at different times. As a rule of thumb a difference is considered small if ES is about 0.2, moderate if ES is about 0.5 and large if ES is 0.8 or higher [20]. Effect sizes of significant differences only are given in the results section. Finally, we used hierarchical linear regression analysis to examine the contribution of change in physical functioning (T3–T0) to depression (T3), controlling for the selected covariates. Variables were entered in the following order: gender and age (1), chronic medical conditions (2), depression at baseline (3) and change in physical functioning (4). Results were considered significant if P<0.05.

**Results**

Figure 1 shows mean depression levels as assessed at baseline (T0) and at 8 weeks (T1), 5 months (T2) and one year post-injury (T3) in each injury group. Apparently, depression does not increase between baseline and 8 weeks post-injury, but tends to increase.
in the subsequent assessment periods, apparently more clearly in the two groups with fractures. However, the three injury groups do not differ significantly on depression, neither at baseline nor at any of the three follow-ups. For this reason, further results are given for the three groups combined. Table 2 presents mean levels of depression and physical functioning for the total sample at each assessment, and the results of paired t-tests for significance of changes between the assessments. Depression did not change significantly between baseline and 8 weeks post-injury, neither between 8 weeks and 5 months, but increased between 5 months and one year (ES=0.23). One year after the injury, depression was higher than at baseline (ES=0.34). Of the 151 patients who had HADS-scores below 8 at baseline (non-cases), four could be considered ‘definite cases’ (11 or more) at 8 weeks and 6 months post-injury, and eight at 12 months post-injury. Physical functioning decreased between baseline and 8 weeks post-injury (ES=1.60), increased between 8 weeks and 5 months (ES=0.82) and did not change significantly after the second follow-up. One year after the injury, patients’ levels of physical functioning were lower than at baseline (ES=1.06). Correlation coefficients of the variables used in the hierarchical multiple regression analysis are presented in Table 3, the model summaries of the analysis in Table 4. The results show that increase in disability between baseline and one year post-injury is a significant independent contributor to depression one year post-injury, and accounts for 19% of the variance explained by the model. Baseline depression accounts for 20%. In the final model, the combined effect of age and gender is not significant, neither is the effect of chronic conditions.

**Table 2.** Mean scores of depression and physical functioning at 4 assessments (n=159)

<table>
<thead>
<tr>
<th></th>
<th>T0a</th>
<th>T1b</th>
<th>T2c</th>
<th>T3d</th>
<th>T1-T0e</th>
<th>T2-T1f</th>
<th>T3-T2g</th>
<th>T3-T0h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression (HADS)</td>
<td>4.24</td>
<td>4.22f</td>
<td>4.69g</td>
<td>5.17</td>
<td>n.s.</td>
<td>n.s.</td>
<td>P&lt;0.001</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>Physical function (GARS)</td>
<td>22.69</td>
<td>34.06</td>
<td>28.22</td>
<td>28.08</td>
<td>P&lt;0.001</td>
<td>P&lt;0.001</td>
<td>n.s.</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>

*a* Pre-injury baseline.  
*b* 8 weeks post-injury.  
*c* 5 months post-injury.  
*d* One year post-injury.  
*e* Paired Student’s t-tests.  
*f* n=157, due to missing data.  
*g* n=156, due to missing data.

**Table 3.** Pearson’s correlation coefficients of variables in the hierarchical multiple regression analysis of depression one year post-injury (T3) with age, gender, chronic conditions at baseline (T0) and change in disability (T3–T0)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.17a</td>
<td>0.14</td>
<td>0.09</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.13</td>
<td>0.12</td>
<td>0.08</td>
<td>-0.00</td>
<td></td>
</tr>
<tr>
<td>Chronic conditions</td>
<td>0.25b</td>
<td>0.14</td>
<td>0.11</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Baseline depression</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
<td></td>
</tr>
<tr>
<td>Change in physical functioning</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
<td></td>
</tr>
</tbody>
</table>

One-tailed significance:  
*a* P<0.05.  
*b* P<0.01.

**Table 4.** Results of hierarchical multiple regression analysis of age and gender (step 1), chronic medical conditions (step 2), baseline depression (step 3) and change in physical functioning between baseline and one year post-injury (step 4) on depression one year post-injury

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>β</th>
<th>β</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.17</td>
<td>0.14</td>
<td>0.09</td>
<td>-0.02</td>
</tr>
<tr>
<td>Gender</td>
<td>0.13</td>
<td>0.12</td>
<td>0.08</td>
<td>-0.00</td>
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<tr>
<td>Chronic conditions</td>
<td>0.25b</td>
<td>0.14</td>
<td>0.11</td>
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<tr>
<td>Baseline depression</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
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<tr>
<td>Change in physical functioning</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
<td>0.46b</td>
</tr>
</tbody>
</table>

R² change (%)  
Overall F:  
R² change (%)  
F change  
*a* P<0.05.  
*b* P<0.01.

