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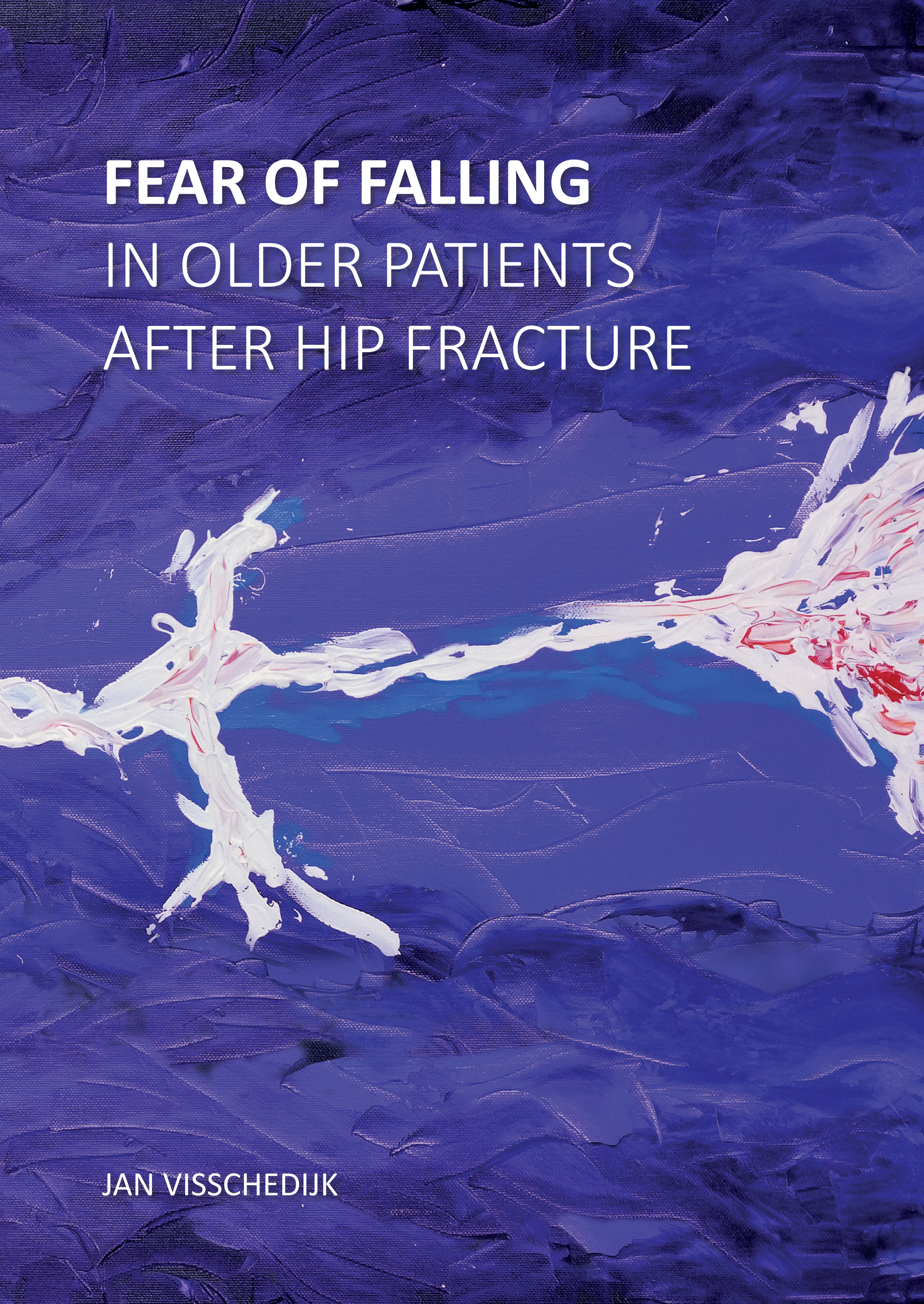

FEAR OF FALLING IN OLDER PATIENTS AFTER HIP FRACTURE

JAN VISSCHEDIJK

Fear of falling in older patients after hip fracture

Jan Visschedijk

Colofon

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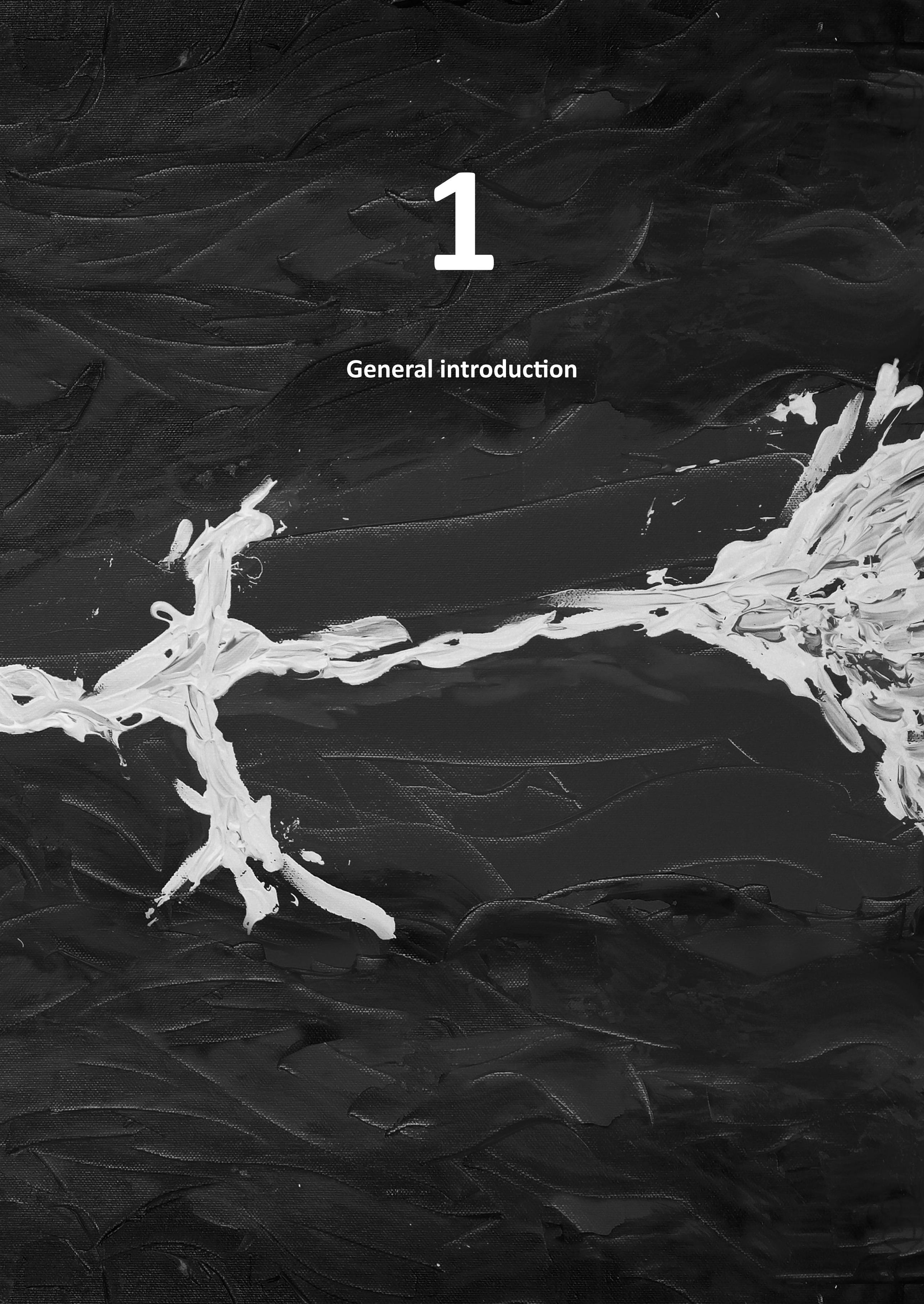
CONTENTS

Success is not final, failure is not fatal: it is the courage to continue that counts.

W.S. Churchill



1

General introduction

On August 27, 2014 Mrs V. fractured her left hip. She was 88 years old, widowed and living independently in an apartment in Rotterdam (the Netherlands). Her husband had passed away two years earlier and her only daughter lived 150 miles further north.
Mrs. V. had a hip replacement (right side) in 2006; she also has arthritis in both knees, hypertension and was wearing hearing devices. During the last two years she had fallen on several occasions. Early 2014, when she fell again, she also complained of temporary difficulties in speaking. The family physician suspected a transient ischemic attack.
Soon after another fall, a hip fracture was diagnosed for which she was operated and received a hemi-arthroplasty. Due to a wound infection she was given antibiotics and for mild anemia she received ferrous fumarate.
On September 9th 2014 she could be transferred to a nearby skilled nursing facility within a nursing home for rehabilitation. Rehabilitation started with a geriatric assessment by the elderly care physician. Based on this assessment a rehabilitation plan was formulated. Mrs V.'s goal was to function again independently at home within 8 weeks. The plan focused on wound care, pain control, continuation of hypertensive treatment, stimulation to independently carry out activities of daily living, and improvement of gait and balance. In addition, a fall analysis was carried out including a medication review, screening for osteoporosis, and a home visit to ensure a safe environment after discharge home. Unfortunately Mrs. V. made little progress and was often reluctant to train with the physiotherapist. She complained that she was very concerned that she would fall again and her rehabilitation was hampered because of this severe fear of falling.

1.1. Introduction

In essence, this thesis is about Mrs. V and, in particular, about her fear of falling (FoF) which impaired her rehabilitation process after a hip fracture. Before presenting the specific aims and research questions in relation to FoF after hip fracture, some background information is given about falls, hip fractures, geriatric rehabilitation, FoF in general, and the instruments used to measure FoF.
This introduction also presents the study design and outline of the thesis.

1.2. Falls

Falls are a major health problem among older adults.[1] More than one third of community-dwelling people aged over 65 years fall at least once a year and the rates increase with age.[2] After a fall, about 20% of the persons seek medical attention from a general practitioner or visit an emergency department. About 5% of the falls result in a fracture and 2% in a hip fracture,[3] while 5-10% of falls cause other serious injuries, such as head injuries, bruises and contusions.[4] When a person has to be admitted to a hospital as a result of a fall, the most common diagnoses are hip fracture (34%), fracture of the lower arm (10%), fracture of the ankle (7%), concussion (6%) and fracture of the upper arm (6%).[5] The impact of falls on a global scale is enormous and the WHO report 'Global Burden of Disease' indicates that fall-related injuries are the third leading cause of years lived with disability.[6] Therefore, falling is justifiably classified (along with other conditions such as delirium, functional impairment, frailty and urinary incontinence) as an important geriatric syndrome.[7]

1.3. Hip fractures: incidence, consequences and treatment

Falls, often the result of polypharmacy, cognitive impairments, chronic diseases and unsteady gait, are (together with osteoporosis) the most important risk factor for hip fractures.[8] In 2008, the incidence of hip fractures in the Netherlands was estimated at about 16,000[9] and is expected to rise by about 40% by 2025,[10] mainly because of the increasing number of older people. In the Netherlands, for instance, the number of people aged 65 years and over will double between 2007 and 2030 to about 4 million.[11] The worldwide number of hip fractures is more than 1.6 million annually,[12] and it is estimated that this number may increase to 4.5 million by 2050.[13] About three-quarters of all hip fractures occur in women, while persons aged 85 years and older are 10 times more likely to sustain hip fracture than those aged 65-69 years.[14] The average age of patients suffering a hip fracture is 79 years[15] and more than 85% is aged ≥ 65 years.[16] Compared with other European countries the incidence in the Netherlands is about average, with higher incidences in northern European countries than in southern European countries.[17]

