J Rehabil Med 2014; 46: 258–263

ORIGINAL REPORT

FEAR OF FALLING AFTER HIP FRACTURE IN VULNERABLE OLDER PERSONS REHABILITATING IN A SKILLED NURSING FACILITY

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Objective: **To identify factors that explain differences in patients with high and low levels of fear of falling after a hip fracture.**
Design: **Cross-sectional study in 10 skilled nursing facilities in the Netherlands.**
Patients: **A total of 100 patients aged ≥65 years admitted to a skilled nursing facility after a hip fracture.**
Methods: **Participants were divided into 2 groups; low and high level of fear of falling, based on median Falls Efficacy Score – International. Data relating to factors that might explain fear of falling were collected, including demographic variables, aspects of functioning, psychological factors, and comorbidities. For every factor a univariate logistic regression was conducted. For the multivariate regression model a backward procedure was used in which variables with $p<0.05$ were included.**
Results: **Walking ability and activities of daily living before fracture, number of complications, activities of daily living after fracture, anxiety and self-efficacy were significantly associated univariately with fear of falling. Multivariate analysis showed that walking ability before fracture (odds ratio (OR) 0.34, 95% confidence interval (CI) 0.14–0.83), activities of daily living after fracture (OR 0.89, 95% CI 0.80–0.99), and anxiety (OR 1.22, 95% CI 1.05–1.42) were independently associated with fear of falling.**
Conclusion: **Impaired walking ability before fracture, impaired activities of daily living after fracture, and increased anxiety help distinguish between older persons with high and low levels of fear of falling after hip fracture. Because the last 2 factors are modifiable, this information enables the development of specific interventions for older persons with a high level of fear of falling.**

Key words: fear of falling; falls-related self-efficacy; hip fracture; regression analysis; skilled nursing facility.

J Rehabil Med 2014; 46: 258–263

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Accepted Sep 18, 2013; Epub ahead of print Nov 21, 2013

INTRODUCTION

The number of patients with hip fractures is increasing; the current worldwide incidence is more than 1.6 million, and it is estimated that this may increase to 4.5 million by 2050 as the population ages (1, 2). The main risk factors for hip fractures are osteoporosis and falls, often resulting from polypharmacy, cognitive impairment, chronic diseases and unsteady gait (3). For society, both the short- and long-term costs associated with these fractures are high and for the individual a hip fracture can be regarded as a life-changing event (4, 5). Overall mortality is reported to be 20–36% and only a minority of patients recover completely (6–8).

Many factors are related to poor outcomes after a hip fracture, including age, gender, marital status, living situation, pre-morbid activities of daily living (ADL), physical performance, cognition and number of co-morbidities (9–11). In addition, psychological factors, such as fear of falling (FoF), are associated with these unwanted outcomes (12, 13). FoF may even have more impact on functional recovery than pain or depression (12), because it hampers participation in exercise during the rehabilitation process (14). FoF results in avoidance of activities, reduces mobility after a hip fracture and is, in itself, a risk factor for falls (15, 16). Prevalence of FoF is highly variable among older persons (21–85%), and studies among patients after a hip fracture report figures as high as 50–65% (16–19).

The concept of FoF has been used in particular in the context of post-fall syndrome (20). Efforts have been made to operationalize this concept, particularly when measurement instruments were developed. Fear of falling is defined as "a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing" (21). Although falls-related self-efficacy may refer to a slightly different concept (22), the term is often used in the literature as a proxy for FoF. Falls efficacy scales assess "concern" about falling, a term closely related to FoF, but probably less intense and emotional (23). An example of such a scale is the Falls Efficacy Scale – International (FES-I), which was developed and validated by the Prevention of Falls Network

 doi: 10.2340/16501977-1264
 ISSN 1650-1977

Europe (ProFaNE) (23, 24). It is widely used and regarded as a suitable instrument for FoF (24).