Depression in older people after fall-related injuries
Discussion

The aims of this study were two-fold: to investigate whether and how depression changes in older persons who sustained fall-related injuries and to determine to what extent incomplete recovery of physical functions might be responsible for increased depressive symptoms, one year after the injury. Data were assessed pre-injury, and at 8 weeks, 5 months and one year post-injury. First, we looked for differences in depression between different levels of severity of the injury. No such differences were found at any of the assessments. Further results, for the combined group, showed that depression levels remained comparable to those at baseline until 5 months post-injury but increased significantly between 5 months and one year. Disability, on the other hand, increased between baseline and 8 weeks, decreased between 8 weeks and 5 months and did not change after 5 months. One year post-injury both disability and depression were higher than at baseline. The calculated effect sizes indicate that the changes in depression may be considered small to moderate, whereas the changes in physical functioning may be considered substantial. We also found an increase in the number of patients who, according to the HADS criteria, were non-cases at baseline but were definite cases after the fall. Hierarchical multiple regression analysis showed that baseline depression accounted for 20% of the variance in depression one year post-injury, and increased disability for 19%. Age, gender and chronic conditions did not contribute independently to depression one year after the injury was sustained.

It cannot be concluded, generally, that falling and its consequences resulted in serious depressive disorders in our patient group. However, we observed distinct and significant increases in depression scores at 5 months and 1 year, and the association of increased disability and depression one year post-injury appears substantial. This points to reduced feelings of general well-being and quality of life at the very least.

A noticeable outcome is that significantly elevated depression levels were not found until 5 months after the injury, when physical recovery appeared to have reached its maximum. Apparently, at that time, patients realised that further improvement was doubtful and that they had to reckon with lasting impairments resulting from the injury. That such a conclusion may lead to depressive reactions is not surprising since, specifically in this group of older patients, loss of physical functions may involve loss of independence and, often, loss of quality of life. Also noteworthy is the fact that the results not only relate to hip fractures, but also to other fractures and serious non-fracture injuries. This, too, is only natural, since poor recovery of, for example, severe wrist or ankle fractures may lead to lasting difficulties with activities of every day life and loss of independence [4].

Our results are consistent with those of Mutran, who observed that low improvement of walking ability led to increased depression, six months after hip fracture [10]. However, the initial post-injury depression levels of the hip fracture patients in our study were lower than those observed by Mutran, who measured depression in hospital, shortly after surgery, whereas depression in our study was measured 8 weeks post-injury.

A few studies suggested a predictive role of depression or mental distress for (recurrent) falling [21, 22]. The present study does not confirm this suggestion, since the baseline depression scores of the eligible patients did not differ from those of the remaining participant of the GLAS sample.

Some comments need to be made about these results. A strong point of the study is its prospective design. Since we had pre-injury data of the patients, we could assess whether elevated post-injury depression rates were a reaction to the event, or merely an extension of a chronic state of depression, an answer that previous studies could not provide. Additionally, we had baseline data on the relevant variables from the eligible non-responders.

We consider a response rate of 62% satisfactory for a cohort of elderly people followed for a comparatively long time (1993–1998). As to the unequal proportion of men and women in the sample, this rather reflects a sex bias in the population than a sample bias. Generally, compared to men, women run a greater risk of sustaining injuries after falls accidents [3].

A limitation is a potential ‘healthy selection’ of the patients in the sample. Patients with hip fractures, the most serious injury studied, are underrepresented, 20% vs 31% in the non-participating group. Furthermore, the non-participants were older and more disabled at baseline than the participants were. A health-related bias is a common problem in health research. Responders are generally more likely the people with the comparatively ‘better’ conditions among the eligible population. This is all the more true for longitudinal studies of older people who suffer from health conditions. However, if the more healthy people in the population react with depressive feelings to their increased disability, we can hardly find grounds for the assumption that people who were (initially) in a worse condition, would react very differently. Advancing age is supposed to be associated with both depression and physical functioning. The mean interval of two years between the baseline assessment and the first post-injury follow-up might therefore account for a proportion of the explained variation in depression. However, the outcomes of the study were not affected by the inclusion of this interval in the regression analysis.

Overall, the results of our study contribute to the insight in older peoples’ psychological reactions to fall-related disability. Two conclusions specifically add to previous findings. First, the fact that depressive reactions did not occur as long as the patients experienced improvement of their physical functioning, but became manifest after 5 months, as recovery appeared to...
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stagnate and physical functions appeared to remain below pre-injury levels. Secondly, the fact that, in this respect, we did not find significant differences between hip fracture patients and patients with other serious injuries. These findings imply that the psychological conditions of older injured patients do not only warrant attention immediately after the injury (e.g. post-surgery), but certainly also after 5 to 6 months, when the patients are confronted with the lasting consequences of their fall. Such attention has to be extended to outpatients who are treated for serious limb injuries, such as wrist and ankle fractures, since these patients, too, are at risk of acquiring lasting impairments that may threaten their quality of life. For effective psychological interventions it might be important to differentiate between post-injury depression with roots in chronic disorders on the one hand and depressive feelings that are specifically related to the consequences of lasting impairments for patients’ future everyday lives on the other hand.

Key points
- Recovery appears to plateau 5 months after the injury.
- Levels of depression did not increase until 5 months post-injury.
- Depressive reactions do not occur as long as patients experience improvement of physical functions.
- Hip fracture patients do not differ from patients with other injuries in this respect.

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