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Recovery of physical function after limb injuries in independent older people living at home

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Abstract

Objectives: to describe changes in physical functioning after fall-related injuries to the limbs in independently living older people.

Design: prospective cohort study, including a pre-injury assessment and post-injury assessments at 8 weeks and 5 and 12 months.

Setting: the study is part of the larger, population-based prospective and longitudinal Groningen Longitudinal Aging Study on the determinants of health-related quality of life of people aged 57 and over, who are living independently in the north of the Netherlands.

Subjects: 171 patients who sustained injuries at various sites on the limbs and who had completed all four assessments (66% of the eligible population). Patients were grouped according to injury site.

Outcome measure: self-reported grades of difficulties with performing basic and instrumental activities of daily living as measured by the Groningen Activity Restriction Scale.

Results: 1 year after the injury, pre-injury (mean) levels of functioning were not regained in any of the groups studied. However, only those with fractures of the wrist or hip experienced a substantial decrease in ability to perform basic and instrumental activities of daily living between baseline and the final assessment. Furthermore, of the 44 subjects with wrist fractures, seven (15.9%) needed help with at least one relevant activity at baseline and 18 (40.9%) at 12 months. Of the 34 subjects with hip fractures, four (11.8%) needed help with at least one activity at baseline and 18 (52.9%) at 12 months. Practically no changes were found in any of the groups after 5 months post-injury.

Conclusions: not only hip fractures, but also wrist fractures may reduce older people’s chances of remaining independent. Prospects of further recovery are minimal 5–6 months after the injury.

Keywords: activities of daily living, falls, injuries, recovery

Introduction

Community-based studies report that 25–40% of people aged 65 or over living at home fall at least once a year. Major injuries occur in 6–10% of all falls; about half of these are fractures [1–4]. Most research into the recovery of physical function after fall-related injuries has focused on hip fractures [5–7]. Little attention has been paid to the impact of less severe injuries, such as fractures or serious sprains of shoulders, wrists, knees or ankles.

Studies on long-term effects of fractures at sites other than the hip are scarce, especially those including baseline assessments [8]. However, injury resulting in malfunctioning of the hand or restricted mobility may also lead to loss of independence and, consequently, reduced quality of life [9].

The aim of this prospective study was to describe changes in physical functioning in a cohort of community dwelling older patients up to 1 year after they had injured a limb through a fall or other accident. We
examined injuries at different sites for their impact on functions essential for managing independently in and near the house. We gave special attention to the extent to which patients experienced difficulties or became dependent in activities of daily living (ADLs) 1 year after the injury.

Methods

Procedures

The subjects of this study are participants in the Groningen Longitudinal Aging Study (GLAS). This is a population-based prospective study on the determinants of health-related quality of life of independently living people aged 57 years and older. In 1993, 5279 subjects completed baseline assessments (62% of the eligible population). Participating subjects were asked to give informed consent to be approached for follow-up studies stemming from the baseline assessment and focusing on different health problems. The objectives, design and matters of generalisability of GLAS have been described previously [10, 11].

For this cohort study, local general practitioners participating in the GLAS reported patients who sustained injuries to the limbs that needed medical treatment, according to site as coded by the International Classification of Primary Care (ICPC) [12]. The codes used in the current study were: L72, fractures of wrist or forearm; L73, fractures of ankle or lower leg; L74, fractures of hand or foot; L75, hip fractures; L76, other fractures (e.g. collarbone, upper arm, heel); L77, ankle sprains; L78, knee sprains; L80, other sprains and dislocations. The code L79, which comprises only minor injuries (bruises, abrasions) at various sites, was not included.

Patients who had completed the baseline assessment up until 31 December 1997 were included. The study consisted of three assessments, comprising semi-structured interviews and self-report questionnaires administered at around 8 weeks (T1) and 5 (T2) and 12 (T3) months after the date of the injury.

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 respondent’s cognitive capacity to complete the assessment. A cut-off score of ≥5 was used to exclude people with serious cognitive disorders [13–15]. If patients were too ill to complete the assessment, proxy interviews on aspects of subjects’ physical functioning were conducted with relatives or carers.

