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ORIGINAL ARTICLE

EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

Less than one-third of hip fracture patients return to their prefracture level of instrumental activities of daily living in a prospective cohort study of 480 patients

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Aim: A significant loss of instrumental activities of daily living (IADL) after a hip fracture has been reported. The aim of the present study was to identify specific predictors for low IADL after a hip fracture, in order to target better postoperative care for these patients.

Methods: A prospective observational cohort study of 480 hip fracture patients was carried out. IADL was measured at baseline, and after 3 and 12 months using the Groningen Activity Restriction Scale. Multivariable logistic regression analysis was carried out using age, sex, American Society of Anesthesiologists classification, prefracture living with a partner, prefracture living situation, prefracture use of walking aids, type of fracture, type of anesthesia, length of hospital stay, postoperative complications and prefracture IADL as potential predictors for low IADL after a hip fracture. The correlation between IADL, mobility and living situation, both at admission, and 3 and 12 months postoperatively, were measured.

Results: Three months after hip fracture treatment, 24% of patients returned to their baseline IADL level, at 12 months postoperative this was 29%. Factors associated with a larger loss in IADL after a hip fracture were older age, prefracture living with a partner, prefracture living at home, prefracture use of walking aids and longer length of hospital stay. The correlation between IADL and living situation was 0.69, and between IADL and use of walking aids was 0.80.

Conclusions: A return to prefracture IADL level was low. Healthier patients have a steeper decline in postoperative IADL. **Geriatr Gerontol Int 2018; 18: 1244–1248.**

Keywords: activities of daily living, hip fracture, outcome, trauma.

Introduction

It is expected that in 2050 the annual number of hip fracture patients will increase to 1 million fractures in the USA and 4.5 million fractures worldwide.[1,2] A hip fracture often leads to a functional decline and loss of mobility.[3] Furthermore, functional decline is associated with disability, institutionalization and even death of the patient.[4]

Nevertheless, a functional decline partially recovers during the first 6 months after the hip fracture.[3] According to a recent review, 34–59% of all hip fracture patients regain their basic activities of daily living (ADL) by 3 months and 42–71% by 6 months.[3]

Functional decline can lead to a lower quality of life for the patients[5] and higher costs for society (as a result of more institutionalized care or domestic help).[6] It is known that function after a hip fracture can be improved by a number of interventions, such as home-based rehabilitation[7] anabolic steroids[8] and comprehensive geriatric care.[9] However, these measures have to be targeted on the populations that need it the most and they are expensive. Therefore, it is important to identify risk factors for a larger functional decline. Age, the number of comorbidities, cognitive status and prefracture functional level are associated to some extent with this functional decline and recovery after hip fracture surgery;[10–12] however, the exact predictors for functional decline are at this moment unknown. Knowing these predictors for functional decline can make our care more "tailor made," and using these interventions in patients at risk for a larger decrease in ADL could potentially lead to better outcomes and savings of costs by reducing the need for help in ADL. Therefore, the aim of the current study was to evaluate the functional decline during the first year after a hip fracture and to identify potential predictors for larger loss in instrumental ADL (IADL) in a prospective cohort study.

Methods

The data of patients in the current study were retrieved from our prospective observational cohort of 517 hip fracture patients. The study did not fall under the scope of the medical research with human subjects act (WMO), therefore no ethical approval was necessary. Information about the present observational study for patients or family members was provided in a binder specially designed for hip fracture patients in our hospital.[13] All hip fracture patients were consecutively admitted to a 450-bed teaching hospital (Reinier de Graaf Hospital, Delft, the Netherlands) between January 2008 and December 2009. Patients with a fracture due to a high-energy trauma or with a pathological fracture were not included in this database. All patients had a complete dataset of baseline functional status. Patients aged <50 years (n = 24) and those treated conservatively (n = 13) were excluded from the database for this specific study, as shown in the flowchart. The length

of follow up for all patients was at least 12 months or until death. The number of patients at baseline, and 3 and 12 months are described in the flow chart (Fig. S1).

Uniform collection and recording of data of all patients of this cohort was achieved by evaluation at admission (baseline), and after 3 and 12 months, according to the local standardized care pathway for hip fracture patients.[13] Collected demographic data were age, sex, American Society of Anesthesiologists (ASA) Physical Status classification,[14] prefracture living with a partner, prefracture living in an institution or living at home and prefracture use of walking aids. A cane, crutch(es) or walker were all considered an aid. Characteristics obtained during admission were: type of hip fracture (intracapsular or extracapsular), type of treatment (osteosynthesis or arthroplasty), type of anesthesia (locoregional or general) and length of hospital stay. Complications were scored during the hospital stay. Mortality was scored meticulously by repeated consultation of the population registers of the counties in the region of the hospital, as well as the hospital's patient registration systems for the full length of follow up.