Hip fractures have implications for both society and individuals, and both the short and long-term costs are high. Direct medical costs have been estimated at 14,000 euro per hip fracture[10] and the societal costs at 19,425 euro at two-year follow-up for femoral neck fractures.[18] For older persons a hip fracture is usually a life-breaking event and the negative consequences, such as an isolated life with more restricted activities and more limited ability to move, are both substantial and long-lasting.[19,20] Persons experience an increased relative risk for mortality following a hip fracture, at least double that of age-matched controls.[21] One year after a hip fracture the overall mortality is reported to be between 20-36%.[22-24] In addition, many patients are unable to regain their functional level.[23] Less than half of the patients reach their pre-fracture mobility within one year.[25] Particularly age, dementia and a lower level of activities of daily living (ADL) before fracture are risk factors for not returning to the pre-fracture place of residence.[26] As a result, older adults with a hip fracture are five times more likely to be institutionalised after one year than age-matched controls.[27]

When a hip fracture is suspected, most patients are assessed at the emergency department of a hospital. The vast majority of patients then undergo surgery. Only patients with a non-displaced or impacted femoral neck fracture, or terminal patients, may not be operated and can be treated conservatively.[28,29] Different surgical procedures are available, such as plate and screw (sliding hip or intramedullary) fixation, and partial or total hip replacement, depending on factors such as the type and site of the fracture, and the overall condition of the patient.[13,30,31] Surgery should be carried out as soon as possible after the diagnosis is confirmed and the clinical condition of the patient is medically optimised.[13,32] This implies that disorders such as coagulopathies, electrolyte disturbances, and heart and respiratory failure should be addressed first. After surgery, the initial focus is on pain control, treatment of delirium if present, pressure ulcer prevention, nutrition, and wound care. Early mobilisation and unrestricted weight bearing may improve patient outcomes, thereby enhancing functional recovery and lowering mortality rates.[33]

1.4. Geriatric rehabilitation

In the Netherlands, after hospitalization, relatively healthy patients with a hip fracture are discharged home to rehabilitate ambulatory, and young persons with a hip fracture as part of a multi-trauma are discharged to specialised rehabilitation facilities. Older persons who already reside in a long-term care facility often return to their facility after surgery. Nevertheless, in 2007 about 40% of the older persons, previously living at their own home, rehabilitated after a hip fracture in a skilled nursing facility (SNF) of a nursing home, specialised in geriatric rehabilitation.[34] This percentage has probably increased over recent years.

Geriatric rehabilitation has been defined as "…*evaluative, diagnostic and therapeutic interventions whose purpose is to restore functional ability or enhance residual functional capability in older persons with disabling impairments*".[35] In the Netherlands, a working group of the Dutch Association of Elderly Care Physicians (Verenso) described geriatric rehabilitation as "…*integrated multidisciplinary care aimed at expected recovery of functioning and participation in vulnerable older people, after an acute disease or functional decline*".[36] This rehabilitation focuses on persons aged 65 years and over who often have a considerable number of co-morbidities and are more vulnerable for complications.[37-39] As a result, these older persons have a diminished exercise tolerance, are less trainable, and (often) are not capable to follow intensive rehabilitation programmes. Also, because they fit less well into a medical specialised rehabilitation facility, they are more suitable for a rehabilitation programme focusing on geriatric patients, as provided in nursing homes.

Nowadays, 25,000-30,000 patients are admitted to nursing homes for geriatric rehabilitation after discharge from a hospital.[34] The most important underlying conditions for geriatric rehabilitation are stroke (24%), elective orthopaedic operation (19%) and trauma (26%), particularly a hip fracture.[34] About 60% of these patients return home after rehabilitation.[34]

After admission to a SNF, a multidisciplinary rehabilitation plan is made by the elderly care physician. This physician is specially trained in medical care of vulnerable older people and is part of the staff of a nursing home.[40] Patients generally follow a 4-16 weeks rehabilitation programme, which includes treatment of pain and comorbidity, training in activities of daily living, and occupational and physical therapy. Also, a fall analysis and assessment of osteoporosis is generally included. When required, a social worker, psychologist or a dietician is consulted. Patients are discharged when they can function independently or with assistance of formal or informal care at home. Many patients continue physical therapy after discharge.

Since the aim of geriatric rehabilitation is to restore activities and to enhance participation, the WHO model of International Classification of Functioning, Disability and Health (ICF) is mostly used as a framework for defining goals and implementing interventions.[41] The model ensures a common structure and language for geriatric rehabilitation and emphasises the importance of activities and participation, in addition to health conditions and body functions (Figure 1).

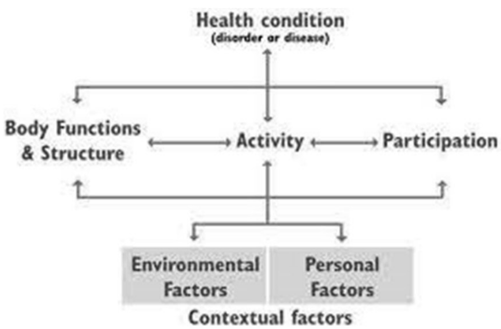


Figure 1 - International Classification of Functioning, Disability and Health (WHO)[41]

In older persons, the ultimate multidisciplinary rehabilitation goal is defined at the ‘participation’ level, i.e. functioning adequately at home after discharge and being able to continue the earlier lifestyle. This requires that an individual needs to be able to master certain activities, such as walking indoors/outdoors, getting in and out of bed, and going to the toilet. Goals for body function or structure may be set (such as strengthening of quadriceps muscles, adequate gait and aerobic endurance, and wound healing) to finally achieve the goals for activities and participation.

During the initial geriatric assessment not only the health condition but also all the contextual factors need to be considered. Health condition not only refers to the main reason for rehabilitation, e.g. a hip fracture, but also other relevant disorders which may influence the rehabilitation process and final outcomes.[42] This may include co-existing diseases such as pulmonary or cardiac disorders, as well as mental disorders such as a depression or dementia. Environmental factors encompass the social network of a patient, for instance the presence or absence of informal caregivers and the residence of an older person, which may facilitate or hamper discharge home. Personal factors in older persons include important features of an individual, such as his/her character and motivation. Other psychological factors, such as FoF, may also influence rehabilitation outcomes.[43] FoF may even be more crucial than other factors such as pain or depression.[44]

1.5. Fear of Falling

FoF is common among patients with a hip fracture[45] and an important theme in recovery after hip fracture.[46] Feared consequences of falling are (in particular) functional independence and damage to identity caused by humiliation and shame.[47] FoF after a hip fracture contributes to avoidance of training activities and results in poorer quality of life.[48] FoF has been defined by Tinetti et al. as "*…a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing"*.[49] Others have defined FoF as "*…a loss of confidence in ability to maintain balance*",[50] and "*low perceived self-efficacy in carrying out certain activities without falling*".[51] Self-efficacy is defined as an individual's perception of capabilities within a particular domain of activities, and efficacy is the amount of self-confidence a person has in his/her ability to perform a specific activity.[52] Falls-related self-efficacy has often been used as a proxy for FoF, although it refers to a different concept.[53,54] Falls-related self-efficacy scales mostly assess 'concerns' about falling, a term related to FoF but probably with less intensity and emotion.[55] Fall-related self-efficacy focuses particularly on a person's confidence in his/her ability to avoid falling while undertaking activities of daily living.[53] The distinction between fall-related self-efficacy and FoF is also important when developing and evaluating fall-related psychological measurement instruments.[56]

1.6. Measurement of Fear of Falling

Various efforts to operationalise FoF have resulted in different measurement instruments.[56,57] The most direct and simple instrument is the question "Are you afraid of falling: yes or no?". This instrument has the advantage of being straightforward and its ease of generating prevalence estimates.[58] However, it does not reflect any variability in degrees of FoF and possibly reflects a more general state of anxiety. Therefore, measurement instruments have been developed that allow more gradations in response (e.g. 'not at all afraid', 'a bit afraid', 'quite a bit afraid', and 'very much afraid').[56 59] Tinetti et al. developed the Falls Efficacy Scale (FES) considering that FoF can best be measured through the construct of fall-related self-efficacy or, even better, the confidence somebody has **not** to fall during certain activities.[51] The original scale has 10 items, with questions such as "How confident are you that you can clean the house without falling?". The scale has been modified several times over the decades by adding and removing items.

The scoring and wording of the FES was further addressed in the development of the Falls Efficacy Scale-International (FES-I) (see Appendices 1-3).[57] This instrument was developed

by the Prevention of Falls Network Europe (ProFaNE), a European committee focusing on fall prevention and the psychology of falling.[60] The FES-I measures level of concern when carrying out both easy and more difficult physical and social activities without falling, on a 4-point Likert-type scale ranging from 1=not at all concerned to 4=very concerned.[55 61] The group tested and validated the FES-I using different samples in different countries.[60] Other instruments developed to measure FoF include the Activities-specific Balance Confidence Scale,[62] which is particularly directed to active older people, and the Survey of Activities and Fear of Falling in the Elderly (SAFFE), which also includes the negative consequences, such as restriction of activities and impaired quality of life.[63] However, the FES-I appears to be the most appropriate measurement tool to assess fear of falling.[57,61]
Although the Falls Efficacy Scales are used in patients after hip fractures, the measurement properties of the FES-I have not yet been tested in this specific patient group. Such evaluation is important, since patients with a hip fracture differ from those without a hip fracture because they have recently experienced a traumatic fall and their health status is worse, i.e. they are more vulnerable and have higher comorbidity.[22]

2. Aims and research questions

FoF is possibly one of the most important factors in patients after hip fracture, with a substantial impact on the final results of the rehabilitation process. Moreover, patients with hip fracture who rehabilitate in a SNF with high rates of comorbidity and complications, may have even worse outcomes as a result of FoF. Unfortunately, the role of FoF in the rehabilitation of these older persons has not yet been investigated.
The overall aim of the work in this thesis is to study FoF in vulnerable older people with hip fractures who rehabilitate in a SNF. To gain more insight into FoF in older patients with hip fracture, the following research questions are addressed:

1. What is the prevalence of FoF in older patients with a hip fracture rehabilitating in a SNF?
2. Which factors are related to FoF in older patients with a hip fracture?
3. What is the course of FoF after a hip fracture?
4. Is the FES-I a suitable instrument to measure FoF after a hip fracture?
5. Which interventions reduce FoF after hip fracture?
6. What is the prevalence and what are the consequences of FoF in other patient groups who rehabilitate in a SNF?

3. Outline of the thesis

Different study approaches were employed to examine the research questions of this thesis. Firstly, an extensive review of the literature was carried out in which the available knowledge based on earlier studies on FoF was assessed. The aim of this review was to systematically describe and analyse FoF in patients after a hip fracture, focusing on measurement instruments, prevalence, factors associated with FoF, and interventions that may reduce FoF (Chapter 2).

Secondly, a cross-sectional study was designed and carried out in 10 SNF in nursing homes, focusing on vulnerable older patients with a hip fracture, to explore FoF in older vulnerable persons. Data collection took place between September 2010 and March 2011. In every participating SNF, data were collected during a two-week period by two researchers, a psychologist and elderly care physician, and through questionnaires developed for the treating physicians and nurses. This cross-sectional study was also used to analyse the measurement properties of the FES-I. For the evaluation of inter-rater reliability, an additional group of older adults with a hip fracture rehabilitating in a SNF was assessed.

Chapter 3 describes the measurement properties of the FES-I, using two populations of older patients rehabilitating in a SNF. The structural validity, the internal consistency and the construct validity of the FES-I are investigated in the first study group of 100 patients. The inter-rater reliability is studied in a different study population of 22 patients.

Chapter 4 focuses on the prevalence of FoF after a hip fracture, the relation between FoF and other psychological factors, and the relation between FoF and time after fracture. This study uses the same study population of 100 participants recruited from 10 SNF in the Netherlands.