Outcome measures

Functional status was assessed by the Groningen Activity Restriction Scale (GARS). The GARS is an unidimensional, hierarchical scale measuring grades of difficulties a person may experience when carrying out ADLs without help. The GARS was used earlier in several studies in the Netherlands and in a multicentre, longitudinal European study on incapacitating diseases, ‘EURIDISS’ [10, 16]. The GARS comprises 18 items, each with four response categories, and can be used either to measure overall ADL disability, or to distinguish between the performance of basic and instrumental ADLs (BADLs and IADLs). The 11-item BADL subscale addresses difficulties in the domain of personal care (scale range 11–44), the 7-item IADL subscale addresses difficulties in the domain of domestic care (scale range 7–28). 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). In this study, we present subjects’ performances of BADLs and IADLs separately.

Subjects and response

During the inclusion period, general practitioners registered 287 patients who sustained injuries to the limbs. Of these, 18 did not meet the inclusion criteria: two had scores on the shortened version of the MMSE that were < 5; 16 were enrolled in another GLAS cohort. Four had died between the date of registration and the date of contact and five could not be located. Another 59 subjects refused to participate: 22 because they felt too ill and 37 for other reasons. Proxy interviews were conducted on the functional status of 10 patients who were in hospital at the time of the assessment or felt too ill for the assessment.

We obtained data from 201 subjects (including the proxies) participating in the first series of interviews. Of these, 186 participated in the second series and 181 in the third. Loss of subjects after the first series was a result of refusal to continue in nine subjects, institutionalization in one and death in two. The loss of three people was not well documented. Loss after the second assessment was a result of refusal in one subject, poor health in one and death in three. Ten subjects who participated in three follow-up assessments appeared to have completed a concise version of the baseline measure, which did not include the GARS. We have omitted these subjects and included only those with complete data for the dependent variables at all four measurements in the analyses (n=171; 66% of the 259 eligible patients).

Of the 116 patients not in the study (including those who had died and those who did not meet the inclusion criteria), 12 (10.3%) sustained fractures of wrist or forearm, five (4.3%) of ankle or lower leg, nine (7.8%) of hand- or foot-bones, 37 (31.9%) of the hip, 27 (23.3%) ‘other fractures’, 14 (12.1%) sprains of the knee, seven (6.0%) sprains of the ankle and five (4.3%) ‘other sprains and dislocations’. The mean age of the non-participants at baseline was 72.6 years (SD 8.8); the mean
Recovery of physical function after injury

<table>
<thead>
<tr>
<th>Table 1. Demographic characteristics by injury group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group (ICPC code for injury)</td>
</tr>
<tr>
<td>L72</td>
</tr>
<tr>
<td>No. of subjects (%)</td>
</tr>
<tr>
<td>Mean age, years (SD)</td>
</tr>
<tr>
<td>Sex, %</td>
</tr>
<tr>
<td>Men</td>
</tr>
<tr>
<td>Women</td>
</tr>
<tr>
<td>Marital status, %</td>
</tr>
<tr>
<td>Married</td>
</tr>
<tr>
<td>Never married</td>
</tr>
<tr>
<td>Widowed</td>
</tr>
<tr>
<td>Divorced</td>
</tr>
<tr>
<td>Living alone, %</td>
</tr>
<tr>
<td>Education, %</td>
</tr>
<tr>
<td>Elementary</td>
</tr>
<tr>
<td>Secondary</td>
</tr>
<tr>
<td>Higher</td>
</tr>
<tr>
<td>Mean time baseline-injury, months (SD)</td>
</tr>
</tbody>
</table>

1L72, fractures of wrist or forearm; L73, fractures of ankle or lower leg; L74, fractures of hand or foot; L75, hip fractures; L76, other fractures (e.g. collarbone, upper arm, heel); L77, ankle sprains; L78, knee sprains; L80, other sprains and dislocations.

2Including life companionship, not married.

3Highest completed school education according to the International Classification of Education (ISCED, Netherlands’ Central Bureau of Statistics, 1989).

baseline scores on BADL and IADL were 15.9 (SD 6.1) and 12.3 (SD 6.0) respectively. Table 1 summarizes the personal characteristics of the participants in each injury group.