IADL

Daily life functioning can be divided in two categories, ADL and IADL. ADL are self-care activities (like dressing), whereas IADL are activities necessary for independently living in a community (shopping, preparing meals). We measured both ADL and IADL in one questionnaire using the Groningen Activity Restriction Scale (GARS).[15] The GARS consists of 18 questions, 11 ADL items and seven IADL items. The questionnaire is shown in the additional document (Fig. S2). It has a four-category response format:

1. able to perform the activity without any difficulty;
2. able to perform the activity with some difficulty;
3. able to perform the activity with much difficulty;
4. unable to perform the activity independently.

The score ranges from 18 to 72. With a score of 18 one can perform all the activities without any difficulty; with a score of 72 one cannot perform any activity without the help of others. The reliability of the GARS is acceptable, with good to excellent internal consistency (Cronbach's alpha 0.86–0.94), poor to acceptable test-retest correlation (0.53–0.74) and acceptable inter-item correlation (0.25–0.54). Construct validity is good (Pearson's correlation coefficient 0.65 with "physical functioning" in the 36-item Short Form Health Survey).[15,16] However responsive, the minimal clinically important difference and ceiling and floor effect are not well known.

Baseline IADL was registered at admission in the emergency department. Patients were asked to score their prefracture level of IADL retrospectively, referring to a period before the fracture. Measurement of the IADL was repeated prospectively during routine follow up at 3 and 12 months after the hip fracture in the outpatient clinic or by a questionnaire sent to the patient.

In order to measure whether a lower level of IADL is correlated to lower mobility and dependent living situation after a hip fracture, the percentage of patients mobilizing with aid and the percentage of patients living in an institution were measured at baseline, and 3 and 12 months after the fracture.

Table 1 Baseline characteristics

Characteristic		Number (%)
Median age (range)	Years	82.6 (50–101)
Sex	Female	342 (71%)
ASA classification	ASA I and II	328 (68%)
Prefracture living with a partner[†]	Yes	158 (33%)
Prefracture living situation	Independent	324 (68%)
Prefracture use of walking aids	No aid	190 (40%)
Type of fracture	Intracapsular	284 (59%)
Type of treatment	Osteosynthesis	294 (61%)
Type of anesthesia	Locoregional	450 (94%)
Median length of hospital stay (range)	Days	10 (2–71)
Postoperative complications	≥1	248 (52%)

[†]No data for 31 patients. ASA, American Society of Anesthesiologists.

Statistical analysis

Statistical analysis was carried out using SPSS 19.0. (IBM Corporation, Somers, NY, USA). IADL was not normally distributed. The difference in IADL between baseline and 3 months was calculated with a Wilcoxon signed-rank test. A multivariable logistic regression analysis was carried out to calculate factors associated with baseline IADL. Age, sex, ASA classification, prefracture living with a partner, prefracture living situation, prefracture walking with aids and type of fracture were used as potential variables associated with baseline IADL. To determine factors associated with IADL at 3 and 12 months, the type of anesthesia, length of hospital stay, postoperative complications and prefracture IADL were added to the same analysis. Furthermore, predictors for decline in IADL and later recovery in IADL were calculated with a multivariable logistic regression analysis with the same potential variables. Multicollinearity was tested by collinearity statistics. Non-significant variables were removed one by one, removing the largest *P*-value first, until all remaining variables in the model had a *P*-value ≤0.10. The coefficient of determination (R^2) showing how much of the variability in the IADL is explained by the explanatory variables was calculated.

Correlations between IADL, percentage of patients walking with aid and percentage of patients with an independent living situation were calculated with Pearson's correlation; 0–0.20 was regarded as slight agreement, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial and 0.81–1 as almost perfect agreement.[17]

Results

A total of 480 patients were included in the present study. The median age was 83 years, and 71% were women. Baseline characteristics are shown in Table 1. Mortality was 13% at 3 months (n = 60) and 23% at 1 year (n = 109).

Baseline IADL

Mean baseline IADL was 41 (SD 18.3). IADL was higher in patients who were younger, had a lower ASA classification, those living independently before the fracture and patients who used no walking aid prefracture (Table S1). Sex, prefracture living with a partner and type of fracture were not predictors of baseline ADL.

