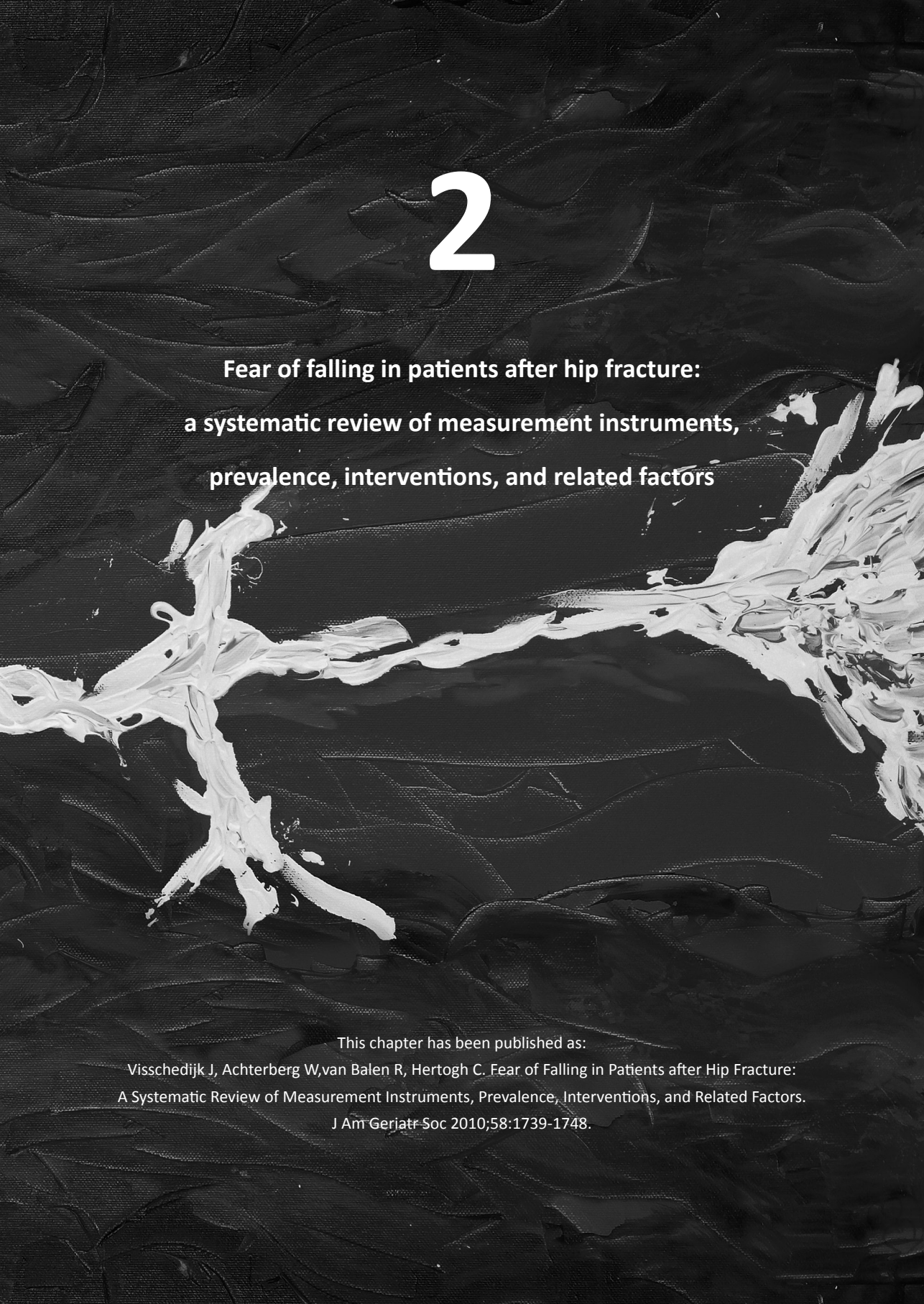

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Fear of falling in patients after hip fracture: a systematic review of measurement instruments, prevalence, interventions, and related factors

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ABSTRACT

The objective of this review was to systematically describe and analyze fear of falling (FoF) in patients after a hip fracture, focusing on measurement instruments for FoF, the prevalence of FoF, factors associated with FoF and interventions that may reduce FoF. Fifteen relevant studies were found through a systematic literature review, in which the PubMed, Embase, PsychINFO and CINAHL databases were searched. Some of these studies indicated that 50% or more of patients with a hip fracture suffer from FoF, although adequate instruments still have to be validated for this specific group. FoF was associated with several negative rehabilitation outcomes, such as loss of mobility, institutionalization, and mortality. FoF was also related to less time spent on exercise and an increase in falls, although knowledge about risk factors, the prevalence over a longer time period, and the exact causal relations with important health outcomes is limited. Most studies suffer from selection bias by excluding patients with physical and cognitive disorders. Hence, more research is required, including in patients who are frail and have comorbidities. Only when knowledge such as this becomes available can interventions be implemented to address FoF and improve rehabilitation outcomes after a hip fracture.