The impact of FoF is best illustrated by its role in predicting rehabilitation outcomes at discharge and follow-up (25). Reduction in FoF may therefore improve the outcomes of rehabilitation after a hip fracture. Hence it is essential to understand which factors are associated with FoF after hip fracture in order to identify factors that can be addressed in intervention programmes. Although ADL and history of falls are associated with FoF after hip fracture (26), the determinants for FoF after hip fracture remain, to a large extent, unknown (27).

Most studies on FoF after hip fracture are limited by selection bias, because vulnerable older persons with substantial co-morbidity, who constitute the majority of patients with hip fractures, are often excluded (27). Therefore, we conducted a study in patients with hip fracture and focussed on factors that are common in vulnerable older persons, such as number of comorbidities and complications, cognitive impairments, hearing and vision impairments, anxiety and depression (28, 29). The present study aims to develop a model that explains the differences between older patients with high and low levels of FoF after a hip fracture. This information is important for developing interventions to improve rehabilitation outcomes in older patients with FoF.

METHODS

Design and study population

A cross-sectional study on hip fracture patients was conducted in 10 skilled nursing facilities (SNF) in Dutch nursing homes. In the Netherlands relatively healthy persons usually rehabilitate after a hip fracture at home when discharged from the hospital. Most vulnerable older people, approximately 40% of all the patients with a hip fracture, rehabilitate in a SNF, while older persons who already live in a long-term care facility return to this facility after surgery.

Upon admission to a SNF, a rehabilitation plan is made by the elderly care physician, who supervises the multidisciplinary rehabilitation process (30). In all 10 SNFs patients follow a 4–16 week rehabilitation programme which focuses on wound care, treatment of pain and comorbidity, and training of ADL, muscle strength, balance and walking ability.

Patients (aged ≥ 65 years) were included in the present study if they were admitted to a SNF for multidisciplinary rehabilitation after a hip fracture. Hip fractures were defined as fractures of the cervical, the pertrochanteric, and the subtrochanteric area of the femur. Patients were excluded if, according to the treating elderly care physician, they were not able to respond adequately to questions. Patients with severe communication problems were also excluded.

Data collection took place between September 2010 and March 2011. In every participating SNF, cross-sectional data were collected during a 2-week period by 2 researchers, a psychologist and elderly care physician, and through questionnaires for the treating physicians and nurses. Because the data were collected cross-sectionally the participants could be assessed at any time between admission and discharge from the SNF.

The medical ethics committee of the VU University Medical Center approved the study and the protocol. All patients enrolled in the study gave written informed consent.

Fear of falling

The FES-I was the main outcome measure for FoF. The FES-I reflects concern about falling when performing 16 activities. The FES-I was developed from the Falls Efficacy Scale, which has ceiling effects and lacks social activities (31). The response to the FES-I consists of 4 levels, from "not at all concerned" to "very concerned" (score range 16–64) (31).The FES-I has good psychometric properties in community-dwelling elderly and other patient samples (31, 32).

Selection of factors associated with fear of falling

Based on the literature (16, 26, 27) and clinical experience, potential correlates for FoF were selected and divided into 3 categories: demographic data, data related to functioning and comorbidity, and data related to psychological factors.

Demographic data

Data were collected on age, gender, marital status, living situation, site of fall, and fall frequency before fracture.

Functioning and comorbidity

ADL before and after fracture was measured using the Barthel Index (33). Scores on the Barthel Index range from 0 to 20, with higher scores indicating more independence in conducting activities such as eating, dressing and going to the toilet. Walking ability before fracture was measured with the functional ambulation categories (FAC) score (34). Scores on the FAC range from 1 to 5, with higher scores indicating better ability to walk more independently. In addition, data on the patient's dizziness, ADL and fall frequency after hip fracture were collected via the questionnaires completed by nurses. Information on fracture type, fracture site, kind of surgery, days after fracture, use of benzodiazepines, opioids and anti-hypertensives, were collected by the questionnaires completed by the treating elderly care physician. Because the focus was particularly on vulnerable older patients, data on comorbidities and complications, short-term and long-term memory, hearing and visual impairment, anxiety and depression were also collected.