Course of IADL

Figure 1 shows the course of IADL in time. Between baseline and 3 months, IADL declined (thus GARS augmented Δ6.8 [4.4–9.2, $P < 0.01$]). A total of 95 patients (24%) returned to their prefracture level of IADL after 3 months. Between 3 and 12 months, IADL recovered (thus GARS declined Δ2.8 [0.17–5.3; $P < 0.01$). IADL did still not recover to the baseline value ($P < 0.01$). A total of 105 patients (29%) returned to their prefracture level of IADL after 12 months.

The multivariable analyses (Table 2) showed that a lower level of IADL (i.e. higher GARS) at 3 and 12 months postoperative was correlated with older age, higher ASA classification, living in an institution before the fracture, prefracture use of walking aids, longer length of hospital stay, having a postoperative complication and a higher prefracture IADL. Sex, prefracture living with a

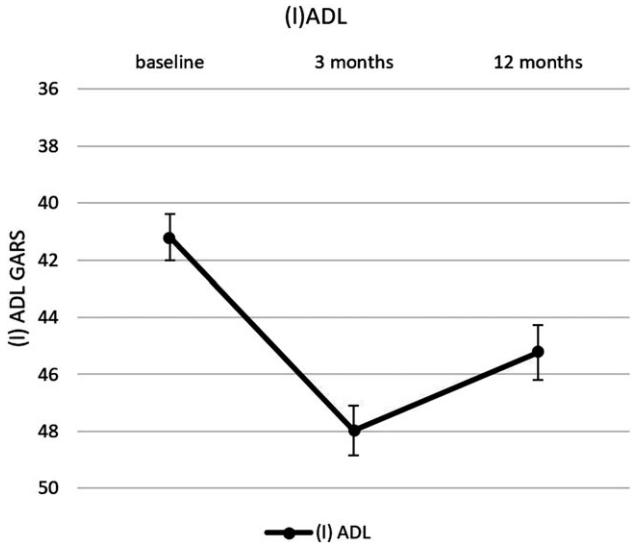

Figure 1 Course of instrumental activities of daily living (IADL) in time. GARS, Groningen Activity Restriction Scale.

partner and type of fracture were not predictive. General anesthesia was only a predictor of lower IADL at 12 months.

A decline in IADL between baseline and 3 months was greater with older age, living at home before the fracture, prefracture walking without the use of walking aids and longer length of hospital stay (Table 3). Recovery of IADL between 3 and 12 months was more common in patients living with a partner prefracture and in patients who used no walking aids prefracture.

Correlation between IADL, mobility and living situation

The percentage of patients mobilizing without a walking aid, as well as the percentage of patients who lived independently, declined between baseline and 3 months (Fig. 2). Although mobility recovered between 3 and 12 months postoperative, the percentage of patients living independently did not increase. The correlation between IADL and the percentage of patients living independently at baseline, and 3 and 12 months together was 0.69 ($P < 0.001$), and IADL and the percentage of patients walking without an aid was 0.80 ($P < 0.001$).

Discussion

The present cohort study showed a great loss of IADL after surgical hip fracture treatment: just 29% returned to their preoperative level of IADL at 1 year postoperative. Factors associated with a greater loss in IADL after a hip fracture were older age, prefracture living at home, prefracture not using walking aids and longer length of hospital stay. Furthermore, the association between IADL, mobility and living situation (i.e. institutionalized or independent) was high. The latter stresses the importance of recognizing which patient will decline in overall functionality and which patient will regain his or her functionality as good as present at the preoperative level.

The great loss of independence (expressed in a lower level of ADL) after hip fracture treatment has been reported previously.[10,18,19] The present study shows that IADL recovers between 3 and 12 months postoperative, but not to baseline levels; this is in line with the results of earlier studies on recovery of IADL and ADL.[3,10,12,20]

In the present study, prefracture IADL was the most important predictor for a lower IADL at both 3 and 12 months. This and other significant risk factors (older age, higher ASA classification, prefracture living institutionalized and prefracture use of walking aids) are signs of increased frailty. A longer length of hospital stay and having a postoperative complication were also associated with lower IADL. A postoperative complication will affect a patient's health and in that way will lower their abilities to carry out IADL activities. Longer length of hospital stay is usually related to patients requiring additional care post-discharge (such as nursery homes). This factor could possibly partially represent vulnerability.