Analyses
For each ICPC subgroup, we calculated changes in mean BADL and IADL scores between the four measurements.

Within-group changes were tested for significance by using Wilcoxon’s matched-pairs signed-ranks test. Between-group differences in recovery were not tested because the sizes of the respective injury groups diverged too much. Observed differences were considered significant if $P$ was < 0.05.

Dependence on help with specific activities was measured by dichotomizing the response categories into “can do it independently without or with more or less difficulty” (1–3) and “cannot do it without help” (4). For those injury groups where difficulties appeared to persist (according to T0–T3 changes in mean scores), dependence in individual BADL and IADL items is shown for T0 and T3.

Results

BADLs
At T1, 8–10 weeks after the injury, mean scores on BADL were significantly higher than at baseline in all eight groups, implying an increase in difficulties with personal care tasks (Table 2). Hip fracture patients (L75) showed the largest increase; patients with fractures of hand- or foot-bones (L74) the smallest.

Five months after injury (at T2), BADL appeared to have improved in four groups: patients with fractures of the wrist or forearm (L72), ankle or lower leg (L73) or hip (L75), and those with ‘other fractures’ (L76). The three groups that experienced the steepest increase in difficulties between T0 and T1 also had the biggest decrease between T1 and T2: these were the patients with fractures of wrist or forearm (L72), ankle or lower leg (L73) and hip (L75).

Between T2 and T3, changes were small and not significant: some groups showed a slight decrease; others a slight increase. Only in patients with knee sprains (L78) did improvement continue significantly.

One year after the injury (T3), none of the groups had regained their pre-injury level of functioning. Significant differences from baseline functioning were found in the five groups with fractures (L72 to L76), although the differences among patients with fractures of ankle or lower leg (L73) and of hand- or foot-bones (L74) were small.

IADLs
As Table 3 shows, changes in IADL scores follow largely the same patterns as those of BADL—a marked increase in difficulties at T1 in patients with fractures of wrist or forearm (L72), ankle or lower leg (L73) and hip (L75) and in those with ‘other fractures’ (L76), a more moderate increase in difficulties among patients with
Table 2. Change in basic activities of daily living (measured by the Groningen Activity Restriction Scale) over the study period

<table>
<thead>
<tr>
<th>Group(^a)</th>
<th>(#)</th>
<th>Mean value (SD)</th>
<th>Difference(^b)</th>
<th>T1 vs T0</th>
<th>T2 vs T1</th>
<th>T3 vs T2</th>
<th>T3 vs T0</th>
</tr>
</thead>
<tbody>
<tr>
<td>L72</td>
<td>44</td>
<td>12.0 (1.7)</td>
<td>15.3 (5.8)</td>
<td>+ 4.61(^c)</td>
<td>- 2.16(^c)</td>
<td>+ 0.86</td>
<td>+ 3.32(^c)</td>
</tr>
<tr>
<td>L73</td>
<td>14</td>
<td>11.7 (1.9)</td>
<td>13.2 (3.0)</td>
<td>+ 5.95(^c)</td>
<td>- 3.50(^c)</td>
<td>- 0.93</td>
<td>+ 1.50(^c)</td>
</tr>
<tr>
<td>L74</td>
<td>12</td>
<td>15.0 (6.2)</td>
<td>16.5 (6.9)</td>
<td>+ 1.75(^c)</td>
<td>- 0.67</td>
<td>+ 0.42</td>
<td>+ 1.50(^c)</td>
</tr>
<tr>
<td>L75</td>
<td>34</td>
<td>13.1 (3.8)</td>
<td>17.3 (7.3)</td>
<td>+ 8.71(^c)</td>
<td>- 4.62(^c)</td>
<td>+ 0.21</td>
<td>+ 4.29(^c)</td>
</tr>
<tr>
<td>L76</td>
<td>32</td>
<td>13.3 (2.4)</td>
<td>16.6 (5.9)</td>
<td>+ 4.06(^c)</td>
<td>- 1.72(^c)</td>
<td>+ 0.91</td>
<td>+ 3.25(^c)</td>
</tr>
<tr>
<td>L77</td>
<td>14</td>
<td>12.8 (2.6)</td>
<td>14.7 (7.2)</td>
<td>+ 3.36(^c)</td>
<td>- 0.86</td>
<td>- 0.57</td>
<td>+ 1.93</td>
</tr>
<tr>
<td>L78</td>
<td>14</td>
<td>14.3 (6.7)</td>
<td>15.6 (6.9)</td>
<td>+ 3.86(^c)</td>
<td>- 1.14</td>
<td>- 1.36</td>
<td>+ 1.36</td>
</tr>
<tr>
<td>L80</td>
<td>7</td>
<td>15.1 (5.3)</td>
<td>18.6 (6.5)</td>
<td>+ 3.57(^c)</td>
<td>- 0.86</td>
<td>+ 0.71</td>
<td>+ 3.43</td>
</tr>
<tr>
<td>Total</td>
<td>171</td>
<td>13.0 (3.5)</td>
<td>16.0 (6.5)</td>
<td>+ 5.02(^c)</td>
<td>- 2.33(^c)</td>
<td>+ 0.26</td>
<td>+ 2.95(^c)</td>
</tr>
</tbody>
</table>