Psychological factors

Data related to psychological concepts were collected by interviewing the participants through an elderly care physician or psychologist. Depressive symptoms were measured with the Geriatric Depression Scale 8-item version (GDS8), which is an adaption of the GDS30 and is more suitable for institutionalized older people (35). The GDS8 has 8 items with higher scores (range 0–8) indicating more depressed. Anxiety was assessed with the anxiety component of the Hospital Anxiety and Depression Scale (HADS-A) (36). The HADS-A has 7 items (range 0–21) with higher scores indicating more anxiety. Self-efficacy was measured with the Self-Efficacy Scale (SES) (37). This scale has 10 items and higher scores (range 0–30) indicate a higher level of competence to cope with various challenges. Pain was assessed by asking patients to indicate their level of pain on a visual analogue scale, ranging from 0 (no pain) to 10 (extreme pain) (38).

Statistical analysis

Participants were divided into 2 groups based on the median FES-I score: participants with a low level of FoF (FES-I ≤ 32) and those with a high level of FoF (FES-I ≥ 33). The Student's *t*-tests and Pearson's χ^2 test were used to assess differences between patient characteristics. Where appropriate, the Mann-Whitney *U* test was used for non-normal distributed continuous variables. A p-value < 0.05 was considered statistically significant.

Categorical factors (living situation, residence, fall frequency, hearing and vision) were dichotomized by merging categories (see Table II). For each factor we performed a univariate logistic regression analysis with the FES-I as dependent variable. Subsequently, variables with a $p < 0.10$ were selected and entered into a multivariate logistic regression model. Using a backward stepwise procedure, variables with a p-value ≥ 0.10 were removed. In the final multiple regression model only variables with a p-value < 0.05 were accepted. When in this procedure variables were removed from the model, their relation with the remaining variables was calculated using the Pearson's correlation coefficient.

Analyses were performed using SPSS for Windows (Version 17, SPPS, Inc., Chicago, IL, USA).

RESULTS

Study population

A total of 124 patients with hip fracture were rehabilitating at the SNFs at the time of the study. Of these, 13 were excluded because they were unable adequately to respond to the questions, 6 did not give consent to participate, and 4 were excluded because of communication problems. Another patient was excluded from analysis because of insufficient data. This resulted in a study population of 100 participants.

The participants and the 24 patients who did not participate, did not differ significantly in age ($p=0.50$), gender ($p=0.10$), marital status ($p=0.44$), living situation ($p=0.75$), and type of fracture ($p=0.38$). However, the location of fall was significantly different ($p=0.01$), with relatively more non-participants falling inside their home.

Table I presents the characteristics of the participants with low and high levels of FoF. Most participants were female, older than 80 years, widowed and lived alone. Almost all could walk independently before fracture. The mean number of co-morbidity and complications were 3.5 and 1.6, respectively. In participants with a low and with a high level of FES-I the mean FES-I was 24.1 and 40.2, respectively. Persons with a high level of FoF were significantly more dependent in ADL before hip fracture and had a significantly higher number of complications after hip fracture.

Regression analysis and model

Six variables were significantly associated with FoF ($p<0.10$) in the univariate regression analysis (Table II). These were walking ability before fracture, number of complications, ADL before fracture, anxiety, ADL after fracture and self-efficacy.

In the multivariate model 3 variables lacked significance and were rejected. There was a strong correlation between ADL before fracture and walking ability before fracture (Pearson's correlation coefficient: 0.697). Hence the final model contained walking ability before fracture, ADL after fracture and anxiety. The Nagelkerke R square was 0.26, i.e. the model explains 26% of the variability in FoF.