Two other studies (Mariconda *et al.* and Gonzalez Zabaleta *et al.*) investigated predictors for IADL after a hip fracture. Older age, higher ASA classification and lower prefracture IADL were

Table 2 Multivariable analysis of instrumental activities of daily living at 3 and 12 months

	3 months				12 months			
	B	β	T	Sig	B	β	T	Sig
Age	0.13	0.08	2.22	0.027	0.20	0.11	3.22	0.001
ASA classification	2.53	0.06	2.09	0.038	2.69	0.06	1.99	0.048
Prefracture living situation	4.59	0.12	3.20	0.001	2.92	0.07	1.77	0.078
Prefracture use of walking aids	2.58	0.07	1.71	0.088	3.91	0.11	2.39	0.017
Type of anesthesia					5.94	0.07	2.19	0.029
Length of hospital stay	0.32	0.17	5.16	0.000	0.26	0.12	3.70	0.000
Postoperative complications	2.85	0.08	2.45	0.015	3.53	0.10	2.83	0.005
Prefracture IADL	0.54	0.54	10.75	0.000	0.60	0.56	10.74	0.000

3 months adjusted $R^2 = 0.69$. 12 months adjusted $R^2 = 0.71$. ASA, American Society of Anesthesiologists; IADL, instrumental activities of daily living; Sig, significance.

Table 3 Multivariable analysis of difference in instrumental activities of daily living between baseline and 3 months, and between 3 and 12 months

	Difference in IADL between baseline and 3 months				Difference in IADL between 3 and 12 months			
	B	β	T	Sig	B	β	T	Sig
Age	0.14	0.13	2.27	0.02				
Prefracture living with a partner					1.78	0.10	1.80	0.07
Prefracture living at home	2.27	0.09	1.68	0.09				
Prefracture use of walking aids	5.50	0.24	4.18	0.00	2.84	0.97	2.92	0.00
Length of hospital stay	0.26	0.21	4.01	0.00				

Difference between baseline and 3 months Adjusted $R^2 = 0.08$. Difference between 3 and 12 months adjusted $R^2 = 0.04$. IADL, instrumental activities of daily living; Sig, significance.

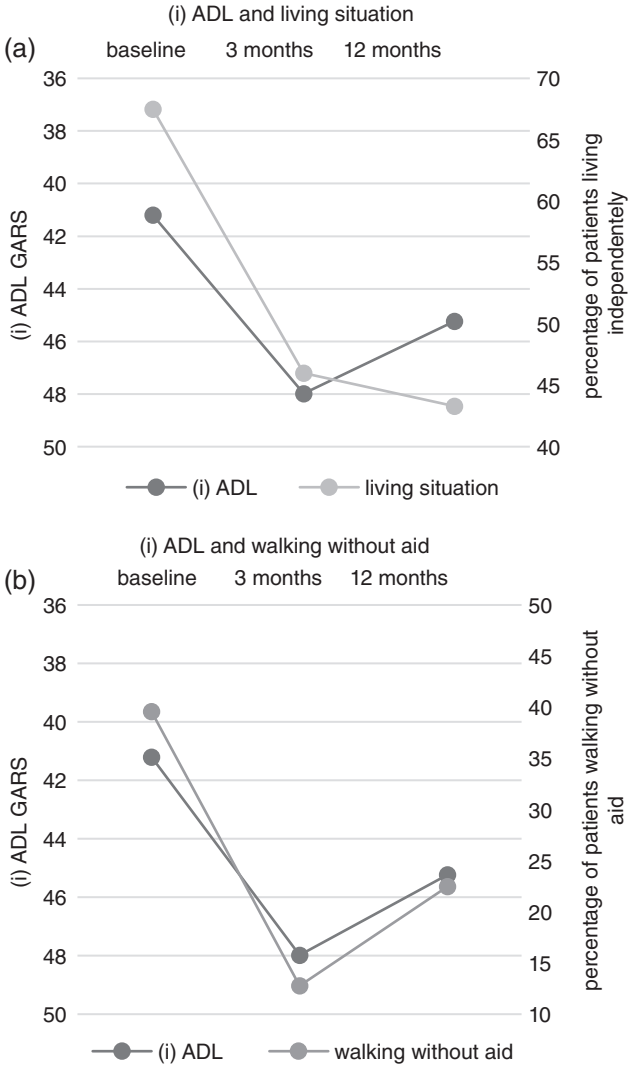

Figure 2 (a) Instrumental activities of daily living (IADL) and living situation, and (b) IADL and walking without an aid. GARS, Groningen Activity Restriction Scale.