Key words: hip fractures, rehabilitation, fear of falling, falls efficacy, elderly

INTRODUCTION

Although the primary treatment of a hip fracture is mostly surgical, the final functional result also depends on multidisciplinary rehabilitation practices.[1,2] Several factors have been associated with recovery after a hip fracture, such as age, sex, marital state, residence, pre-morbid activities of daily living (ADLs), walking ability, cognition, and number of co-morbidities.[3-5] Despite much that is still unknown, the importance of psychological factors has been emphasized.[6,7] Fear of falling (FoF), in particular, seems to be an important psychological factor, which may have an even greater impact on functional recovery than pain or depression.[8] FoF also reduces participation in exercises during the rehabilitation process.[9,10] Functional disabilities caused by FoF may restrict outcomes in the long term,[11] particularly because FoF is known to result in dependency and poor functioning in older adults.[12,13]

FoF was first used in the context of the post-fall syndrome.[14] Several efforts have been made to operationalize this concept, particularly when measures were being developed. Tinetti describes FoF as "a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing" and has operationalized FoF as a loss of self-efficacy to perform certain activities without falling.[13] Others relate FoF to deteriorated postural control.[15] FoF has often been described more generally as a broader concept of intrinsic fear or worry about falling.[16]

FoF is common among community-based older adults[17] but may be different in patients after a hip fracture, because these patients have fallen and are suddenly restricted in their activities. In addition, patients with a hip fracture have higher levels of comorbidity and premorbid disability.[18,19] Hence, the objective of this review was to systematically describe and analyse FoF in patients after hip fracture. The important questions to be addressed were:

Which instruments are used to measure FoF in patients with a hip fracture?
What is the prevalence of FoF among patients with a hip fracture?
Which factors are associated with FoF after a hip fracture?
Which interventions may reduce FoF after a hip fracture?

A systematic review was carried out to answer these questions. All relevant studies related to FoF in patients with hip fractures were examined in this review.

METHOD

Data sources and search strategy
In March 2009 a literature search was carried out using four databases: PubMed (Medline), Embase, PsychINFO, and CINAHL. The Cochrane Library was consulted. Finally, the reference lists of selected articles were scrutinized for relevant articles.

The databases were searched using both controlled terms (e.g., Medical Subject Headings in Medline) and free text words. These were customized to the database. The following search was used most frequently: *((hip fracture*) OR (proximal femur fracture*)) AND ((fear of fall*) OR (concern of fall*) OR (self-efficacy) OR (fear) OR (psychological factors)).*

Study selection (see Figure 1)
All possible studies, retrospective and prospective, were included in the search. Because the majority of hip fractures occur in people aged 65 and older, no age limitation was included. Furthermore, no restriction on the year of publication of the article was made.

The initial search resulted in 819 titles (Figure 1). In PubMed, 362 titles were found, to which 161, 282 and 14 new articles were subsequently added by searching Embase, PsychINFO, and CINAHL, respectively. No additional studies were found in the Cochrane Central Register. Two investigators (WA, JV) screened the titles to find eligible studies. The most important criterion was whether these articles could describe studies related to FoF in patients with hip fractures. Where there was any doubt, the article was included. One hundred fifty-one articles were selected and the abstracts read (WA, JV). Articles were selected when they probably presented a study (not a review) that included FoF or balance problems in patients with a hip fracture. Furthermore, the full article needed to be available in English, German, French, or Dutch. In addition, the article needed to describe a study and not a comment or personal opinion.

Thirty-two articles met the above-mentioned criteria. Two investigators (WA, JV) read the full articles and assessed their ability to answer the research questions. Qualitative studies and articles in which no analysis for patients with hip fractures was provided were excluded. Fourteen articles were found providing relevant information for the research questions. An additional article was included after reviewing the references.