The study in Chapter 5 determines (by means of regression analysis) which factors are related to high and low levels of FoF after a hip fracture. The 100 participants of the cross-sectional study are divided into two groups based on their level of FoF. Both univariate and multivariate logistic regression analysis are used to reveal which factors help distinguish between older people with high and low levels of FoF.

Thirdly, data from a longitudinal study were used to study FoF, also after discharge, among different groups of older patients rehabilitating in a SNF, such as patients after a stroke or an elective orthopaedic procedure (Chapter 6). This study also evaluates the consequences of FoF for the Instrumental Activities of Daily Living (IADL).

Finally, Chapter 7 presents a general discussion on the main results and places them in a broader perspective. The methodological strengths and weaknesses of the studies are addressed and some implications for future clinical practice and research are discussed.

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2

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.

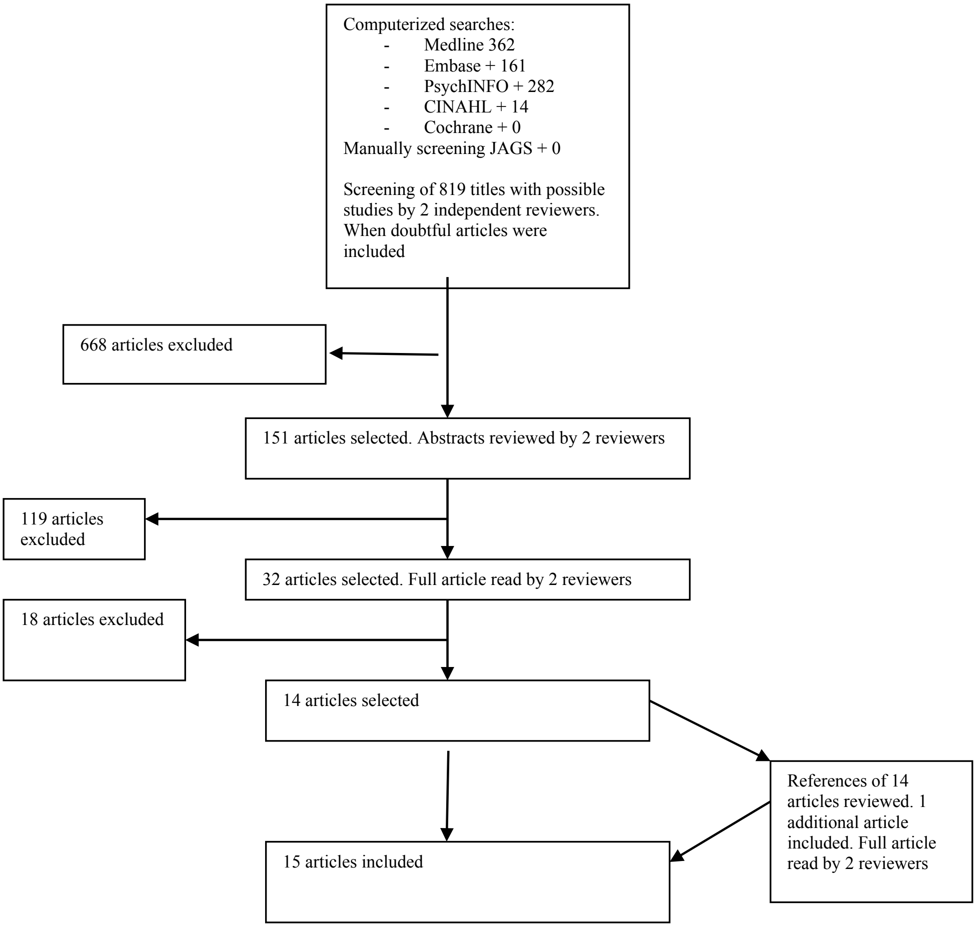

Figure 1 – Strategy used for selection of published reports on fear of falling in patients with hip fracture

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

2

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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3

Reliability and validity of the Falls Efficacy Scale-International after hip fracture in patients aged ≥65 years

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ABSTRACT

Purpose: To assess the measurement properties of the Falls Efficacy Scale–International (FES-I) in patients after a hip fracture aged ≥ 65 years.

Methods: In a sample of 100 patients, we examined the structural validity, internal consistency and construct validity. For the structural validity a confirmatory factor analysis was carried out. For construct validity predetermined hypotheses were tested. In a second sample of 21 older patients the inter-rater reliability was evaluated.

Results: The factor analysis yielded strong evidence that the FES-I is uni-dimensional in patients with a hip fracture; the Cronbach's alpha was 0.94. When testing the reliability, the intraclass correlation coefficient was 0.72, while the Standard Error of Measurement was 6.4 and the Smallest Detectable Change was 17.7 (on a scale from 16-64). The Spearman correlation of the FES-I with the 1-item fear of falling instrument was high (r=0.68). The correlation was moderate with instruments measuring functional performance constructs and low with instruments measuring psychological constructs.

Conclusions: Reliability and structural validity of the FES-I in patients after a hip fracture are good. The construct validity appears more closely related to functional performance constructs than to psychological constructs, suggesting that the concept measured by the FES-I may not capture all aspects of fear of falling.

Key words: Falls Efficacy Scale-International, fear of falling, measurement properties, hip fractures.

INTRODUCTION

The annual incidence of patients with hip fractures is expected to grow substantially in the coming decades, i.e. from 1.3 million in 1990 to about 4.5 million in 2050.[1] Overall mortality is reported to be 20-33% and only a minority of patients recover completely.[2,3] Psychological factors, such as fear of falling, are associated with these unwanted outcomes.[4,5] Fear of falling may even have more impact on functional recovery than pain or depression.[4] Fear of falling results in avoidance of activities and reduces mobility after a hip fracture.[6] Fear of falling is common among older persons (21-85%)[7]; moreover, in older patients after a hip fracture figures as high as 50-65% are reported.[8-10]

Fear of falling has initially been regarded as the “postfall syndrome”[11], i.e. excessive fear of falling after a fall. Though fear of falling is indeed related to earlier falls, fear of falling has also been reported in many older people who did not fall at all, suggesting a multifactorial etiology including other psychological factors such as anxiety and depression.[7,12] Fear of falling has been defined as *a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing.*[13] Fall-related self-efficacy has been used as a proxy for fear of falling and is related to fear of falling but probably with less intensity and emotion.[14] More recently, fear of falling and fall-related self-efficacy have increasingly been regarded as different concepts.[15] Fall-related self-efficacy focuses particularly on a person’s confidence in his or her ability to avoid falling while undertaking activities of daily (ADL) and is conceptually similar to balance confidence.[14] Though related with fall-related self-efficacy, fear of falling (FoF) can be regarded as a broader concept which includes physiological, behavioural as well as cognitive elements. The distinction between fall related self-efficacy and FoF has also been important when developing and evaluating fall-related psychological measures.[16]

The most frequently used scale for fear of falling, which measures different levels of concern about falling, is the Falls Efficacy Scale-International (FES-I), developed and validated by the Prevention of Falls Network Europe (ProFaNE).[17,18] It is widely used and regarded as a suitable instrument to evaluate for fear of falling among community dwelling older people.[18] A shorter version has also been developed and tested.[19] Validation studies for the FES-I have been carried out in different patient groups.[20-22] Though there is some minor overlap with patients in these studies, the measurement properties of the FES-I have not been tested in older patients rehabilitating after a hip fracture. Such an evaluation is important since patients with a hip fracture differ from community dwelling older persons because they have recently experienced a traumatic fall and their general health status is worse, with more disabilities and comorbidity.[2] Therefore, it remains unclear whether the FES-I is a reliable and valid instrument to measure fear of falling after hip fracture. Such an instrument is particularly needed when interventions are designed and implemented to reduce fear of falling in order to improve the outcomes of rehabilitation after hip fracture. A reliable and valid instrument will be useful to select patients for these interventions and to monitor and evaluate outcomes.

Hence, this study aims to evaluate the measurement properties of the FES-I after a hip fracture in patients aged ≥65 years, based on the guidelines of the COSMIN (Consensus-Based Standards for the Selection of Health Measurement Instruments) group.[23] Therefore, in patients with a hip fracture, we assessed the structural validity, internal consistency, inter-rater reliability, measurement error, construct validity, and floor and ceiling effects of the FES-I.

METHODS

Design and study population

For this study we used two study samples of older patients with hip fracture who underwent rehabilitation in a Dutch skilled nursing facility (SNF); in the Netherlands, about 40% of patients with a hip fracture rehabilitate in a SNF.[24] The first study sample consisted of 100 patients who rehabilitated after a hip fracture in 10 different SNFs. Only patients aged ≥ 65 years were included. Patients with communication problems and/or who (according to the treating elderly care physician) were unable to respond adequately to questions, were excluded. Data collection, which included also information through a questionnaire for the treating elderly care physician and responsible nurse on age, gender, marital status, living situation, comorbidities, complications, short-term and long-term memory, took place between September 2010 and March 2011.[24]

The second study sample consisted of patients who were admitted to the SNF of the PW Janssen Nursing Home in Deventer (the Netherlands). Patients were included between October 2011 and April 2012. These patients were aged ≥ 65 years, were admitted because of a hip fracture, and (according to the elderly care physician) were able to answer questions on the FES-I. In the 3rd and 4th week after admission to the SNF all patients were interviewed three times using the FES-I by a psychologist, a physiotherapist and a nurse, after they received a brief collective training on the use of the FES-I. The sequence of the interviewers was randomized and the time between the first and last interview was 10 d or less, with a period of at least 3 d between each interview. Basic information on the participants (age, gender, marital status, living situation and site of the fall) was also collected. In total 23 patients participated in this part of the study, of whom 21 completed all measurements.

The Medical Ethics Committee of the VU University Medical Center approved the study protocol. All patients gave informed consent for participation.

Measurement instruments

Falls Efficacy Scale-International

Various attempts have been made to assess fear of falling.[16] Single items have been used but generally do not determine the intensity of fear of falling, and do not detect specific changes in fear of falling over time. The Falls Efficacy Scale (FES) was initially developed to solve these problems, focussing on self-confidence not to fall when carrying out certain activities.[25] However, 'self efficacy' in performing activities without falling, operationalised in the FES, and actual fear of falling are not the same concepts.[26] Furthermore, the FES suffered from ceiling effects and lacked social activities.[18] Therefore, the Falls Efficacy Scale-International (FES-I) was developed by the ProFaNE group, which also facilitates cross-cultural validation of the instrument for coordinated international studies and comparison. The initial validation was done in English[18], followed by validation in many other languages.[27-30]

The FES-I can be completed within 3-4 min. It can be filled in directly by the patient or the information can be collected through an interview, as was done in our study. The FES-I reflects concern about falling when performing 16 ADL. The response to the FES-I consists of 4 levels ranging from "not at all concerned" to "very concerned" (score range: 16-64).[26] The FES-I has shown good measurement properties in community-dwelling older people.[26] In a group of 94 people which were recruited in a postal survey in Germany the Cronbach's alpha was 0.90 and the intra-class correlation was 0.79.[26] In a sample of 193 participants aged 70 years or more in the Netherlands these figures were respectively, 0.96 and 0.82.[26]

One-item fear of falling instrument

The one-item fear of falling instrument poses one question: *Are you afraid of falling?* It has four answer options "not at all", "a little", "quite a bit", and "very much".[16] The test-retest coefficient kappa was 0.66 with a retest after 4-7 days.[16] Although it is often used, the evidence for adequate validity of one-item instruments is weak.[16] However, when considering that the FES-I measures fall-related self-efficacy, researchers have been advised to add a single-item measure specific to fear of falling to ensure measurement of both concepts.[31] Information for the one-item fear of falling instrument was also collected by interview.

Instruments for psychological and cognitive factors

Data related to psychological constructs were collected through interviews with the participants by an elderly care physician or psychologist. No data on the measurement properties specific for patients with hip fractures of these patient-reported outcomes were found in the literature.