T1, 8 weeks post-injury; T2, 5 months post-injury; T3, 12 months post-injury.

1L72, fractures of wrist or forearm; L73, fractures of ankle or lower leg; L74, fractures of hand or foot; L75, hip fractures; L76, other fractures (e.g. collarbone, upper arm, heel); L77, ankle sprains; L78, knee sprains; L80, other sprains and dislocations.

2Between the two measurements.

3Wilcoxon matched-pairs signed-ranks test, \(P<0.05\).

Table 3. Change in instrumental activities of daily living (measured by the Groningen Activity Restriction Scale) over the study period

<table>
<thead>
<tr>
<th>Group(^a)</th>
<th>(#)</th>
<th>Mean value (SD)</th>
<th>Difference(^b)</th>
<th>T1 vs T0</th>
<th>T2 vs T1</th>
<th>T3 vs T2</th>
<th>T3 vs T0</th>
</tr>
</thead>
<tbody>
<tr>
<td>L72</td>
<td>44</td>
<td>8.6 (2.8)</td>
<td>12.3 (5.5)</td>
<td>+ 6.95(^c)</td>
<td>- 3.16(^c)</td>
<td>- 0.02</td>
<td>+ 3.77(^c)</td>
</tr>
<tr>
<td>L73</td>
<td>14</td>
<td>8.8 (3.2)</td>
<td>10.1 (4.2)</td>
<td>+ 8.78(^c)</td>
<td>- 6.14(^c)</td>
<td>- 1.36</td>
<td>+ 1.28</td>
</tr>
<tr>
<td>L74</td>
<td>12</td>
<td>12.2 (7.3)</td>
<td>14.0 (6.7)</td>
<td>+ 1.92</td>
<td>- 0.83</td>
<td>+ 0.67</td>
<td>+ 1.75</td>
</tr>
<tr>
<td>L75</td>
<td>34</td>
<td>9.8 (4.4)</td>
<td>14.3 (6.3)</td>
<td>+ 10.00(^c)</td>
<td>- 5.76(^c)</td>
<td>+ 0.23</td>
<td>+ 4.47(^c)</td>
</tr>
<tr>
<td>L76</td>
<td>32</td>
<td>10.6 (4.6)</td>
<td>13.7 (5.5)</td>
<td>+ 5.19(^c)</td>
<td>- 2.84(^c)</td>
<td>+ 0.72</td>
<td>+ 3.06(^c)</td>
</tr>
<tr>
<td>L77</td>
<td>14</td>
<td>9.3 (3.7)</td>
<td>11.5 (5.9)</td>
<td>+ 3.64(^c)</td>
<td>- 1.14</td>
<td>- 0.28</td>
<td>+ 2.21</td>
</tr>
<tr>
<td>L78</td>
<td>14</td>
<td>10.4 (5.0)</td>
<td>12.9 (6.7)</td>
<td>+ 3.29(^c)</td>
<td>- 1.00</td>
<td>+ 0.21</td>
<td>+ 2.50(^c)</td>
</tr>
<tr>
<td>L80</td>
<td>7</td>
<td>14.4 (6.8)</td>
<td>15.4 (8.9)</td>
<td>+ 1.57</td>
<td>- 0.71</td>
<td>+ 0.14</td>
<td>+ 1.00</td>
</tr>
<tr>
<td>Total</td>
<td>171</td>
<td>9.9 (4.5)</td>
<td>13.0 (5.8)</td>
<td>+ 6.25(^c)</td>
<td>- 3.26(^c)</td>
<td>+ 0.11</td>
<td>+ 3.09(^c)</td>
</tr>
</tbody>
</table>