found to be predictors in these studies, which is in accordance with the present results.[10,18] Furthermore, Mariconda *et al.* found that prefracture ambulatory ability and postoperative complications were associated with IADL, as we did. In addition to these predictors, they found the Mini-Mental State Examination score, postoperative allowance of full weight-bearing on the operated limb, surgery within 72 h, Parkinson's disease and educational status to be associated.[10] These factors were not included in the present study. Gonzalez- Zabaleta *et al.* found the type of fracture and surgical delay to be other predictors. That study had just a 90-day follow up.[18]

Age, ASA classification, prefracture living situation and use of walking aids were predictors for baseline IADL. Sex, prefracture living with a partner and type of fracture were not predictors for lower baseline IADL in the present multivariate analysis, in accordance with other cohort studies.[10,12,18] Two previous studies showed that an extracapsular fracture is more common in older patients with more comorbidities and lower functional recovery.[21,22] It is possible that the relationship between sex, prefracture living with a partner and type of fracture with the other predictors could have led to these factors being omitted from our multivariate analysis.

Patients mobilizing without an aid and those living at home before the fracture had greater loss of IADL after their hip fracture. This is in accordance with studies of the same cohort of hip fracture patients as the current study. The studies focusing on of the level of mobility and health-related quality of life showed that the most mobile patients were least likely to return to their prefracture mobility level and the healthier patients were less likely to return to their prefracture health-related quality of life level.[23,24] These healthier and more active patients have more to lose. The type of anesthesia was no predictor in ADL decline between baseline and 3 months. Earlier research in large cohort studies confirmed this finding.[10,25] In the present cohort, general anesthesia was infrequent (30 patients, 6%). This is mainly due to local guidelines in our hospital.

Recovery of IADL was associated with prefracture mobilizing without aid and prefracture living with a partner. Apparently, the presence of a partner contributes to the recovery of IADL. This is in accordance with the study of Koval *et al.* who found that younger age, having no comorbidities and having a partner before the fracture were predictors for recovery of ADL.[12]

We noted a moderate-to-strong association between the level of IADL, living situation and use of walking aids at baseline, and 3 and 12 months, which also confirms earlier research.[5] These strong associations underscore the importance of the use of measurements such as IADL in hip fracture patients, as they represent the patient's condition. The latter stresses the importance of using these measurements of overall functionality scores in all patients.

The strengths of the present study were its prospective character, the size of the cohort and the length of follow up (1 year). The loss to follow up corrected for mortality was very low: 5% at 3 months and 2% at 1 year. The GARS as an instrument to measure IADL has been proven to be relevant and comprehensive, it has good construct validity and internal consistency. However responsiveness, the minimal clinically important difference, and ceiling and floor effect are not well known.[15,16,26] Although this minimal clinically important difference is unknown, we do not know whether the statistical differences we found in the GARS score during follow up were clinically relevant.

A recent review identified 24 existing ADL and IADL questionnaires.[27] The three ADL scores in hip fracture patients that are currently used the most are the Barthel Index, Katz ADL and Functional Independence Measurement.[28] Comparison with different studies would have been easier using one of these outcome measures. However, the GARS has the advantage of being a combined list of both ADL and IADL.

Another limitation is that recall bias might exist on measuring baseline IADL during admission to hospital in the emergency department. The patient's ability to recall this prefracture IADL with a painful hip fracture might be questioned, although recent literature showed that recall data is accurate.[29]

In summary, IADL declined after a hip fracture, and less than one-third of all patients returned to their prefracture level of IADL after 3 and 12 months. Predictors for lower IADL after a fracture were older age, higher ASA classification, prefracture living institutionalized, prefracture use of walking aids, longer length of hospital stay, having a postoperative complication and lower prefracture IADL score; that is, vulnerable patients. However, predictors for loss of IADL after an hip fracture were older age, prefracture living at home, prefracture not using walking aids and longer length of hospital stay; that is, more healthy patients.

Furthermore, the association between the baseline level and decrease of IADL, mobility and living situation was strong. For that matter, some patients might be identified to have a large decline in their functionality, either due to the presence of the hip fracture or invoked by the surgery, or a combination of the two. For those hip fracture patients, focus might be based only on adequate pain relief in the post-fracture period. The latter can give a functional outcome without the risk involved with surgery.[30] In the end, it is the patient that matters.

Disclosure statement

Nina Mathijssen and Sophie Moerman work at the Department of Orthopedic Surgery at Reinier de Graaf Hospital. This department

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's website: .

Figure S1 Flowchart of included and excluded patients.

Figure S2 Groningen Activity Restriction Scale questionnaire.

Table S1 Multivariable analysis of prefracture instrumental activities of daily living.

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