Depressive symptoms were measured using the Geriatric Depression Scale 8-item version (GDS8); this is an adaptation of the GDS30 that better fits institutionalised older people.[32] The GDS8 has 8 items (score range: 0-8) with higher scores indicating more depression. The GDS has good measurement properties; it was validated using the DSM-IV diagnosis for depression, is internally consistent (Cronbach's alpha= 0.80) and has high sensitivity rates for major (96.3%) and minor (83.0%) depression.[32]
Anxiety was assessed using the anxiety component of the Hospital Anxiety and Depression Scale (HADS-A).[33] The HADS-A has 7 items (score range: 0-21) with higher scores indicating more anxiety. The measurement properties of the HADS are good. Cronbach's alpha for the HADS-A ranges from 0.68 to 0.93 and the validity is good when compared with other commonly used questionnaires.[34]
Self-efficacy was measured using the Self-Efficacy Scale (SES).[35] This scale has 10 items (score range: 0-30) with a higher score indicating a higher competence to cope with different challenges. The scale has been used in numerous studies and generally yielded internal consistency (alpha: 0.75-0.91). For a total sample of 19 120 respondents from 25 countries Cronbach's alpha was 0.86. The scale can be regarded as a uni-dimensional instrument.[36] The test-retest score is fair and, for example, was reported to be r=0.67 in German cardiac surgery patients.[37] Evidence for the validity of the SES has also been published.[36]
Impairment in short- and long-term memory was rated based on an assessment by the responsible nurse using the Cognitive Performance Scale from the Minimum Data Set of the nursing home resident assessment instrument.[38]

Functional outcomes
Three functional outcome measurements were used to measure balance and walking ability. Both the Performance-Oriented Mobility Assessment (POMA) and the Timed-Up-and-Go (TUG) test measure balance and walking ability, while functional ambulation categories (FAC) only give an indication of a patient's walking ability. With the POMA, the participant follows the instructions of the physiotherapist, who scores the different components of the test. The score of the POMA ranges from 0-28, with a higher score indicating better balance and walking ability.[39] The inter-rater and test-retest reliability for the POMA is excellent (r=0.82-0.93).[39] The correlation with reference performance tests (r=0.65-0.70) indicates satisfactory construct validity for the POMA.[39]
With the TUG the physiotherapist measures the time it takes to stand up from a chair, walk 3 m, turn around, and walk back to the chair and sit down, all at a comfortable speed.[40] The inter-rater and intra-rater reliability is high and the construct validity is reported to be fair when compared with other measures that assess walking ability and balance in community-dwelling older people.[41]

The FAC was scored by the physiotherapist. The score of the FAC ranges from 0-5, with higher scores indicating a person's ability to walk more independently.[42] The inter-rater reliability of the FAC is high (r=0.91) and the FAC has a good construct validity in relation to other tests such as the 6-minute walking test and walking velocity.[42]

ADL after hip fracture were measured using the Barthel Index (BI).[43] The BI was scored by the responsible nurse. It has 10 items and assesses the degree of support a person needs in performing ADL, such as eating, getting dressed and going to the toilet. Although the index initially focused on stroke patients, it is used for a wide variety of patients. The score of the BI ranges from 0 to 20, with a higher score indicating more independence in ADL activities. The internal consistency of the score is high; for example, it is 0.84 in patients with a stroke.[44] The inter-rater reliability is also high (r=0.88-0.99)[45] and the BI has proven to be a valid measure for activities of daily living.[46]

A fall was defined as an event that results in a person coming to rest inadvertently on the ground or lower level. [47.] It includes also falls from internal causes such as fainting or collapse. Besides the site of the fall, indoor versus outdoors, the fall history of the participants was assessed. Fall history was measured on a 3-point scale by asking the participants how often they had fallen during the last 6 months before hip fracture. The answer categories were: not at all, one time, or more than one time.

Assessment of measurement properties

Structural validity

Structural validity is defined as "the degree to which the scores of a measurement instrument are an adequate reflection of the dimensionality of the construct to be measured"[15] and can be assessed by factor analysis.

Internal consistency

Internal consistency is the interrelatedness among the items in a scale.[23] Different items in an instrument may ask the same questions in a slightly different manner to reliably capture the respondent's opinion or level of function. The Cronbach's alpha is considered to be an adequate measure of internal consistency when it is shown that the scale is uni-dimensional (e.g. by factor analysis). A low Cronbach's alpha indicates a lack of correlation between the items in a scale, which implies that summarizing the items is unjustified. A very high Cronbach's alpha (>0.95) reflects high correlations among the items in the scale, which may indicate redundancy of one or more items.[48]

Reliability

Reliability is the proportion of the total variance in the measurement that is due to true differences between patients. This refers to the degree to which the measurement instrument is free from measurement error, and estimates the extent to which scores for patients who have not changed are the same for repeated measurements, e.g. by different raters (inter-rater reliability).[23]

Measurement error

Measurement error is the systematic and random error of a patient's score that is not attributed to true changes in the construct to be measured.[23] Measurement error can be expressed as the standard error of measurement (SEM) or the smallest detectable change (SDC). These calculations are expressed in the unit of measurement of the scale of the instrument. The SEM represents the standard deviation (SD) of repeated measures of 1 patient. The SDC represents the minimal change that a patient has to show on the scale to ensure that the observed change is real and not just an inter-rater measurement error.

Construct validity

Validity is the degree to which an instrument measures the construct it is supposed to measure. In the absence of a gold standard, as is the case for the FES-I, construct validity refers to the extent to which a particular measure relates to other measures based on theoretically derived hypotheses for the constructs that are being measured. We used the one-item fear of falling instrument, the HADS-A, the GDS8, the SES, the POMA, the TUG, the FAC score, the BI, and the fall history, including both falls indoors and outdoors, to assess the construct validity of the FES-I for patients with a hip fracture. Based on our knowledge at the time of design of the study we formulated 11 *"a priori"* hypotheses for the minimal level of validity. We expected the FES-I to have the highest correlation with the one-item fear of falling instrument, because both measure a similar construct (correlation of >0.50). Also, the HADS-A was expected to be highly associated with FES-I because of the similarities of both constructs; we expected a correlation of 0.30-0.50 between these constructs. The FES-I was expected to have a higher correlation with the HADS-A than with the GDS and SES, since these constructs are substantially different; we expected a correlation of ≤0.30 between the FES-I and the GDS8, and between the FES-I and the SES. Furthermore, we expected a smaller correlation with functional outcomes such as the POMA, the TUG, the FAC score, BI and fall history (correlation of ≤ 0.30). In the case that ≥ 75% of the hypotheses can be confirmed, the construct validity is considered to be adequate.[49]

Floor and ceiling effects
The presence of floor or ceiling effects may have a negative effect on the quality of the instrument. If a group of patients scores mainly in the extremes or within the SDC of the extremes, the responsiveness may be limited.

Statistical analyses

We first assessed structural validity to evaluate whether the scale is uni-dimensional. Confirmatory factor analysis for categorical items was performed in Mplus (Meuthen and Meuthen, Los Angeles, CA, USA) by use of weighted least squares, with means and variance adjustment. We examined factor loadings and model fit. Factor loadings represent the correlation between the items of the FES-I and the factor (the underlying dimensions). Analogous to Pearson r, the squared factor loading is the percentage of variance in the indicator variable explained by the factor. Factor loadings are generally considered to be meaningful when they are ≥0.30 or 0.40 [50]. We considered factor loadings of ≥0.50 to be appropriate. The Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA) were used as measures for model fit. A CFI and TLI ≥0.95 and a RMSEA of ≤0.05 were considered to be an adequate fit. For a moderate fit, values of ≥0.90 and ≤0.08 were used. The internal consistency was assessed by calculating Cronbach's alpha, using the widely accepted cut-off of ≥0.7.[49]
Reliability was assessed by calculating the intra-class correlation coefficient (ICC) with a 95% confidence interval (95% CI). A two-way mixed-effects model for absolute agreement was used. An ICC ≥0.7 was considered to be good.[51] The SEM was calculated from the square root of the variance between the raters and the error variance of the ICC. The SDC was calculated as 1.96 x √2 x SEM. Because most variables were not evenly distributed validity was tested by calculating Spearman correlation coefficients**.**
We calculated the floor and ceiling effects as the percentage of the participants who had the minimum and maximum score, respectively (i.e. 16 or 64, respectively). Floor or ceiling effects were considered to be present when ≥15% of the respondents achieved the minimum or maximum possible score.[52] Analyses were performed with SPSS for Windows (Version 19, SPSS, Inc., Chicago, IL, USA).

RESULTS

Table 1 presents the characteristics of the two study groups. In Group 1 and Group 2 the mean FES-I was 32.2 and 36.0, and the mean age was 83.1 and 83.2 years, respectively. In both groups the majority of the participants were widows and lived alone. Most falls, resulting in a hip fracture occurred indoors. Only 30% of the participants in group 1 and 19% of the participants in group 2 fell outdoors.

Table 1 - Characteristics of the two study groups

	Group 1 (n=100)	Group 2 (n=21)
FES-I, mean (SD)	32.2 (9.6)	36.0 (10.9)
Age in years, mean (SD)	83.1 (8.3)	83.2 (7.2)
Female, n (%)	75 (75%)	19 (90%)
Marital status, n (%)		
- Married	18 (18%)	3 (14%)
- Widow/widower	68 (68%)	16 (76%)
- Divorced	4 (4%)	1 (5%)
- Single	10 (10%)	1 (5%)
Living alone, n (%)	78 (78%)	17 (81%)
Site of fall[a], n (%)		
- Indoors	70 (70%)	17 (81%)
- Outdoors	30 (30%)	4 (19%)
Fall history (Nr of falls in half year before hip fracture)		
- Nil	77 (77%)	
- Once	11 (11%)	
- Twice or more	12 (12%)	
ADL (BI), mean (SD)	12,7 (4,6)	
Ability to walk independent[b]	44 (45%)	
TUG, mean (SD)	38.7 (31.7)	
POMA, mean (SD)	17.0 (6.3)	
Number of comorbidities, mean (SD)	3.5 (1.5)	
Number of complications, mean (SD)	1.6 (1.4)	
Impairment of short-term memory, number (%)	19 (19%)	
Impairment of long-term memory, number (%)	6 (6%)	

FES-I, Falls Efficacy Scale-International (range 16 – 64); SD, standard deviation; Nr, number; ADL, activities of daily living; BI, Barthel Index (range 0 – 20); TUG, timed up and go test; POMA, performance oriented mobility assessment (range 0 – 28).
[a]This refers to the place where the participant fell when fracturing the hip
[b]This refers to a FAC score of 4 of 5.

Structural validity

Table 2 presents the results of the confirmatory factor analysis on the baseline data. A 1-factor model fitted the data adequately. The CFI was 0.994, the TLI was 0.993, and the RMSEA was 0.047. No items had a factor loading ≤0.50 and only two items had a factor loading ≤0.70, i.e. item 2 (loading 0.695) and item 4 (loading 0.669). Thus, there is strong evidence for the uni-dimensionality of the FES-I.

Table 2 - Factor loadings of the Falls-Efficacy Scale-International

Item/Factor		Estimate	Standard error
F1	Cleaning the house	0.826	0.035
F2	Getting dressed /undressed	0.695	0.073
F3	Preparing simple meals	0.796	0.045
F4	Taking a bath or shower	0.669	0.055
F5	Going to the shop	0.910	0.025
F6	Getting in or out of a chair	0.842	0.035
F7	Going up or down stairs	0.744	0.049
F8	Walking around outside	0.831	0.036
F9	Reaching up or bending down	0.782	0.042
F10	Answering the telephone	0.729	0.051
F11	Walking on a slippery surface	0.765	0.047
F12	Visiting a friend/relative	0.876	0.032
F13	Going to a place with crowds	0.807	0.040
F14	Walking on an uneven surface	0.835	0.033
F15	Walking up or down a slope	0.834	0.037
F16	Going out to a social event	0.955	0.018

Internal consistency

The Cronbach's alpha was 0.94 which implies good internal consistency.