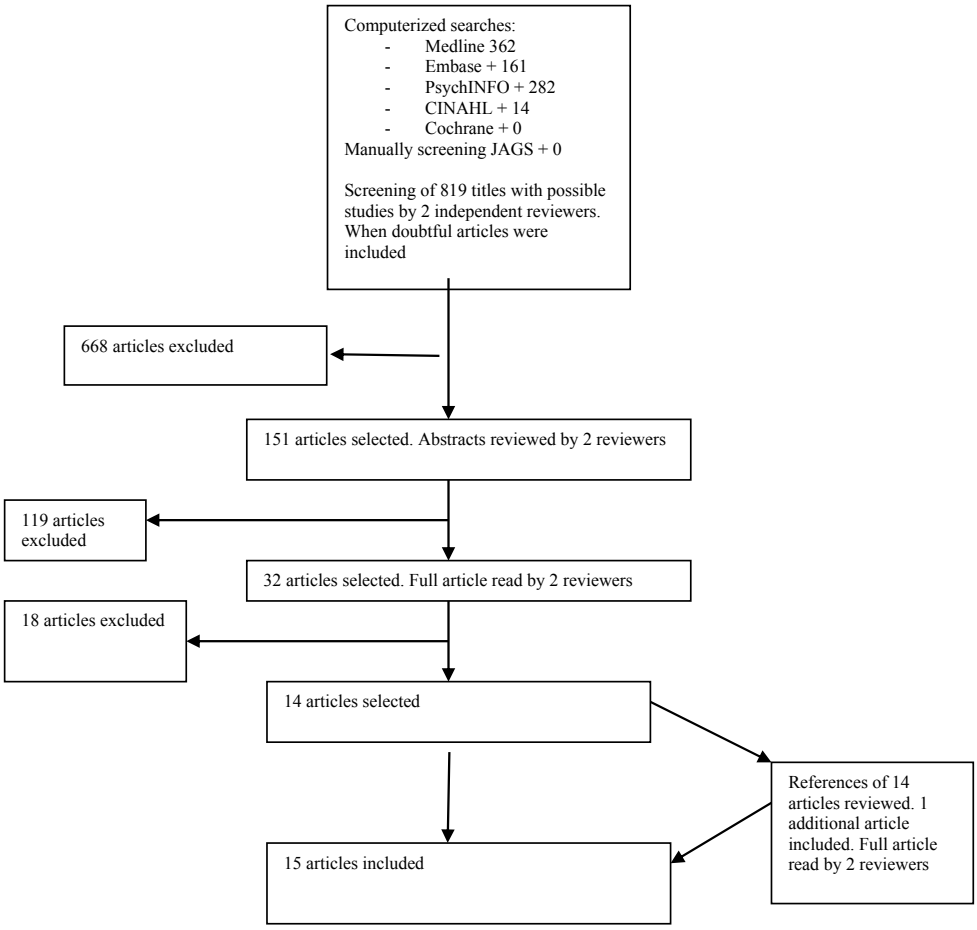

Figure 1 – Strategy used for selection of published reports on fear of falling in patients with hip fracture

Data extraction and synthesis

Appraisal tools that the Centre of Evidence-Based Medicine and other institutions provided were used to analyze the quality of the studies.[20-23] The articles were assessed in particular on validity (Is there a well-defined study question?), importance of results (How great is the likelihood of the results? How precise are the results?), and their applicability to the rehabilitation process (Will the results be helpful for the rehabilitation of our patients? Are the benefits worth the harms and the costs? Do the results fit with other available evidence?). Using this format, studies were further analyzed and evaluated, although it was not possible to make adequate comparisons between the studies and to provide a quality assessment because of the heterogeneity of the studies in terms of design, objectives, variables, and outcome measures. Statistical pooling of data (meta-analysis) was not possible either.

RESULTS

The 15 studies that were found are summarized in Table 1.

All studies included measures for FoF. Two studies addressed risk factors for FoF[11,16] and one compared different diagnostic measurements.[31] Eleven studies provided information about the association between FoF and other variables. Four intervention studies could be retrieved in which the effect of an intervention on FoF was assessed. The study features are summarized in Table 1. Two articles refer to the same group of patients.[24,35]

Table 1 - Summary of Publications About Fear of Falling After Hip Fracture

Study	Objective and design	Setting	Sample	Measurement instrument for FoF
Becker et al.[24]	Prognostic study to identify factors that predict mortality, morbidity and admission to a long-term care facility after hip fracture	Patients admitted in 5 hospitals in south Germany.	134 (home-dwelling) patients with hip fracture, 65 and older. Mean age +/- SD 80,3 +/- 7,6	Single question: Do you have fear of falling? Scale 1- 6.
Casado et al.[25]	Prognostic study, using data from Baltimore Hip Study 5, examining how social support for exercise by experts affected self-efficacy, outcome expectations, and exercise behavior	Patients admitted to 9 hospitals in Baltimore, MD.	164 community-dwelling women with hip fracture aged ≥65, mean age +/- SD 81.0 +/- 6.9	Single question: Can you rate your fear of falling on a scale 0-4? Range 0-4[26]
Crotty et al.[27]	Randomized controlled trial to measure effect of intervention (home rehabilitation after early discharge with therapists visiting home focusing on negotiated set of goals)	Patients admitted to 3 hospitals in Adelaide, Australia.	66 patients aged ≥65 with hip fracture; 34 with accelerated discharge with home-based rehabilitation and 32 allocated to control group with conventional care. Median age (quartiles) intervention group 83.5 (76.6, 85.5); control group 81.6 (78.2, 85.4)	ABC Scale, 16 items; range 0-100[28] FES, 10 items; range 10-110[29]
Hauer et al.[30]	Randomized, controlled trial to measure effect of intervention (3-month physical training after hip surgery)	Patients admitted to acute care or inpatient rehabilitation because of hip fracture or hip replacement; Germany	28 women with hip fracture aged ≥75; 15 in intervention group, 13 in control group, mean age +/- SD 81.3 +/- 3.9	Single question: Are you afraid of falling? Range 0- 3[15]
Ingemarsson et al.[31]	Diagnostic cross-sectional study to investigate relationship between fall-related efficacy and tests of balance	Patients postoperatively cared for at the Geriatric Clinic in Vasa Hospital, Göteborg, Sweden	55 patients operated on for hip fracture, mean age +/- SD 82.3 +/- 6.8	FES - Swedish version, 13 items; range 0-130[32] Single question: Are you afraid of falling? Range 0-3