T1, 8 weeks post-injury; T2, 5 months post-injury; T3, 12 months post-injury.

1L72, fractures of wrist or forearm; L73, fractures of ankle or lower leg; L74, fractures of hand or foot; L75, hip fractures; L76, other fractures (e.g. collarbone, upper arm, heel); L77, ankle sprains; L78, knee sprains; L80, other sprains and dislocations.

2Between the two measurements.

3Wilcoxon matched-pairs signed-ranks test, \(P<0.05\).

Sprains of ankle and knee (L77, L78), and, unlike BADL, no significant increase among patients with fractures of hand- or foot-bones (L74) and ‘other sprains and dislocations’ (L80).

Patients with fractures of wrist or forearm (L72), ankle or lower leg (L73) and hip (L75) and those with ‘other fractures’ (L76) made a good recovery during the period between T1 and T2—patients with fractures of the ankle or lower leg (L73) and hip (L75) more so than patients in the other groups.

Like BADL, IADL score did not improve greatly after the second follow-up. Post-injury levels of difficulties with IADLs remained higher than at baseline in all groups, significantly so in patients with fractures of wrist or forearm (L72) and hip (L75), those with ‘other fractures’ (L76) and those with sprains of the knee (L78). Patients with fractures of wrist or forearm and the hip showed the largest increase.

Dependence regarding specific activities

Table 4 shows dependence for BADLs and IADLs at baseline (‘T0’) and 1 year after the injury (‘T3’) for patients with fractures of wrist or forearm (L72) and hip (L75), the two groups with the most noticeable change in mean scores in the intervening period.

Apart from foot-care, none of the subjects with fractures of wrist or forearm and only a few of those with hip fractures needed help with personal care tasks before the injury was sustained. One year after the injury, 4–5 people in each group needed help from others with dressing and washing and drying their (entire) body,
while five and seven people respectively could not walk up or down stairs on their own. In the domain of
domestic care, the increase is even more noticeable,
especially in the group with hip fractures. Many subjects
in this group have to call in help for more complicated
activities, from preparing dinner to heavy cleaning.
Dependence in this domain does not appear to be sex-
related: of all the subjects (in both groups) who needed
help for preparing dinner, only one was a man. Likewise,
only two of the people who needed help with washing
and ironing clothes, making beds or shopping, were men.

Another indication of growing dependence is the
number of people who need help with at least one
activity. Foot-care and heavy cleaning are activities for
which older people often have to rely on others.
Excluding these two specific activities, the number of
subjects in both groups who needed help with the
remaining activities is much larger at T3 than at T0. Of
the 44 patients with fractures of wrist or forearm, seven
needed help with at least one activity at T0, whereas
18 needed help at T3. Of the 34 patients with hip frac-
tures, four needed help at T0 with at least one activity
and 18 at T3.

Discussion
Overall, the results show a clear and consistent pattern
for both personal care and domestic care, indicating a
substantial and significant decline in physical functioning
8–10 weeks after the injury (T1), a significant recovery at
5 months (T2), and no substantial change after T2. The
final assessment, 1 year after the injury (T3), revealed a
much lower level of functioning than at the baseline (T0)
in both domains. The mean differences between pre-
and post-injury functioning were substantially higher
than those observed in another study that examined
changes in disability over a period of 2 years in a cohort
of low-functioning people from the same population
who had not sustained fall-related injuries [17].