Reliability

The ICC for all raters was 0.72 (95% CI: 0.52-0.87). The ICCs for the physiotherapist vs. the nurse, the physiotherapist vs. the psychologist, and the nurse vs. the psychologist were 0.70 (95% CI: 0.41-0.87), 0.78 (95% CI: 0.53-0.90) and 0.69 (95% CI: 0.34-0.87), respectively. The SEM for all raters was 6.4 and the SDC was 17.7. Table 3 presents the mean scores of the physiotherapist, nurse and psychologist.

Table 3 - Inter-raters reliability of the Falls Efficacy Scale-International.

Mean (SD)			**SEM**	**SDC**	**ICC (95% CI)**
Observer 1 (physiotherapist)	Observer 2 (nurse)	Observer 3 (psychologist)			
36.3 (11.3)	33.5 (11.9)	38.3 (12.5)	6.4	17.7	0.72 (0.52-0.87)

SD, standard deviation; SEM, standard error of measurement; SDC, smallest detectable change; ICC, intra-class correlation coefficient.

Construct validity

Construct validity was assessed by testing the "a priori"-defined hypotheses. Correlations between the FES-I and the other constructs are presented in table 4. The table shows that hypothesis numbers 1, 3, 5 and 11 could be confirmed; this is 36% of all the hypotheses.

Table 4 - Validity of the Falls Efficacy Scale-International (FES-I)

No.	Hypothesis	Comparison measurement instrument	Observed correlation with FES-I (Spearman correlation)	Hypothesis confirmed
1	A correlation of > 0.5 was expected between the FES-I and the one-item fear of falling instrument	One-item fear of falling instrument	0.68	Yes
2	A correlation of > 0.3 but ≤ 0.5 was expected between the FES-I and the HADS/A	HADS/A	0.30	No
3	The correlation between the FES-I and the HADS/A is stronger than that between the FES-I and the GDS8	HADS/A GDS8	0.30 0.03	Yes
4	The correlation between the FES-I and the HADS/A is stronger than that between the FES-I and the SES	HADS/A SES	0.30 -0.32	No
5	A correlation of ≤ 0.3 was expected between the FES-I and the GDS8	GDS8	0.03	Yes
6	A correlation of ≤ 0.3 was expected between the FES-I and the SES	SES	-0.32	No
7	A correlation of ≤ 0.3 was expected between the FES-I and the POMA	POMA	-0.43	No
8	A correlation of ≤ 0.3 was expected between the FES-I and the TUG	TUG	0.31	No
9	A correlation of ≤ 0.3 was expected between the FES-I and FAC score after fracture	FAC score after fracture	0.31	No
10	A correlation of ≤ 0.3 was expected between the FES-I and ADL after fracture	ADL after fracture	-0.34	No
11	A correlation of ≤ 0.3 was expected between the FES-I and the fall-history	Fall history	0.17	Yes

HADS/A, Hospital Anxiety and Depression Scale/Anxiety component; GDS8, Geriatric Depression Scale-8 item version; SES=Self Efficacy Scale; POMA, performance oriented mobility assessment; TUG, timed up and go test, FAC, functional ambulation categories; ADL, activities of daily living.

Floor and ceiling effects

There were no floor or ceiling effects: 0% of all patients had the maximum score (64) and 1% had the minimum score (16). When assessing how many participants had a score within the SDC (17.7) of the maximum (i.e. 47 or higher), i.e. indicating a high level of fear of falling, the percentage was 8%. For the minimum score (i.e. 33 or lower), i.e. indicating a low level of fear of falling, the percentage was 54%.

DISCUSSION

This study shows that the FES-I is an internally consistent and reliable instrument to measure fear of falling in patients after a hip fracture. For this population the instrument is uni-dimensional; it has no floor and ceiling effects. Based on our "*a priori*" hypotheses the validity is fair but not excellent, since we could confirm only 4 of the 11 predetermined hypotheses. When testing the construct validity, the correlation with the 1-item instrument for fear of falling was strong (r=0.68) and higher than that in a recent study performed in China (r=0.42).[29] Also, the FES-I was found to have a stronger relation with physical performance constructs (such as mobility, balance and ADL) than with psychological constructs (such as anxiety and self-efficacy).

Others also found a strong correlation with physical performance constructs, such as the TUG. For example, a study in Greece reported the Pearson correlation to be 0.638.[28] In a recent validation of the Chinese version of the FES-I among 399 community-dwelling Chinese older people, the FES-I score was significantly higher in participants with poor physical performance.[29] In this Chinese study, Pearson correlations between the FES-I and the TUG, the IADL and depressive symptoms were 0.22, 0.21 and 0.13, respectively; this also indicates a better relation with physical performance than with psychological factors. Similarly, in a validation study in Turkey among 70 older people, the Pearson correlation coefficient between the FES-I and the Modified Barthel Index and TUG was 0.622 and 0.743, respectively.[30] In fact, our "*a priori*" defined hypotheses related to physical performance and psychological concepts were not in line with more recent studies. We also found that the FES-I in older patients with a hip fracture is much stronger correlated with physical performance than with psychological factors such as anxiety. It also emphasizes that fall-related self-efficacy and fear of falling are related but different concepts.

In our study the Spearmen correlation coefficient between the FES-I and fall history was only 0.17; this is much lower than in a study among persons with multiple sclerosis (r=0.46).[53] Fall history reflects in our study the number of falls over the last 6 months in addition to the fall in which the participant fractured his or her hip. As a result, a group of non-fallers did not exist in our study and all participants experienced at least one traumatic fall with tremendous consequences, such as long-lasting pain, admission to a hospital, surgical repair and inability to walk. This may have weakened the relation between fall history and fear of falling.

Our factor analysis suggested uni-dimensionality of the FES-I. In other studies among community- dwelling older persons, the factor analysis was suggestive for two underlying factors, i.e. concern about falling during ADL, and concern about falling during social activities.[27,29] It is possible that, after a hip fracture, rehabilitating older patients are mainly concerned with basic ADL and hardly discriminate between these activities and social activities (which may seem less relevant to them during rehabilitation).

Our Cronbach's alpha of 0.94 indicates a good internal consistency and is similar to studies among community-dwelling elderly in Brazil[27] and China[29], as well as among other patient groups such as cognitively impaired geriatric patients[21] and patients with multiple sclerosis[53]; in these latter studies the Cronbach's alpha were 0.93, 0.94, 0.93-0.95 and 0.94, respectively. In a study by Kempen et al. among community-dwelling older persons in Germany, the Netherlands and the UK, the Cronbach's alpha was 0.90, 0.96 and 0.97, respectively.[26] Our inter-rater reliability was ICC=0.72 which is good. A higher reliability, e.g. in the studies of Camargos et al. (ICC=0.91)[27] and Yardley et al. (test-retest reliability ICC=0.96)[17], has been reported. In a study in China among community-dwelling older people the inter-rater reliability was very high (ICC=0.95).[29] In the study of Kempen et al., which included community-dwelling older persons in the Netherlands, the test-retest reliability was also higher (ICC=0.82).[26] Reasons for the lower correlation coefficient in our study might be because: (i) the relatively older and vulnerable patients (some with a cognitive disorder, most with rather high number of comorbidities) may have been less consistent in answering the FES-1 questions, and (ii) different types of professionals rated the FES-I.

The absence of floor and ceiling effects is common in most studies on the FES-I.[28] In a study among cognitively impaired patients, the floor effect (minimum score) was 3.2% and the ceiling effect (maximum score) was 0%.[54.] In our study the SDC was substantial (i.e. 17.7 compared to a range of 16-64). Though this may make it more difficult to measure changes in fear of falling in patients with a low level of fear of falling, since 54% of the participants had a score of ≤ 33, for interventions which are targeted towards patients with higher levels of FoF, improvements can be correctly measured.

Since the FES-I particularly focuses on fall-related self-efficacy and does not cover all elements of fear of falling it has been advised to use simultaneously a one-item instrument in research.[31] This will ensure that besides the concept of fall-related self-efficacy also the concept of fear of falling is measured including more emotional and physiological dimensions of fear of falling. Recently also a modification of the FES was made for nursing homes, i.e. the Nursing Home Falls Self-Efficacy Scale.[20] This instrument has items on both self-efficacy expectations and outcome expectancy, focussing on the consequences of falling (embarrassment, pain, risk of fracture, etc.). More research is required to assess whether this instrument can also be relevant for older patients rehabilitating in a SNF of a nursing home.

In some studies the FES-I was administered through self-reporting.[26] In a study by Hauer et al. to validate the FES-I in geriatric patients, the FES-I was administered by both self-report and interview-based questionnaires.[54] The intra-class correlation coefficients (ICCs) were respectively for the interview and self-reported method 0.744 and 0.584. The authors concluded that in vulnerable older persons, especially with cognitive impairment, an interview-based method is recommended. We also used the interview-based method, which may have had a positive influence on the outcomes of the measurement properties. However, since 19% and 6% of the participants had respectively short-term and long-term cognitive impairments, the answers to the FES-I may have been less consistent, hampering the reliability of the FES-I, even when using an interview-based approach. In addition, since the FES-I particularly measures concerns about falling, participants with impaired cognition may evaluate their risk to fall different from those who have no cognitive impairment. More research is needed to assess how strong the impact of such conditions is on fall-related self-efficacy.

Strength of our study is that we assessed the measurement properties of the FES-I in a population of vulnerable people in which fear of falling may have substantial consequences for daily activities and quality of life.[6] To our knowledge, this is the first study to assess the measurement properties of the FES-I in people aged ≥ 65 years who had a traumatic fall resulting in a hip fracture. In addition, to assess the validity of the FES-I we included a wide variety of tests used in daily practice. Although the concept of fear of falling needs further research, the FES-I seems to be a suitable instrument to assess FoF among patients after a hip fracture. Nevertheless, future studies need to further explore this concept, particularly with regard to how it interacts with other concepts of psychological and physical performance.

CONCLUSION

The results of the present analysis indicate that the reliability and structural validity of the FES-I in patients aged ≥ 65 years after a hip fracture is good. When assessing the construct validity of the FES-I, the construct seems to be more closely related to functional constructs than to psychological constructs. This may indicate that the concept measured by the FES-I does not capture all aspects of fear of falling.

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4

Fear of falling in patients with hip fractures: prevalence and related psychological factors

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ABSTRACT

Objectives: To determine the prevalence of FoF in patients after a hip fracture, to investigate the relation with time after fracture and to assess associations between FoF and other psychological factors.

Design: Cross-sectional study in elderly patients after a hip fracture performed between September 2010 and March 2011.

Setting*:* Ten post-acute geriatric rehabilitation wards in Dutch nursing homes.

Participants: A total of 100 patients aged ≥ 65 years with a hip fracture admitted to a geriatric rehabilitation ward.

Measurements*:* FoF and related concepts such as falls-related self-efficacy, depression and anxiety were measured by means of self-assessment instruments.

Results: Of all patients, 36% had a little FoF and 27% had quite a bit or very much FoF. Scores on the Falls-Efficacy Scale-International were 30.6 in the first 4 weeks after hip fracture, 35.6 in the second 4 weeks, and 29.4 in the period ≥ 8 weeks after fracture. In these 3 periods, the prevalence of FoF was 62%, 68% and 59%, respectively. Significant correlations were found between FoF and anxiety (P<.001), and self-efficacy (P<.001).