The final explanatory model (Table III) indicates that when the FAC score before fracture decreases by 1 point, the odds ratio (OR) that a person has a high level of FoF is 1.66. It means that an individual who needs guidance from another person when walking is 1.66 times more likely to have a high level of FoF than someone who walks independently. When the Barthel Index after fracture is 1 point higher, the OR that a person has a high level of FoF is 0.89. This means that an individual who needs no assistance at all when going to the toilet is 0.89 times less likely to have a high level of FoF than an individual who needs some assistance. An increase in the HADS/Anxiety by

Table I. *Characteristics of the study population (*n *= 100)*

Characteristics	Total group ($n=100$)	Participants with a low level of FoF (FES-I≤32) ($n=50$)	Participants with a high level of FoF (FES-I≥33) ($n=50$)	p-value[a]
FES-I, mean (SD)	32.2 (9.6)	24.1 (4.1)	40.2(6.2)	<0.001[b]
Age, years, mean (SD)	83.1 (8.3)	81.9 (8.5)	84.3 (8.0)	0.14[b]
Female, %	75	72	78	0.49[c]
Marital status, %				
Married	18	14	22	
Widow/widower	68	64	72	
Divorced	4	6	2	
Single	10	16	4	0.13[c]
Living alone, %	78	80	76	0.63[c]
ADL before fracture (BI), mean (SD)	18.8 (1.7)	19.1 (1.4)	18.4 (1.8)	0.03[b]
Independently walking before fracture[e], %	97	100	94	0.08[c]
Fallen indoors, %	70	68	72	0.66[c]
Fall frequency in last half year, %				
Nil	77	80	74	
Once	11	10	12	
Twice or more	12	10	14	0.76[c]
Fracture type, %				
Cervical	46	44	48	
Trochanteric	40	42	38	
Subtrochanteric	6	6	6	
Other/not known	8	8	8	1.00[c]
Fracture left side, %	51	48	54	0.55[c]
Kind of surgery, %				
Hemiarthroplasty	29	24	34	
Total arthroplasty	6	6	6	
Proximal femur nail or gamma nail	41	46	36	
Dynamic hip screws	13	14	12	
Surgical screws	4	4	4	
Other/not operated	7	6	8	0.89[c]
Days after fracture, median (IQR)	44.5 (28–63)	48.5 (28–68)	42.0 (28–55)	0.25[d]
Impairment short-term memory, %	19	20	18	0.80[c]
Impairment long-term memory, %	6	10	2	0.09[c]
Hearing impairment, %	35	36	34	0.83[c]
Visual impairment, %	27	20	34	0.12[c]
Dizziness, %	14	14	14	1.00[c]
Number of co-morbidities, mean (SD)	3.5 (1.5)	3.4 (1.6)	3.6 (1.5)	0.52[b]
Number of complications, mean (SD)	1.6 (1.4)	1.3 (1.1)	1.9 (1.6)	0.03[b]

[a]p-value between participants with low and high levels of FoF; [b]Student's t-test; [c]Pearson's χ^2 test; [d]Mann-Whitney test; [e]Independently walking implies a score of 4 or 5 on the Functional Ambulation Categories.

FoF: fear of falling; FES-I: Falls Efficacy Scale-International; SD: standard deviation; ADL: activities of daily living; BI: Barthel Index; IQR: interquartile range.

Table II. *Univariate logistic regression for each potential correlate for the Falls Efficacy Scale – International*