However, the extent of the changes in functional
status varied greatly among the different groups. At T1,
the largest differences from BADL and IADL at baseline
were reported by patients with fractures of the hip, the
wrist or forearm and the ankle or lower leg, the smallest
by patients with fractures of hand- or foot-bones and
those in the group with various sprains and dislocations.
At T2, patients in all groups made at least some recovery,
most markedly the patients with fractures of wrist or
forearm, ankle or lower leg and hip, and those with ‘other fractures’. The more the (short-term) effect of the
injury on the decline of the functional status, the more,
apparently, the degree of recovery. After this second post-
injury assessment, progress appeared to have slowed
down or to have stopped altogether in all groups. One
year after the injury, none of the groups had recaptured
their pre-injury level of BADL or IADL.

However, lasting difficulties in these two domains
were only of importance for patients who sustained
fractures of wrist or forearm and hip and, to some
extent, those with ‘other fractures’. In the remaining
groups, changes between functioning at baseline and
at T3 were comparatively small or not significant.
The standard deviations of the mean scores in nearly all injury groups were larger at T3 than at baseline, most markedly with BADL, indicating individual variations in recovery. Individual variations in psychosocial characteristics or co-morbidity may account for differences in speed and level of recovery. These aspects need further research.

The groups with fractures of the wrist or forearm and hip showed a big increase in dependence on help 1 year after the injury compared with their pre-injury situations, more obviously with household tasks than with personal care tasks. This suggests that household activities may require greater dexterity and endurance than personal care activities.

Some comments must be made about these results. A response rate of 66% is satisfactory for a cohort of older people who are followed for a comparatively long period (1993–1998). The unequal proportion of men and women in the sample does not so much reflect a bias in the sample as a sex bias in the population. Generally, women are more at risk of sustaining injuries after falls or other accidents [8].

Nevertheless, we cannot rule out some selection with regard to both the proportional distribution of injury types over the sample and the functional status of the subjects. Patients with hip fractures, the most serious injury studied, are underrepresented in the sample (20% versus 32% in the non-participating group). Furthermore, the participants had lower baseline scores on the dependent variables than the non-participants, but no difference in mean age.

Health-related bias is common in health research. Responders are generally more likely to be those with comparatively ‘better’ conditions and, consequently, also those with the best prospects of recovery. This is particularly true if the study is longitudinal and needs the long-term co-operation of older people with health conditions, as is the case in this study (which covers 6 years). However, if our results are valid for the more healthy people in the population, and if these do not recapture their pre-injury levels of functioning, there will be little chance that people who were less healthy, and therefore did not respond, would recover better.

A strong point of the study is its prospective character. We obtained pre-injury data on the relevant variables, not only from the subjects in the sample but also from eligible people not in the sample. Since most studies on the effects of fall-related injuries in older people concentrate on hip fractures, and prospective studies are few [8], our results give more insight into the process of recovery in the first year after sustaining injuries of various kinds.

Two main conclusions stand out. First, not only hip fractures but also wrist fractures seriously threaten older and fragile people’s chances of remaining independent. A poor recovery from a wrist fracture may result in lasting problems with common everyday tasks, such as making tea or washing up. If patients wish to continue living in their own homes, they will require intensive and frequent help from informal caregivers, professionals or both. The prospects for recovery from the other injuries that were studied, even including ankle fractures, appear to be better.

Secondly, there is little progress in recovery of physical functions after 5–6 months, which means that the level of recovery at that time is about the highest to be expected.

These findings might be of help to general practitioners and home-care institutions in evaluating the period when and the extent to which progress in recovery can be expected of injuries to older patients, and, consequently, the prospects of their being able to live an independent life with or without a certain amount of care.

**Key points**

- One year after an injury, older patients with fall-related injuries had not generally regained their pre-injury levels of physical functioning.
- Not only hip fractures, but also wrist fractures threaten older people’s chances of remaining independent.
- Recovery appears to plateau after 5–6 months.

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