Conclusion: In these patients with a hip fracture, FoF is common and is correlated with anxiety and falls-related self-efficacy. During rehabilitation FoF is highest in the second 4 weeks after hip fracture. More studies are needed to explore the determinants of FoF and develop interventions to reduce FoF and improve outcome following rehabilitation.

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

INTRODUCTION

The burden of hip fractures on the individual and society is considerable and will continue to increase in the future.[1,2] Psychological factors are important for successful rehabilitation after hip fracture.[3] Fear of falling (FoF) is such a factor, which may have more impact on functional recovery than pain or depression.[4] A recent literature review revealed that our knowledge on FoF in older people recovering from a hip fracture is limited.[5] Most studies suffer from selection bias because frail older people with substantial co-morbidity are frequently excluded. Therefore, we conducted a study in hip fracture patients in 10 post-acute geriatric rehabilitation wards of nursing homes in the Netherlands.

In the Netherlands, almost half of the patients with a hip fracture (mostly frail elderly) recover in post-acute geriatric rehabilitation wards of nursing homes. The rehabilitation protocols for these wards are similar, in terms of procedures and inputs. After admission, a multidisciplinary rehabilitation care plan is made by the elderly care physician. This physician is specially trained in medical care of frail elderly and part of the staff of the nursing home.[6] Patients generally follow a 4-16 week rehabilitation program, which includes wound care, treatment of pain and co-morbidity, training in ADL, occupational and physical therapy. When required, a social worker, psychologist or dietician is consulted. Patients are discharged when they can function independently or with assistance of formal or informal care at home. Most patients continue some form of physical therapy after discharge. Patients with little co-morbidity or complications who only need physical therapy after a hip fracture are usually discharged home after hospital admission. Patients who already live in a nursing home are usually not admitted to a post-acute geriatric rehabilitation ward.

The aim of this cross-sectional study was to determine the prevalence of FoF using different instruments, to investigate the relation with time after fracture and to assess associations between FoF and other psychological factors.

METHODS

A total of 124 patients were eligible to participate. Inclusion criteria were age ≥ 65 years and admitted to the ward because of a hip fracture. 24 Patients were excluded because they were unable to adequately respond to the questions, did not give consent to participate or had communication problems. Data were collected cross-sectionally at every site during a period of two weeks. In the first week the investigators provided information to the participants and health workers. In the second week the interviews with the participants and tests by

physiotherapists were conducted. Additional data were collected via questionnaires issued to the physicians and responsible nurses. Every patient rehabilitating after hip fracture on that rehabilitation ward was eligible to participate.
The Medical Ethical Commission of the VU University Medical Center approved the study and the protocol. All participants provided written informed consent.
Because different types of measures, i.e. multi-item self-efficacy and single-item FoF measures are available for FoF, two instruments were used in the study: The Falls Efficacy Scale-International (FES-I) and the One-item FoF instrument.[7] The FES-I reflects concern about falling when performing 16 ADL-tasks.[8] The response to the FES-I consists of 4 levels ranging from “no concern” to “very much concern”.[9] The One-Item FoF instrument asks one question: Are you afraid of falling? and has four answer options “not at all”, “a little”, “quite a bit”, and “very much”.[7]
To assess FoF in relation to the rehabilitation phase, the participants were divided into three groups depending on the number of days between fracture and assessment; phase 1 = up to 28 days, phase 2 = 29-56 days, and phase 3 = ≥ 57 days. These cut-off points ensured comparable numbers of participants in each group and are also clinical relevant for the rehabilitation process. In phase 1 the focus is on strength and balance training, in phase 2 on walking independently and in phase 3 on increasing walking distance and adjusting to circumstances at home.
Depressive symptoms were measured using the Geriatric Depression Scale 8-item version (GDS8).[10] Anxiety was assessed using the anxiety component of the hospital anxiety and depression scale (HADS-A).[11] Self-efficacy was measured using the Dutch translation of the General Self-Efficacy Scale (GSE).[12] This ten-item scale measures the general competence of a person to cope with a broad scope of challenging encounters. Pain was assessed by asking the patients to indicate their level of pain on a visual analog scale (VAS) ranging from 0-10.[13]
Analyses were performed using SPSS for Windows, version 17 (SPPS, Inc., Chicago, IL, USA).

RESULTS

Of the 100 participants, mean age was 83.1 years and 75% were female. The mean FES-I was 32.2. The scores for the FoF 1-item were: no FoF 37.0%; a little FoF 36.0%; quite a bit FoF 23.0%; and very much FoF 4.0%. The Pearson’s correlation between the FES-I and the 1-item FoF instrument was 0.668 ($p<.001$).
Table 1 shows that the percentage of patients with FoF (measured with the FES-I and the FoF 1-item instrument) is highest in phase 2 of the rehabilitation process. In phases 1, 2 and 3 the FES-I is 30.6, 35.6 and 29.4, respectively ($P=.025$; Kruskal-Wallis test).

Table 1 - Fear of Falling and Falls-Related Self-Efficacy in different periods of rehabilitation.

Characteristics	First four weeks (≤ 28 days) after fracture	Second four weeks (28-56 days) after fracture	More than 8 weeks (≥ 57 days) after fracture)	P-value
Number in group	26	40	34	
Range of days after fracture	[7-28]	[29-56]	[57-292]	
Days after fracture, mean (median)	21.0 (22)	42.2 (42)	87.7 (73.5)	
FES-I, mean (CI)[a] [range]	30.6 (27.0-34.2) [16-46]	35.6 (32.2-39.0) [19-60]	29.4 (26.7-32.1) [17-52]	Kruskal-Wallis test: P=.025
FoF 1-item, % with FoF[b]	62%	68%	59%	Pearson's Chi-Square test: P=.731
GSE, mean, (CI), [range]	22.9, (20.5-25.4), [8-30]	21.0, (19.2-22.9), [8-30]	21.0, (18.7-23.3), [5-30]	
VAS, mean, (CI), [range]	2.5, (1.7-3.3), [0-6]	3.1, (2.4-3.8), [0-8]	2.3, (1.6-3.1), [0-7]	
GDS, mean, (CI), [range]	0.2, (0.0-0.3), [0-1]	0.7, (0.2-1.2), [0-7]	1.4, (0.6-2,1), [0-7]	
HADS-A, mean, (CI), [range]	2.4, (1.1-3.7), [0-13]	2.7, (1.5-3.8), [0-18]	3.5, (2.1-4.9), [0-14]	

FES-I, Falls Efficacy Scale-International; FoF, Fear of Falling; GDS, Geriatric Depression Scale (8 items, dichotomous yes/no [range 0-8]); GSE, general self-efficacy scale (10 items, 4 point rating [0-3] [range 0-30]);
HADS-A, anxiety component of the hospital anxiety and depression scale (7 items, 4 point rating [0-3] [range 0-21]); VAS, visual analog scale-pain (11 point numerical rating [range 0-10]).
[a]The FES-I score is the summed score of 16 items. For each item a Likert scale is used in which "no", "a little", "quite a bit" and "very much" concern to fall gives a score of 1, 2, 3 and 4, respectively.
[b]Patients with FoF answered to the question "Are you afraid of falling?" with "a little", "quite a bit" or "very much".

The Pearson's correlation between the GDS8 and the FES and the 1-item FoF instrument was 0,111 (P=.271) and 0.190 (P=.058), respectively. The Pearson's correlation between the GSE and the FES and the 1-item FoF instrument was -0.295 (P=.003) and -0.363 (P<.001), respectively. The Pearson's correlation between the anxiety component of the HADS and the FES, and the 1-item FoF instrument was 0.267 (P=.007) and 0.359 (P<.001), respectively. The Pearson's correlation between VAS-pain and the FES and the 1-item FoF instrument was 0.250 (P=.012) and 0.152 (P=.131), respectively.

DISCUSSION

This study shows that FoF is common among patients after a hip fracture. When using a simple 1-item instrument to assess FoF, 63% of the patients had at least some FoF. This is within the broad range of 21-85% reported in other studies, mainly focusing on community-dwelling older persons.[14]

The mean FES-I of 32.2 in our group is similar to that in a German study of geriatric rehabilitation inpatients in which FES-I was 32 on admission to hospital and 34 at 4-months follow-up.[15] In a Dutch study (among mostly independently living older people) the mean score was 26.7 for those aged 70-79 years, and 33.0 for those aged ≥ 80 years.[9] This indicates that also when using the FES-I as a proxy for FoF, FoF is a considerable clinical problem in rehabilitation after hip fracture.

When measuring in different phases of rehabilitation, FoF and FES-I were highest in the group that had rehabilitated 4 to 8 weeks. Studies are required in which individual participants are followed longitudinally to confirm these results and draw further conclusions.

FoF was strongly associated with anxiety and self-efficacy; however, it is not clear how this relationship is established. Anxiety might be a general characteristic of a person and, as such, may facilitate FoF in general. Similarly, a person's lack of self-efficacy about *not* falling may enhance FoF. The exact features of this relationship, and how they might be modified, needs to be examined in future studies.

A limitation of this study is that the data are cross-sectional, meaning that the individual patients were not followed throughout the rehabilitation process. This implies that the different subgroups may not be fully comparable. Patients who rehabilitated at a faster rate may have been discharged earlier and were probably underrepresented; this may have resulted in overestimation of the prevalence of FoF. Although the patients included in this study constitute a large proportion of the (often frail) older people who recover after a hip fracture, caution is required when generalising the results to other groups.

CONCLUSION

FoF is common among patients with a hip fracture, using different measurement instruments, and is related to other psychological factors, such as anxiety and depression. The prevalence was greatest in the group rehabilitating between 28 and 56 days. However, the exact prevalence during different phases in the rehabilitation process has to be further explored in longitudinal studies. This information is necessary to develop interventions to diminish FoF in order to improve functional capacity and participation after hip fractures.

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5

Fear of falling after hip fracture in vulnerable older persons rehabilitating in a skilled nursing facility – regression analysis

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ABSTRACT

Objective: To identify factors which explain differences in patients with high and low fear of falling (FoF) after a hip fracture.

Design: Cross-sectional study in 10 skilled nursing facilities (SNF) in the Netherlands.

Patients: A total of 100 patients aged ≥ 65 years admitted to a SNF after a hip fracture.

Methods: Participants were divided into a low and high FoF group, based on median Falls Efficacy Score-International. Data of factors that might explain FoF 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 (ADL) before fracture, number of complications, ADL after fracture, anxiety and self-efficacy were significantly associated with FoF univariately. Multivariate analysis showed that walking ability before fracture (odds ratio (OR) 0.34, 95% confidence interval (CI) 0.14-0.83), ADL 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 FoF.

Conclusion: Impaired walking ability before fracture, impaired ADL after fracture, and increased anxiety help distinguish between older persons with high and with low FoF after hip fracture. Particularly, because the last two factors are modifiable, this information enables developing specific interventions for older persons with high FoF.

Key-words: Fear of falling, falls-related self-efficacy, hip fracture, regression analysis, skilled nursing facility

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 in 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-breaking 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 the 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 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 of 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. Though 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 hip fracture patients 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 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 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 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 0-20 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 filled out 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 institutionalised 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 two 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 chi-square 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 patients 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 1 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 the 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 significant higher number of complications after hip fracture.

Table 1 - Characteristics of the study population (n=100)

	Total Group n=100	Participants with low FoF (FES-I=<32) (n=50)	Participants with high 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 in 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 (%)				0.13[c]
- Married	18	14	22	
- Widow/ widower	68	64	72	
- Divorced	4	6	2	
- Single	10	16	4	
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 (%)				0.76[c]
- Nil	77	80	74	
- One time	11	10	12	
- Twice or more	12	10	14	
Fracture type (%)				1.00[c]
- Cervical	46	44	48	
- Trochanteric	40	42	38	
- Subtrochanteric	6	6	6	
- Other/not known	8	8	8	
Fracture left side (%)	51	48	54	0.55[c]
Kind of surgery (%)				0.89[c]
- 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	
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 FoF; [b]Student's t-test; [c]Pearson's Chi-square 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.