	OR	95% CI	*p*-value[a]
Demographic variables			
Age (continuous)	1.04	0.99–1.09	0.14
Gender (male vs female)	1.38	0.56–3.43	0.49
Marital status (married vs other)	0.58	0.20–1.64	0.30
Living situation (together vs alone)	0.79	0.31–2.05	0.63
Site of fall (indoors vs outdoors)	0.83	0.35–1.95	0.66
Fall frequency (no fall last 6 months vs more than 1 fall in last 6 months)	1.41	0.55–3.59	0.48
Functional variables			
ADL (Barthel index) before fracture (continuous)	0.75	0.57–0.98	0.03
Walking ability (FAC score) before fracture	0.29	0.13–0.66	<0.01
Short-term memory (adequate vs not adequate)	0.88	0.32–2.39	0.80
Long–term memory (adequate vs not adequate)	0.18	0.02–1.63	0.13
Hearing (no loss vs loss)	0.92	0.40–2.08	0.83
Vision (no loss vs loss)	2.06	0.83–5.01	0.12
Dizziness (no vs yes)	1.00	0.32–3.10	1.00
ADL after fracture (Barthel Index, continuous)	0.90	0.82–0.98	0.02
Fall frequency after hip fracture (no fall vs more than one in last 4 weeks)	1.57	0.41–5.94	0.51
Days since fracture (continuous)	0.99	0.98–1.00	0.16
Use of benzodiazepines (no use vs use)	1.67	0.68–4.08	0.26
Use of opioids (no use vs use)	1.53	0.25–9.59	0.65
Use of anti-hypertensives (no use vs use)	0.84	0.38–1.89	0.68
Number of co-morbidities (continuous)	1.09	0.84–1.41	0.52
Number of complications (continuous)	1.40	1.02–1.90	0.04
Psychological variables			
Depressive symptoms (GDS8, continuous)	1.00	0.79–1.26	1.00
Anxiety (HADS-A, continuous)	1.16	1.02–1.33	0.03
Self-efficacy (SES, continuous)	0.93	0.89–0.99	0.03
Pain (VAS, continuous)	1.15	0.95–1.39	0.15

[a]*p*-value between participants with low and with high levels of fear of falling.
OR: odds ratio; CI: confidence interval; ADL: activities of daily living; FAC: Functional Ambulation Categories; GDS8: Geriatric Depression Scale 8-item version; HADS-A: Hospital Anxiety Depression Scale – Anxiety component; SES: Self-Efficacy Scale; VAS: visual analogue scale.

1 point increases the OR that a person has a high level of FoF to 1.22. Hence, an individual who indicates that he or she is sometimes nervous is 1.22 times more likely to have high level of FoF than an individual who is never nervous.

DISCUSSION

FoF was common in patients recovering in an SNF after a hip fracture. Most patients were aged ≥80 years and independent in terms of walking ability and ADL before fracture. After dividing participants into those with a high and a low level of FoF, a multivariate regression model revealed that 3 factors were independently associated with FoF. Patients with impaired walking ability before fracture, impaired ADL after fracture and increased anxiety more often have a higher level of FoF.

Table III. *Final multivariate model for fear of falling (FoF) after hip fracture*

Variable	B	OR	95% CI	*p*-value[a]
Walking ability (FAC-score) before fracture	–1.08	0.34	0.14–0.83	0.02
ADL (BI) after fracture	–0.11	0.89	0.80–0.99	0.04
Anxiety (HADS-A)	0.20	1.22	1.05–1.42	0.01

[a]*p*-value between participants with low and with high level of FoF.
OR: odds ratio; FAC: Functional Ambulation Category; ADL: activities of daily living; BI: Barthel Index; HADS-A: Hospital Anxiety and Depression Scale – Anxiety component.

The association of ADL before fracture and FoF in the univariate logistic regression analysis was in line with a study by McKee et al. (26), in which FoF in patients with a hip fracture was associated with pre-fall activity problems ($r=-0.70$, $p<0.001$) . Nevertheless, ADL before fracture was removed from the final model in our multivariate analysis. This was due to the strong correlation between ADL before fracture and walking ability before fracture. In the study by McKee et al. a weaker, but significant, association was found with history of falls ($r=0.23$, $p<0.05$). In our study the association with fall frequency in the past 6 months was not significant. It is likely that fall history over a longer period, as was used by McKee et al. (never fallen before/fallen, but not during last year/fallen in the last year), might therefore be more informative than fall history over only the last 6 months.

The results of our study are partly in line with a study in community-dwelling elderly people by Kempen et al. (39), in which limitations in ADL, low general self-efficacy and feelings of anxiety were correlated with a high level of FoF. Chronic morbidity, old age, female sex, impaired vision and fall frequency, which were significantly associated with FoF in that study, were not correlated in our study. Similar factors, such as history of falls, older age, female sex and impaired gait, were reported in other studies as factors associated with a high level of FoF in community-dwelling older persons without a recent hip fracture (40–42). Because the number of participants, the range of ages and the number of men included in our study were relatively small compared with the other studies, less significant relations could be demonstrated. In addition, patients included were vulnerable older people with already several comorbidities, making it more difficult to demonstrate a significant association for comorbidities. Nevertheless, the similarity of several factors indicates that, in future interventions for patients after a hip fracture, lessons can be learned from interventions that have been proven successful to reduce FoF in community-dwelling elderly people (43).