Table 1 - Continued

Study	Objective and design	Setting	Sample	Measurement instrument for FoF
Jones et al.[33]	Intervention study to assess effect of community exercise program (focused on functional stepping and lower-extremity-strengthening exercises)	Patients convalescing in a rehabilitation unit in a teaching hospital, Ontario, Canada	25 patients aged ≥65 with hip-fracture, the first 17 enrolled in the intervention group, the next 8 controls, mean age +/- SD 80.0 +/-6.0	ABC Scale, 16 items; range 0 -100% confidence.[28] FES, 10 items; range 10-100[29]
Kulmala et al.[34]	Cross-sectional study to investigate association between self-assessed balance confidence and functional balance with falls	Patients operated on at local hospital in. Finland	79 patients operated on with hip fracture, aged 60-85, women aged 76.0 +/- 6.2 years; men aged 73.4 +/- 7.4	ABC Scale, 16 items; range 16-160[28]
McKee et al.[16]	Descriptive follow-up study to determine whether FoF and falls efficacy contribute to prediction of health outcomes after hip fracture	Patients admitted to hospital, United Kingdom	82 patients with hip fracture, aged ≥65, mean age +/- SD 80.2 +/- 7.3	Perceived risk of further falls in the next 2 months, 1 item; range 1-6. Worry over further falls in the next two months, 1 item; range 1- 6 FES, 10 items; range 10-60[29]
Muche et al.[35]	Prognostic study to identify risk factors for mortality, institutionalization and mobility limitations	Patients admitted to 5 hospitals in south Germany	135 patients with hip fracture aged ≥65; 15 died in first 6 months so data of 120 patients used for institutionalization and mobility, mean age +/- SD 80.3 +/- 7,6	Single question: Do you have fear of falling? Range 1- 6.
Oude Voshaar et al.[8]	Prospective study to assess factors such as pain, depression, and FoF on functional outcome; part of a randomized controlled trial to prevent and treat depression after hip fracture	Patients admitted to one of 4 orthopedic units in Manchester, United Kingdom	187 patients with hip fracture aged ≥60 years, mean age +/- SD 79.8 +/- 8.7	Modified FES, 14 items; range 0-140[36]
Petrella et al.[11]	Prospective study to establish relationship between physical function and fall-related self-efficacy	Patients admitted to rehabilitation programme from acute care setting, Ontario, Canada	56 patients with hip fracture aged ≥65, mean age 79.7 (range 65-95)	FES, 10 items; range 1-10 (average of items)[29] ABC, 16 items; range 0-100% confidence[28]

Study	Objective and design	Setting	Sample	Measurement instrument for FoF
Resnick et al. (1)[10]	To describe through modelling selected intra- and interpersonal factors that influence exercise behaviour in women after hip fracture who participated in the Exercise Plus Programme	Patients from 6 hospitals in greater Baltimore, MD	209 female hip fracture patients aged ≥65, 165 (79%) of whom were available at 2 months, 169 (81%) at 6 months, and 155 (75%) at 12 months, mean age +/- SD 80.7 +/- 6.9	Single question: Do you have fear of falling? Range 0-4.
Resnick et al. (2)[37]	Cross-sectional study using data from BHS-4 and BHS-5 randomized control trials	Women recruited from 3 acute care facilities in BHS-4 and 9 acute care facilities in BHS-5, Baltimore, MD	315 female patients with hip fracture aged ≥65, mean age +/- SD BHS-4, 82.5 +/- 6.9; BHS-5, 84.0 +/- 6.9	Single question: Do you have fear of falling? Range 0-4.
Whitehead et al.[38]	Prospective study to compare 4-months outcomes of fallers and nonfallers and those with slow gait speed	Patients admitted to Flinders Medical Centre, Australia	73 community dwelling patients aged ≥60 who completed a rehabilitation program after hip fracture, mean age +/- SD 81.3 +/- 6.2	FES, 10 items; range 0-100[29] ABC Scale, 16 items, range 0 -100% confidence[28]
Ziden et al.[39]	A randomized controlled study to investigate whether a home rehabilitation programme can improve balance confidence, physical function, and daily activity level in the early phase after hip fracture	Patients admitted to Sahlgrenska University Hospital, Gotenborg, Sweden	102 community-dwelling patients with hip fracture aged ≥65; 48 enrolled in home rehabilitation programme, 54 in control group with conventional care, mean age +/- SD 81.9 +/- 6.8	FES Swedish version, 13 items; range 0-130[32]

Which Instruments Are Used to Measure FoF in Patients with a Hip Fracture?
All studies used at least one instrument to measure FoF. These instruments can be divided in two groups: instruments intended to measure FoF directly and instruments focusing on balance confidence or self-efficacy related to falls. The first group consisted mostly of single items, whereas the second group usually included instruments consisting of several items.

The direct measures for FoF with single items were mostly answers to questions such as "Do you have fear of falling?" or "Are you afraid of falling?". Two instruments were found that measure balance confidence or self-efficacy related to falls: the Activity-related Balance Confidence (ABC) Scale and the Fall Efficacy Scale (FES). The items on the ABC Scale increase in complexity from the beginning to the end of the instrument. The ABC Scale was used in five studies and the FES in eight. Although these instruments are used for patients with a hip fracture, no studies could be found in which the psychometric features of the instruments had been tested for this group of patients.

Studies that had used or compared two or more instruments were of particular interest. One cross-sectional study used the FES (Swedish version; FES(S)) and a direct measure for FoF using a 4-point ordinal scale.[31] This study, in which patients were assessed approximately 25 days after surgery, found a significant relationship ($p<0.001$) between the two instruments. The less fear a patient felt, the higher the fall-related efficacy in different activities. Patients who were never or seldom afraid of falling had on average a 40% higher score on FES(S) than patients who reported that they were sometimes or often afraid of falling. A particular advantage of the FES(S) was that it indicated which daily activities the patient perceived to be troublesome, highlighting activities in which the patient might require further training.

Another study found that perceived risk of further falls and worry over further falls were significantly correlated (correlation coefficient = 0.40, $P<.001$) with each other.[16] When measured 5 to 8 days after surgery, neither of these measures were significantly associated with the FES, which may indicate that they measure different constructs.