Regression analysis and model

Six variables were significantly associated with FoF in the univariate regression analysis (Table 2). These were walking ability before fracture, number of complications, ADL before fracture, anxiety, ADL after fracture and self-efficacy.

Table 2 - 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 one 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-hypertensive's (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.

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 3) 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 a person 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 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 FoF than an individual who is never nervous.

Table 3 - 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.

DISCUSSION

Fear of falling 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 FoF.

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 a fall history over only the last 6 months.

The results of our study are partly in line with a study in community dwelling elderly by Kempen et al.[39], in which limitations in ADL, low general self-efficacy and feelings of anxiety were correlated with high 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 to 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.[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 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 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 to adequately 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 underrepresented, 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 exactly 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 and suffering from FoF.

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6

Longitudinal follow-up study on fear of falling during and after rehabilitation in skilled nursing facilities

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ABSTRACT

Background: Fear of falling (FoF) is regarded as a major constraint for successful rehabilitation in older people. However, few studies have investigated FoF in vulnerable older people who rehabilitate in a skilled nursing facility (SNF). Therefore, this study measures the prevalence of FoF during and after rehabilitation and assesses differences between those with and without FoF. The relation between FoF and instrumental activities of daily living (IADL) after discharge was also assessed.

Methods: In this longitudinal follow-up study, patients who rehabilitated in a SNF were assessed at admission and at 4 weeks after discharge. A one-item instrument was used to measure FoF at admission; based on their answer, the patients were divided into groups with no FoF and with FoF. To study FoF after discharge, the one-item instrument and the short Falls Efficacy Scale-International (FES-I) were used. IADL after discharge was assessed with the Frenchay Activities Index (FAI).

Results: Of all participants, 62.5% had FoF at admission. The participants with FoF were older, more often female, and had a higher average number of falls per week, more depressive symptoms and a lower level of self-efficacy. Four weeks after discharge, 82.1% of the participants had FoF. IADL after discharge was considerably lower in patients with FoF (FAI of 27.3 vs. 34.8; p=0.001).

Conclusions: FoF is common among older persons who rehabilitate in SNF. FoF seems to be persistent and may even increase after rehabilitation, thereby hampering IADL after discharge. Interventions are needed to reduce FoF to ensure better outcomes in older patients rehabilitating in a SNF.

Keywords: Fear of falling, Rehabilitation, Skilled nursing facility, Discharge, Instrumental activities of daily living

BACKGROUND

Fear of falling (FoF) among older persons can result in increased disability, restriction of activity and loss of functional independence.[1,2] FoF is widespread among community-dwelling older persons and its prevalence is reported to range from 21-85%.[3,4] Among older people in long-term care, more than 50% have FoF.[1] FoF is also common among older people who rehabilitate after a stroke, a hip fracture or other disease and is a major constraint for successful rehabilitation, predicting rehabilitation outcome at both discharge and follow-up.[5,6] For patients with hip fracture, FoF may have an even greater impact on functional recovery than pain or depression.[7]

FoF was first used in the context of the post-fall syndrome[8] and efforts have been made to operationalise this concept. Tinetti et al. describe FoF as "*a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing*" and operationalised FoF as a loss of self-efficacy to perform certain activities without falling.[9] Others relate FoF to deteriorated postural control.[10] FoF has been described more generally as a broader concept of intrinsic fear or worry about falling.[11] Although falls-related self-efficacy may involve a slightly different concept[12], the term is often used as a proxy for FoF. Falls efficacy scales assess 'concern' about falling, a term closely related to FoF but probably less intense and emotional.[13] Therefore, when operationalising FoF different instruments have been used to measure the psychological outcomes of falling.[14]

In the Netherlands, after a short period of hospitalisation, many older persons with an acute decrease in function rehabilitate in a skilled nursing facility (SNF). Four main patient groups can be distinguished based on the underlying condition which requires rehabilitation, i.e. stroke, trauma, elective orthopaedic surgery (e.g. total hip or knee replacement), and 'other' (such as cardiac, respiratory and oncologic diseases). Unfortunately, FoF has rarely been studied in these groups of patients, even though most are vulnerable and have a high level of comorbidity and disability.[15] Moreover, as a result of a trauma or another serious event (e.g. a stroke or surgical procedure), these patients may be more susceptible to have FoF. This may hamper them in performing more complex activities after discharge, such as housekeeping, leisure activities and social interaction. Also, the relation between FoF and these so-called instrumental activities of daily living (IADL) has not been studied in these older patients.

Therefore, the present study aimed to assess FoF in different patient groups rehabilitating in a SNF. The main goal was to assess differences between patients with and without FoF at admission to a SNF, and to assess whether FoF persists after discharge. In addition, the relation between FoF and IADL after discharge was investigated.

METHODS

Setting and study population

The population studied were older patients who were all newly admitted to rehabilitate in a SNF. Soon after admission to a Dutch SNF, a multidisciplinary rehabilitation plan is made by the elderly care physician; this physician is specially trained in medical care of frail older people and is part of the staff of a nursing home.[16] Patients generally follow a 4-16 weeks rehabilitation programme, which includes treatment of pain and comorbidity, training in ADL, and physical and occupational therapy. Physical therapy involves balance and gait exercises, muscle strengthening and aerobic training. Also walking outdoors and climbing stairs are mostly part of the training. The occupational therapist coaches the patient in daily activities such as getting dressed and going to the toilet. He also assesses whether adaptations at home are required to ensure a safe environment when the patient is discharged. When required, a social worker, psychologist, or a dietician is consulted. Patients are discharged when they can function independently, or with assistance of formal/informal care, at home. Many patients continue some form of physical therapy after discharge.

The present longitudinal observational follow-up study was conducted within the framework of the Back Home study.[17] The Back Home study investigated whether the use of a structured scoring of supporting nursing tasks achieved earlier discharge home for geriatric rehabilitation patients. The study was carried out between October 2011 and November 2012 in four SNFs of the University Network for the Care sector South-Holland. During this period, all newly admitted persons to the SNF were asked to participate in the study. Patients were excluded when they were incompetent to express their will, or were expected to die soon; the elderly care physician assessed whether or not an individual was incompetent.

The Medical Ethics Committee of the Leiden University Medical Center approved the study. Verbal informed consent was obtained from all participants.

Data collection

Data on FoF were collected at different points in time. These data could be used to assess the prevalence of FoF during admission in the SNF and after discharge, and to analyze the differences between patients with different levels of FoF and no FoF at all.

Within one week after admission data were collected on age, gender, living situation, diagnosis, and fall frequency (estimated average number of falls per week). Also, questionnaires and tests were completed, i.e. the Minimal Mental State Examination (MMSE), the Barthel Index, the Self-Efficacy Scale (SES), the one-item instrument for FoF, and the Geriatric Depressions Scale-8 items (GDS8).

At discharge the destination was rated. Participants who were discharged within 17 weeks received a questionnaire 4 weeks after discharge from the SNF. This questionnaire included the one-item FoF scale, the Short Fall-Efficacy Scale-International (FES-I) and the Frenchay Activities Index (FAI).

Measurement instruments

Fear of falling

A one-item FoF instrument was used for follow-up of FoF. The validity of this instrument still requires further research but the reliability of this instrument is good and the instrument has been used in many earlier studies to estimate the prevalence of FoF.[14] It asks one question: "Are you afraid of falling?" and has four answer options: "Not at all", "A little", "Quite a bit" and "Very much".[14]

To study FoF after discharge we also used a Fall-Efficacy Scale, i.e. the Short FES-I.[18] The Short FES-I was developed from the FES-I for screening and research purposes. The psychometric properties and discriminative power of the Short FES-I are almost as good as the FES-I.[18] The score on the Short FES-I ranges from 7-28, with higher scores indicating more FoF.

Cognition

The MMSE is a short screening test for cognitive disorders and dementia.[19] It is widely used in clinical and research settings and has excellent measurement properties.[20] The score ranges from 0-30 with higher scores indicating better cognition.

Depression

The GDS8 measures depressive symptoms and was developed to screen depression in nursing homes; it is an adaptation of the GDS30.[21] The score ranges from 0-8 with higher scores indicating more depression. The instrument has good measurement properties.[21]

Activities of daily living (ADL)

ADL were measured with the Barthel Index. The Barthel Index measures independence of a person in doing activities of daily life. Scores of the Barthel Index range from 0-20, with higher scores indicating more independence in ADL such as eating, dressing, and going to the toilet.[22] The Barthel Index is widely used and has good measurement properties.[23,24]

Self-efficacy

Self-efficacy was measured with the SES.[25] The scale has 10 items and higher scores (range 0-30) indicate a higher level of competence to cope with various challenges, such as the confidence to deal with unforeseen circumstances and to find solutions for difficult problems.

Instrumental activities of daily living

The FAI was used to assess IADL.[26,27] It provides a score for the number of times that a person has carried out certain activities (e.g. domestic chores, leisure/work, outdoor activities) and corresponds to the activity/participation domain of the World Health Organization (WHO) International Classification of Function, Disability and Health (ICF).[28] The FAI consists of 15 questions and every item has a score of 1-4, resulting in a summed score ranging from 15-60.[27,29] A higher score indicates that the person is more capable in carrying out IADL.

Statistical analysis

For the analysis patients were divided into two groups based on their answer to the 1-item FoF measure at admission: i) those with no FoF at all, and ii) those with a little, quite a bit and very much FoF. Descriptive measurements such as medians and interquartile ranges (IQR) were used to describe the groups. For continuous data the normality of the distribution was assessed. For normal distributed continuous variables the Student's t-test was used, for non-normal distributed continuous variables the Mann-Whitney U test was used. For dichotomous or ordinal variables the Pearson's Chi-square test was used for independent samples and the McNemar test for correlated samples. A p-value <0.05 was used as the cut-off for statistical significance.

Participants who were discharged within 17 weeks after admission and completed the questionnaire sent to them 4 weeks after discharge from the SNF were analysed to assess FoF at admission and after discharge. The McNemar test was used to assess significance. The T-test was used for these participants to compare the FAI of participants with and those with no FoF.

Analyses were performed with SPSS for Windows (Version 21, SPSS, Inc., Chicago, IL, USA).

RESULTS

Figure 1 presents a flow chart of the participant recruitment and follow-up. Of the 306 patients invited to participate in the study, 22 declined. Of the remaining 284 patients, one participant was discharged almost directly after admission. Subsequently, of the 283 patients who participated, three did not provide sufficient data on FoF and were excluded from the analysis. The majority of participants were women (70.7%), the median age was 82.4 (IQR: 75.8-87.4) years, and most (70.0%) lived alone at home before admission to the hospital and the SNF. The underlying diagnosis at admission was: stroke (22.9%), elective orthopaedic operation (12.9%), trauma (33.9%), or another disease (30.4%). Of all patients, 175 (62.5%) had a little, quite a bit, or very much FoF at admission.