General self-efficacy, measured with the SES, was not independently associated with FoF in our final model, while general anxiety was significantly associated with FoF. This may indicate that the concept of falls-related self-efficacy measured by the FES-I refers to a substantially different construct than general self-efficacy. The construct of falls-related self-efficacy may therefore have more in common with anxiety than with self-efficacy. It supports the use of the FES-I as a measure for FoF to assess the outcomes of intervention programmes.

A strength of the present study is the use of validated instruments to measure both physical and psychological functioning to unravel the factors that may influence FoF. In addition, while the participants in our study were comparable to participants in other studies with respect to gender and type of fracture (7, 12, 25), FoF was assessed in vulnerable patients with hip fractures of very high age and with a high number of comorbidities. In particular, this group is in need of multidisciplinary rehabilitation (44) and at risk of FoF (16). We found that the number of complications and anxiety were significantly associated with a high level of FoF. In our study we could not demonstrate a correlation of high level of FoF with inadequate long-term memory, vision loss and number of comorbidities. Also other factors, such as hearing loss, inadequate short-term memory and depressive symptoms, were not associated with a high level of FoF. Some, though not all, specific features that are common in vulnerable older people make them more prone to a high level of FoF. Given the increasing incidence of persons aged ≥ 80 years with hip fractures, better insight into these factors that influence rehabilitation is needed. Though this study provides some information, further research is necessary to disentangle the complex relationship between vulnerability in older persons, FoF and falls.

The number of patients who refused to participate was low and their data indicate that this subgroup was not substantially different from that of the participants. However, patients who were unable adequately to answer questions, and patients with severe cognitive disorders were excluded from the study. In addition, our study did not include patients who were directly discharged home and patients who were already living in a nursing home. Though generalization of the results to all patients with a hip fracture requires some caution, they are very relevant for vulnerable older people with a hip fracture who are admitted to SNFs for rehabilitation.

A limitation of this study is that the data were collected in a cross-sectional way, i.e. collected at a single moment during the rehabilitation process. Patients who were rehabilitating faster may have been discharged earlier from the SNF and were probably under-represented, which may have resulted in overestimation of the prevalence of FoF. Longitudinal studies on FoF are required to overcome this limitation.

By defining FoF as "a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing" it is assumed that FoF is particularly an obstacle for recovery following hip fracture (15). However, in some participants a high level of FoF and thus high perceived fall risk combined with high physiological fall risk may have been protective (45). The exact impact of FoF as a protective response to a realistic fall risk is, to our knowledge, not known for older persons after hip fracture. In studies of FoF after hip fracture FoF has usually been regarded as an obstacle for successful rehabilitation (12, 27). Further research is needed to determine to what extent FoF can be protective.

In conclusion, poor walking ability before fracture, impaired ADL after fracture, and anxiety are associated with higher risk of FoF. This information can be used in specific interventions to reduce FoF and improve rehabilitation outcomes in older patients with FoF. In clinical settings such interventions are not yet common, while in community-living older people interventions, which focus for instance on misconceptions about physical exercise and encourage simple personal exercises, are proven effective for reduction of FoF and new falls (43). Similar interventions should be developed and evaluated in patients rehabilitating after hip fractures in SNFs who have FoF.

ACKNOWLEDGEMENTS

The authors thank the staff and the patients of the SNFs for their participation in the study.

JV, WA, RB and CH designed the study. JV participated in the data collection. JV, WA and MC interpreted the data, carried out the statistical analysis and prepared the manuscript. All authors critically revised the manuscript and approved the final version.

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