Research also indicated that the FES was more sensitive to change than the ABC scale.[11]This is in line with findings from earlier studies in which the FES was used in particular for frail elderly, whereas the ABC scale, which contains several complex activities, is more often used for relatively healthy community samples.[40]

What Is the Prevalence of FoF in Patients with Hip Fracture?

No studies were found that specifically focused on the prevalence of FoF among patients with hip fractures. In addition, no studies were found in which FoF was measured systematically over a longer period during the rehabilitation process.

Some studies provided useful information about the prevalence of FoF after a hip fracture, although different instruments were used, and evidence-based cutoff points were missing. In some studies, the researchers themselves determined the cutoff point. When FoF was measured within 1 week after surgery on a scale from 1 to 6 (1= no fear to 6=strongest fear), 50% (68/135) of the patients indicated that they were afraid of falling (score of >3).[35] Another study, in which FoF was measured on average 25 days after surgery (range 6-80 days), revealed that 65% (36/65) of the patients had FoF sometimes or often. [31]

In an intervention study, FoF was measured on a scale of 1-3, 3 to 4 weeks after admission to a rehabilitation hospital, after a successive training period of 12 weeks, and 3 months later.[30] In patients who followed a conventional rehabilitation programme, the average FoF was 1.67, 1.55 and 1.78, respectively. Therefore, only some small changes seem to appear over time. Another author indicated an average level of FoF of 2.2 (n = 149) and 2.4 (n = 166) on a scale that ranged from 0-4 (0 = no fear, 4 = strong fear) in two study-cohorts 2 months after a hip fracture.[37]

When using the FES(S), the mean score +/- standard deviation (SD) was 5.6 +/- 2.8 (range 0-10: 0 = no confidence at all, 10 = full confidence), with higher scores reported for activities such as personal grooming, getting on and off the toilet, getting in and out of a chair, and getting in and out of bed.[31] The FES(S) was administered 25 days on average after surgical repair of the hip fracture. Another study reported an average score of 69.8 +/-37.7 (range 0-140) (N=187) on the modified FES right after hip fracture.[8] The wide confidence interval may be due to the heterogeneity of the patients, which was also reflected in wide confidence intervals for depression and pain scales in this study.

Which Factors Are Associated with FoF After a Hip Fracture?

Associations between FoF and other variables were explored in 11 studies.[8,10,11,16,24,25,31,34,35,37,38] The relevant variables to which FoF is associated are listed in Table 2.

Table 2 - Variables Associated with Fear of Falling (FoF) After Hip Fracture

Variables related to FoF in patients with hip fracture	Study	Associated variable	Association
Pre-fracture activity	McKee et al.[16]	Adapted ADL-scale (self-assessed problems with walking, self-care indoor activities and outdoor activities)	FES associated with prefall activity problems (*P*<.001). Association between ADL-scale and "worry over further falls in next two months" and "perceived risk of further falls in the next two months" not significant.
History of falls	McKee et al.[16]	Fall history (never fallen before/fallen, but not during last year/falling in last year)	FES was associated with fall history (*P*<.05). Worry over further falls in next 2 months was associated with fall history (*P*<.001). Association between fall history and "perceived risk of further falls in the next two months" was not significant.
Mortality	Becker et al.[24]	Mortality within 6 months after surgery	Multivariate logistic model: OR FoF = 4,22 for mortality, 95%CI = 0,80-4,80.
	Muche et al.[35]	Mortality within 6 months after surgery	Percentage of patients who died was 17,7% for patients with strong FoF and 4,5% for patients without (*P* =.02).
Institutionalisation	Becker et al.[24]	Living in nursing home 6 months after surgery	Multivariate logistic model: FoF for institutionalization: OR = 2,23, 95% CI = 0,79 – 6,27.
	Muche et al.[35]	Living in nursing home 6 months after surgery	Percentage of patients who were institutionalized was 31.1% for patients with strong FoF and 17,2 % patients without FoF (*P* =0,06).
Physical function, functional recovery, balance, mobility	Becker et al.[24]	Ability to go outdoors without help of others	Multivariate logistic model: FoF for loss of mobility OR = 1,96, 95% CI = 0,80 – 4,80.
	Ingemarsson et al.[31]	Functional reach; balance tests on platform	Significant relationship between subjective ability (FES) and objectively measured balance (FR) (*P* <.001); only a few significant correlations between balance tests on platform and FES(S) and FR.
	McKee et al.[16]	Functional recovery from injury: physical limitation dimension of the FLP	Physical limitation dimension at 2 months was associated with FES score (*P* =.005); physical limitation dimension at 2 months was associated with perceived risk of further falls (*P* =.05); physical limitation dimension at 2 months was not significantly associated with worry over further falls.
	Muche R et al.[35]	Ability to go outdoors without help of others	Percentage of patients with mobility limitations was 37,5% for patients with strong FoF and 18,8% for patients without FoF (*P* =0,02)
	Oude Voshaar et al.[8]	TUG; gait speed; FR; activity subscale of self-report Sickness Impact Profile questionnaire	FoF to predict TUG at 6 months: baseline OR = 0.89 (*P* =.04) and after 6 weeks OR = 0.75 (*P* <.001). FoF to predict gait speed at 6 months: baseline OR = 0.93 (not significant) and after 6 weeks OR = 0.73 (*P* <.001). FoF to predict FR at 6 months: baseline OR = 1.06 (not significant) and after 6 weeks OR = 1.32 (*P*=.006). FoF to predict Sickness Impact Profile at 6 months: baseline OR = 0.92 (*P* =.11) and after 6 weeks OR = 0.70 (*P*< .001).
	Petrella et al.[11]	Physical function: Functional Independence Measure	No correlation was found between changes in the fall-related self-efficacy measures and the Functional Independence Measure.
	Whitehead et al.[38]	10-m walk test for gait speed	Those with slower gait speed had lower self-efficacy (FES and ABC). Patients with normal gait: mean FES 71.3 +/- 22.9, mean ABC 45.6 +/- 21.0; patients with slow gait: mean FES 78.6 +/- 33.8, mean ABC 75.5 +/- 16.6.

Exercise	Casado et al., 2003[25]	Outcome Expectations for Exercise scale Self-efficacy for Exercise Scale	Model indicated significant path between FoF and outcome expectations for exercise
	Resnick et al.[10]	Social Support for Exercise Scale Self-Efficacy for Exercise scale Outcome Expectations for Exercise Scale Stage of Change Questionnaire Exercise time	At 2 months, FoF was not significantly related to any of the variables mentioned (in the table). At 6 months, FoF was related to outcome expectations for exercise (path coefficient –0.23; *P* <0.001) and indirectly related to exercise time. At 12 months, participants with less FoF had strong self-efficacy expectations (path coefficient -0.25 (*P* <0.001). FoF related also to outcome expectations (path coefficient -0.23, *P*<.001). Through these, FoF related to time spent in exercise.
	Resnick et al.[37]	Self-Efficacy for Exercise scale Outcome Expectations for Exercise scale Yale Physical Activity Survey	The participants reported some FoF; however, no significant relation between FoF and self-efficacy expectations and exercise behavior.
Falls	Kulmala et al.[34]	Berg Balance Scale (BBS) for functional balance Self-reported falls during previous 6 months Falls vs no falls; Recurrent falls vs occasional or no falls Indoor falls vs no indoor falls Outdoor falls vs no outdoor falls	Lower ABC score was associated with recurrent falling and lower BBS score. Mean ABC for no recurrent falls was 97 +/- 31, versus 68 +/- 51 for recurrent falls. Lower ABC scores were also related to indoor falls. Mean ABC score for no indoor falls was 100 +/- 32, versus 72 +/- 35 for indoor falls. Patients with outdoor falls did not differ from those with no outdoor falls in ABC scores.
	McKee et al.[16]	Falls in first 2 months after surgery (yes/no)	Not having fallen at 2 months was positively associated with FES score (*P* <.05). Not haven fallen was associated with worry over further falls (*P*<.01). Not haven fallen was not significantly associated with perceived risk of further falls.
	Whitehead et al.[38]	Fall history	Those who had fallen had lower fall self-efficacy. Fallers: FES score 61.7 +/- 22.6, ABC score 33.4 +/- 20.1; nonfallers: FES score 73.5 +/- 26.2, ABC score 53.5 +/- 23.0.

ABC = Activity-specific Balance Confidence Scale; ADL = Activities of Daily Living; BBS = Berg Balance Scale; CI = Confidence Interval; FES = Falls Efficacy Scale; FLP = Functional Limitation Profile; FR = Functional Reach; OR = Odds Ratio; SD = Standard Deviation; TUG = Timed Up and Go Test.

Premorbid factors

One study assessed pre-morbid factors that may have an influence on FoF.[16] The information was collected through interviews just after the fracture had occurred. It was found that the FES had a strong association with pre-fall activity problems and a weaker but significant association with history of falls.

Mortality

FoF may be a predictor for mortality. This was explored in two longitudinal studies from Germany that used the same population sample.[24,35] FoF was the third-best factor after pre-morbid ADL and sex in this study but the first factor that was possibly modifiable.

Institutionalisation

The above-mentioned studies also found associations, although not significant, between FoF and institutionalization (admission to a nursing home within 6 months after hip fracture).[24,35]

Physical Function, Functional Recovery, and Mobility

The majority of studies assessed the relationship between FoF and functional outcomes, particularly mobility.[8,11,16,24,35,38] In two German studies FoF was a predictor for limited outdoor mobility (the capacity of going outdoor without personal assistance).[24,35]

FoF and falls efficacy were assessed as independent variables for the functional limitation dimension of the Functional Limitation Profile (FLP).[16] Functional limitation at 2 months was associated with perceived risk of further falls (P=.04) and FES score (P=.005) measured approximately 1 week after surgery. These relationships were subsequently examined in multivariate models. With functional limitation as the outcome measure, FES score and perceived risk of further falls did not add significantly to the prediction of variance once length of stay, falls history, and pre-fall activity problems had been controlled for.

The relationship between FoF and functional outcomes was strongly established in another study.[8] In the final multivariate model, cognitive functioning and FoF (Modified FES) assessed 6 weeks after surgery consistently predicted functional recovery at 6 months, measured using the Get Up and Go Test, gait speed, and functional reach. Also, the overall multivariate models including all psychological variables (cognition, pain, depression) consistently included FoF at 6 weeks as the most significant predictor after correction for other factors such as age and level of pre-morbid functioning.

Another study found no relationship between changes in physical functioning (Functional Independence Measure, ADL, mobility) during a rehabilitation programme and changes in fall-related self efficacy (FES and ABC).[12] Another author compared groups with different functional outcomes (those with normal walking speed vs those with low walking speed: slower than 2 standard deviation (SDs) below the mean in 10-m timed walking test).[38] The mean of the FES and the ABC 4 months after surgery were significantly lower for slow walkers compared to normal walkers.

Exercise

Data from two cohorts in the Baltimore Hip Studies (BHS-4 and BHS-5), in which an intervention (Exercise Plus Programme) was tested, were also used to assess FoF.[37] When women were tested at 2 months, no significant relationships between FoF and participation in exercises could be demonstrated. In another study, using data from the Baltimore Hip Studies, data were collected at 2, 6 and 12 month, and structural equation models including FoF were tested.[10] Although FoF at 2 months was not significantly related**,** at 6 months it was related to exercise time. In addition, at 12 months, those with less FoF spent more time in exercise. A model developed to analyze data from the BHS-5 indicated an association between FoF and exercise.[25]

Falls

Three studies focused on the relationship between FoF and falls.[16,34,38] In a cross-sectional study, 79 patients were assessed who had undergone surgery for hip fracture 6 months to 7 years before.[34] A lower ABC score was associated with recurrent falling and a lower Berg Balance Score. Participants with indoor falls had lower ABC scores, but no difference in ABC score was found between outdoor falls and no outdoor falls. Another author found that “no history of falls” 2 months after hospital discharge was negatively associated with worry over further falls (P=.005) and positively with FES score (P<0.05).[16]

Finally the association between FoF and falls was confirmed when differences between groups of fallers and non-fallers were studied. Those who had fallen in the 4 months after hip fracture had significantly lower FES and ABC scores at the 4-month follow-up.[38]

Which Interventions May Reduce FoF After a Hip Fracture?

The effect of an intervention on FoF was assessed in four studies.[27,30,33,39] three of which were randomized controlled trials.[27,30,39] Patients with severe comorbidity or cognitive disorders and patients who were not expected to return home were mostly excluded.

One study[27] evaluated a home-based rehabilitation programme with early discharge. After discharge, therapists visited patients at home and negotiated a set of targets. As a result of strict inclusion criteria only 66 out of 188 patients were included. The study found that the mean FES at 4 months was significantly better for the intervention group. The mean ABC of patients was not significantly different between the intervention and control group.

Another study[30] investigated a 12-week programme of ambulatory training that started immediately after discharge from the hospital. The program included intensive training of relevant muscle groups and functional training to enhance balance. Measurements were taken 3 to 4 weeks after admission to the hospital, at the end of the training period, and 3 months later. Although there was a clear improvement in FoF, it was not significant. The mean FoF score in the intervention group decreased from 1.50 +/- 0.71 to 0.78 +/- 0.83 at the end of the training period; 3 months later FoF was 1.00 +/- 0.92. For the control group, only a very small decrease was found, from 1.67 +/- 1.0 to 1.55 +/- 0.88, whereas after 3 months, FoF increased to 1.78 +/- 0.67.

A community exercise programme focusing on functional stepping and lower extremity strengthening exercises was evaluated after a 4-month intervention period.[33] The first 17 patients were enrolled in the intervention group, and the next 10 consecutive patients were controls. The ABC score increased in the intervention group from 76.6 +/- 21.8 to 90.1 +/- 10.1, compared with an increase in the control group from 80.8 +/- 19.1 to 94.3 +/- 6.1. FES increased in the intervention group from 83.9 +/- 15.0 to 93.6 +/- 6.6 compared to increase in the control group from 89.1 +/- 10.8 to 94.4 +/- 6.7. The differences were not significant between intervention and control groups.

In a study of a home rehabilitation program that had a maximum period of 3 weeks after discharge and was aimed to improve balance confidence, physical function and ADLs, the intervention group reported significantly higher confidence in performing daily activities, as measured by the FES.[39] The intervention group had a larger increase than controls in balance confidence on stairs and instrumental activities 1 month after discharge according to the FES. The improvements in the means of the total score for the intervention and control groups were 30.6 and 13.5, respectively (P<.001); the improvements in the means of the stairs climbing item for the intervention and control group were 3.3 and 0.6, respectively (P=.002); and the improvements in the means of the instrumental ADL items of the FES for the intervention and the control groups were 19.7 and 7.1, respectively (P<.001).

DISCUSSION

In this review, 15 studies related to FoF in patients with hip fracture were evaluated. The studies provided information concerning measuring FoF, the prevalence of FoF, associations between FoF and other variables, and interventions to improve FoF.

Measurement instruments can be divided into two groups: those that directly assess FoF by a single question and those that particularly relate to keeping balance or self-efficacy in not falling during certain activities, such as the ABC Scale and FES. The ABC Scale comprises many complex activities and has a greater responsiveness for people with a higher degree of functioning than patients after hip fracture. The FES was used in several modifications, sometimes focusing on the confidence someone has in not falling when doing an activity, sometimes explicitly on the fear someone has about losing balance and falling during an activity. Modified versions of the FES have been developed because the FES probably has a ceiling effect[39] (e.g. the international version (FES-I), to which more-difficult and social activities have been added). For frail elderly patients after hip fracture the FES-I, similar to the ABC, may comprise activities that are too complex, and the ceiling effect may be less relevant. The FES(S) may be more suitable for patients with hip fracture, because it focuses on basic ADLs, which are relevant for patients with moderate to low functional ability.[32]

No studies were found that assessed the psychometric features of these instruments for patients with a hip fracture. A systematic review of measurement instruments for the psychological outcomes of falling evaluated the available instruments for FoF.[40] Most of the instruments found in the current review can also be found in that study, which identified the same main categories (instruments that intend to measure FoF directly and those that focus on fall-related efficacy and confidence, indicating that these are different constructs). In a few studies in which single-item instruments and FES instruments were included, a correlation was found. It is likely that someone who has FoF also has less confidence in performing certain activities that require balance. Exactly how these constructs interact with each other requires further research. In addition, other factors such as coping behavior, motivation, and outcome expectations may influence self-efficacy to execute certain activities. That study concluded that “the majority of research reporting psychometric properties has focused on self-efficacy measures. These instruments may prove superior to others because of the strong and well-researched theoretical base”. Because almost all research has focused on relatively healthy community-dwelling older adults, evidence is lacking as to whether this statement can be extrapolated to all patients with hip fracture.

No studies were found that consistently assessed the prevalence of FoF after hip fracture over a long time period. Most studies used different instruments, and the period between hip fracture and measurement varied substantially. Therefore, it is difficult to compare these findings, because FoF may not be stable over the rehabilitation period. Another limitation is that all studies excluded patients with cognitive and severe medical disorders, which may give selection bias. It is possible that particularly patients with cognitive and severe co-morbidity suffer more often from FoF. A literature review reported that, in community-dwelling older adults, the prevalence of FoF varies between 21% and 85%.[17] The findings of the studies in this review are within these limits.

Many factors have been associated with FoF in community-based older adults.[17] Some of these were also found in the current review. Because most of the studies were cross-sectional, the causality between these factors remains unclear. Only premorbid activity and history of falls were shown to be risk factors for FoF after a hip fracture.[16] Furthermore, this review reveals that FoF is a predictor of important outcomes for the rehabilitation process, such as mobility, mortality, and institutionalisation. Further research is needed to establish whether causal relationships exist with other factors. FoF was related with falling, though not with outdoor falls.[34] It is possible that lack of FoF is a risk factor for outdoor fall because patients with low ABC score are more reluctant to walk outside and are more careful. Patients with severe FoF may reduce their activities and spend more time indoors. FoF may work protectively for these older adults, although the study may have some flaws due to recall bias (for falls) and because only a minority of the potential participants consented to participate in the study.

The finding that FoF may be related to exercise is particularly important.[25] It may imply that FoF has to be addressed throughout the rehabilitation process, because exercise improves health outcomes.[2] One study found that the effect of FoF seemed to be strongest 12 months after fracture rather than in the more-immediate postfracture period,[10] which "suggests that ongoing efforts might be made to address the FoF well after their initial fracture." In addition, it has been speculated that "the level of fear of falling during rehabilitation is a more important predictor for functional outcome than fear of falling directly after surgery by excluding patients who easily overcome their initial anxiety and including those who become aware of their fear during rehabilitation".[8] More research is required to establish the precise (causal) relationship between FoF and important outcomes.

Intervention studies have revealed that FoF can be modified, [27,39] but the studies have to be interpreted with care, because they included only relatively healthy patients, possibly causing a selection bias. It is possible that patients with more-severe medical and cognitive

disorders have less favorable results because they are less trainable and motivated. In one study, [30] 14 of the 28 patients included underwent a total hip replacement, which is a less common procedure for hip fracture and makes it cumbersome to generalize these results to other populations. In addition, sample sizes of the studies were small, and the follow-up periods were mostly short. In one study, the small sample may have caused the association not to be significant.[30] In another study, the high number of non-consenters and the strict inclusion criteria may have caused selection bias.[33] Furthermore, the control and intervention groups may not have been comparable from the start, as indicated by the differences between the groups in relation to the FES score at baseline. In another study, the difference in effect of the intervention on FoF may be even stronger, with six patients in the home-based rehabilitation programme not receiving it (intention-to-treat principle) and several patients in conventional care group receiving other types of treatment after discharge.[39] Because the intervention had only 1 month follow-up, it is not clear whether these improvements will be sustained.

Over the past years several interventions, particularly for community–based older adults, have been developed to reduce FoF.[41,42] Different programmes have been implemented, some focusing more on exercise (balance training, walking, tai chi), others more on education (discussions about risk to fall, adequate feeding habits and being active). Whether such programmes are also useful for patients after hip fracture is largely unknown and requires further research.

A major limitation of this review is the absence of a substantial number of prospective studies. Most studies were cross-sectional, which makes it impossible to describe the severity of FoF during the rehabilitation process and to find causal relationships between FoF and relevant outcomes. Prospective studies are necessary to bring more clarity. Another limitation relates to the inclusion of predominantly relatively healthy older adults in the studies. It makes generalization of results to the whole population of hip fractures cumbersome, because a high proportion of patients with hip fracture suffer from chronic diseases, both physical and mental in nature.[18,19] Finally, the studies included in this review had a wide variety of designs and methodologies, addressing FoF in different modalities. This made comparison between studies and adequate rating not suitable.

This review has shown that FoF among patients with hip fracture is common, although adequate instruments still have to be validated for this specific group. FoF is associated with several negative rehabilitation outcomes. Knowledge about risk factors of FoF, prevalence over a longer time period, and the exact causal relationship with important health outcomes are still obscure. This information is needed to improve the outcomes of rehabilitation

after hip fracture, particularly for patients who also have additional cognitive and medical disorders. Based on this knowledge, adequate interventions can be developed that may reduce FoF and improve outcomes of rehabilitation after a hip fracture.

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