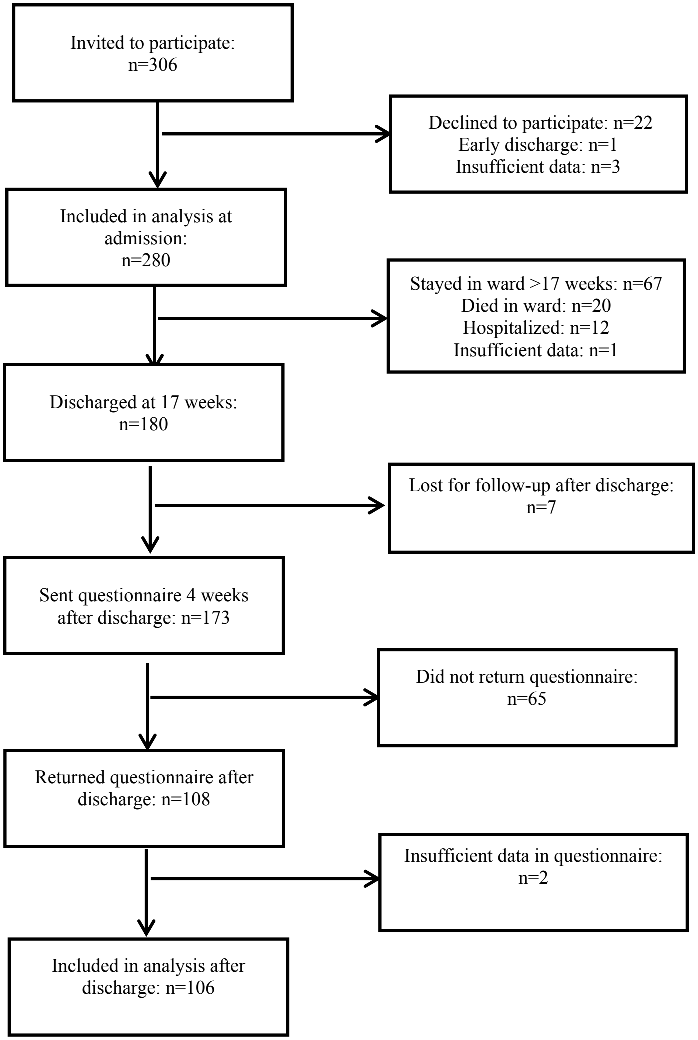

Figure 1 - Flow-chart of recruitment and follow-up of participants

Table 1 presents the differences between the participants without and with FoF at admission. In the group with FoF, both the median age and the percentage of females were significantly higher. Also, the percentage of participants with stroke was significantly lower (Pearson's Chi-square test: p= 0.040) and with elective orthopaedic surgery was significantly higher in those with FoF (Pearson's Chi-square test: p= 0.043). The GDS8 was significantly higher in the group with FoF (Mann–Whitney U test: p= 0.029), whereas the SES was significantly higher in the group without FoF (Mann–Whitney U test: p= 0.043).

Table 1 - Characteristics of participants without and with fear of falling (FoF) at baseline

	All participants n=280	Participants without FoF n=105	Participants with FoF n= 175	p-value
Age in years, median (IQR)	82.4 (75.8 – 87.4)	79.7 (72.6 – 85.7)	83.4 (76.9 – 88.1)	0.005*
Female, n (%)	198 (70.7%)	63 (60.0%)	135 (77.1%)	0.002**
Living alone	196 (70.0%)	69 (65.7 %)	127 (72.6 %)	0.225**
Diagnosis at admission, n (%)				0.017 **
- Stroke	64 (22.9%)	31 (29.5%)	33 (18.9%)	0.040***
- Orthopaedic, elective	36 (12.9%)	8 (7.6%)	28 (16.0%)	0.043***
- Trauma	95 (33.9%)	29 (27.6%)	66 (37.7%)	0.084***
- Other	85 (30.4%)	37 (35.2%)	48 (27.4%)	0.169***
Average number of falls per week, median (IQR)	1 (0-3)	0 (0 – 2)	1 (0 – 3)	<0.001*
MMSE, median (IQR)	25 (21-27)	25 (20 – 27)	25 (22 – 27)	0.289*
GDS8 (total), median (IQR)	0 (0-2)	0 (0 – 1)	1 (0 – 2)	0.029*
Barthel at admission, median (IQR)	10 (6-14)	9.5 (6 – 15)	10 (6 – 14)	0.694*
SES (total), median (IQR)	35 (31-38)	35 (33 – 38)	34 (30 – 37)	0.043*

* Mann-Whitney U test; ** Pearson's Chi-square test, ******* Pearson's Chi-square test per patient group; IQR, Interquartile range; MMSE, Minimal Mental State; GDS8, Geriatric Depression Scale-8 Items; SES, Self-Efficacy Scale

At admission to a SNF, FoF was highest in the group with an elective orthopaedic procedure (77.8%), compared to 69.5% in those with trauma, 56.5% in those with other diseases, and 51.6% in those with stroke (Pearson's Chi-square: p=0.017).

At 17 weeks after admission, 67 (23.9%) of the participants were still in the SNF, 12 (4.3%) were hospitalised, 20 (7.1%) had died, and 180 (64.3%) were discharged. For one patient no data were available at 17 weeks. Of the 180 participants who were discharged, seven were lost to follow-up (five for unknown reasons, while two had died). Of the remaining 173 participants, 108 (62.4%) returned the questionnaire sent to them four weeks after discharge from the SNF (figure 1). Of these 108 participants, 95 (88.0%) were discharged home and 13 (12.0%) were discharged to a long-term care facility or rehabilitation centre.

Two participants provided no data on FoF after discharge. Of the 106 remaining participants after discharge, 19 (17.9%) had no FoF, 32 (30.2%) had little FoF, 28 (26.4%) had quite a bit, and 27 (25.5%) had very much FoF. Table 2 shows the changes between FoF at admission and after discharge. At admission, 61 (57.5%) of these participants had some kind of FoF, whereas after discharge 87 (82.1%) had FoF (McNemar test: p<0.001).

Table 2 - Comparison between fear of falling (FoF) at admission to a skilled nursing facility and after discharge home (n=106)

	No FoF after discharge	FoF after discharge	
No FoF at admission	12 (11.3%)	33 (31.1%)	45 (42.5%)
FoF at admission	7 (6.6%)	54 (50.9%)	61 (57.5%)
	19 (17.9%)	87 (82.1%)	106 (100.0%)

When assessing FoF in these 106 participants based on the main patient groups, 78.3%, 77.8%, 85.4% and 83.3% of the participants with a stroke (n=23), an elective orthopaedic operation (n=18), a trauma (n=41) or another disease (n=24), respectively, had some kind of FoF four weeks after discharge, whereas at admission, 47.8%, 66.7%, 63.4% and 50.0% of these participants, respectively, had FoF. These differences were significant for patients with a trauma (McNemar test: p=0.022) and another disease (McNemar test: p=0.008), not for patients with a stroke (McNemar test: p=0.092) and with an elective orthopedic operation (McNemar test: p=0.688).
Table 3 shows the relation between FoF and the FAI, using the score of the total FAI and the scores of the three subscales, i.e. domestic, leisure/work and outdoors [28]. The domestic domain consisted of the first five items of the FAI, the leisure/work domain of items 7, 9, 11 and 13, and the outdoors domain of items 6, 8, 10 and 12. The items 14 and 15 were not included because they do not fit well into any of the three domains.[29]

6

Table 3 - Instrumental activities of daily living of participants without and with fear of falling (FoF) 4 weeks after discharge

	All participants	Participants without FoF	Participants with FoF	
FAI Total, mean (SD)	28.67 (9.07)	34.84 (8.51)	27.27 (8.70)	T –test for equality of means: p=0.001
- **FAI Domestic (SD)**	6.49 (5.08)	9.95 (4.09)	5.72 (5.01)	T-test for equality of means: p<0.001
- **FAI Leisure (SD)**	3.21 (2.52)	3.95 (2.37)	3.03 (2.56)	T-test for equality of means: p=0.145
- **FAI Outdoors (SD)**	2.81 (2.81)	4.53 (2.59)	2.45 (2.67)	T-test for equality of means: p=0.004

FAI, Frenchay Activity Index; SD, standard deviation

A significant relation exists between FoF and the FAI. When assessing the subscales, FoF was significantly related to the domestic domain and to the outdoors domain. The short FES-I of participants with and without FoF after discharge also showed a significant difference, i.e. 17.11 (standard deviation (SD) 5.49) for participants with FoF and 8.65 (SD 2.21) for those without FoF (T-test: p<0.001). The Pearson correlation between the short FES-I and the one-item FoF instrument was 0.765 (p<0.001).

DISCUSSION

FoF is common in older patients who rehabilitate in a SNF of a nursing home. In the present study 62.5% had FoF at admission. Participants with FoF were more often female and older. Also, they were more often depressed and had a significantly lower self-efficacy. For patients who could be followed-up after discharge, the prevalence of FoF was even higher after discharge. When dividing these patients in different diagnosis groups the increase in FoF after discharge was significant for patients with a trauma and with another disease. Furthermore, the study demonstrated that FoF after discharge was significantly related with IADL.

Although 62.5% is a relatively high proportion for FoF, it is comparable to another Dutch study investigating patients who rehabilitated in SNF after a hip fracture. In the latter study, 63.0% had some kind of FoF [30]. In other studies among patients with hip fractures, 50% indicated to be afraid of falling[31], and 65% sometimes or often had FoF.[32] In addition, female sex, older age and depression are known risk factors for FoF.[33,34] These latter factors are also correlated with FoF in long-term care.[1.]

The present study found that, four weeks after discharge from the SNF, the percentage of patients with at least some FoF ranged from 77.8-85.4% for all four groups. This may indicate that, in older persons rehabilitating in a SNF, FoF is more strongly associated with characteristics other than the underlying health condition itself. More studies are needed to establish whether this is related to the vulnerable condition and the high number of comorbidities in these older patients, or due to the ageing process itself.[35,36]

FoF has rarely been assessed longitudinally. Therefore, our remarkable finding that the prevalence of FoF increases four weeks after discharge needs to be further evaluated over longer periods of time. A study in community-dwelling older adults, in which the 24-month cumulative incidence of FoF was 45.4%, found that FoF can persist over time.[37] Predictors for persistent FoF in this latter study were depressive symptoms, clinical gait abnormality, female sex and previous falls; all these factors are reported to be related to vulnerability.[38] Depression, female sex, and average number of falls were also characteristics in our study which were related to FoF.

A possible explanation for the increase of FoF after discharge is that patients cannot immediately oversee all possible consequences, but are confronted with their shortcomings at home. Also, when patients are rehabilitating in a SNF, they encounter substantial physical, psychological and social support during admission. Particularly because 70% of these patients lived alone, this support will have been missed after discharge, which may have enhanced FoF.

While FoF has been identified as an obstacle for rehabilitation after hip fracture[6,7], more recently FoF has also been regarded as an emerging issue in other diseases, such as a stroke.[39,40] For example, Schmid et al., assessed FoF directly after stroke and six months later.[41] In that study (which also used a one-item instrument), FoF at baseline was 54%; after six months, 7 (39%) of the 18 patients that could be followed-up had some FoF. Unfortunately, that study included only 18 patients with a 6-month follow-up and the characteristics of the group were different from those of our participants. Only participants from a single, university-based, teaching hospital were recruited, with a mean age of 59 years, and 64% of the participants were male.[41] In another study from Korea, in which FoF was assessed in sub-acute stroke patients (3-6 months of stroke duration), 18 of the 34 (53%) patients reported to have FoF.[39] The results of these studies are in line with the prevalence of FoF among stroke patients in our study, in which about half of the patients with a stroke, i.e. 33 of the 64 patients (51.6%), reported FoF at admission. In a qualitative study three factors were possibly associated with the development of post-stroke FoF: a) an initial fall coinciding with the stroke onset, b) perception of post-stroke body changes, and c) a pervasive everyday fear of future falls.[40] Particularly the post-stroke body changes may explain the rather high and persistent prevalence of FoF in stroke patients, even after discharge home.

FoF is particularly important because, as shown in the present study, it is directly related to conducting more complex activities. FoF may hamper IADL after discharge. Feared consequences of falling such as loss of functional independence and damage to identity (i.e. through social embarrassment and indignity) are reported to be correlated with avoidance of activity.[2] When dividing FoF into three components, i.e. physiological, behavioural and cognitive, particularly the behavioural component of FoF of self-restricted avoidance of activities, may lead to a negative spiral toward frailty and increased dependency in these discharged patients.[12]

A study by Denkinger et al.[5] demonstrated that falls-related self-efficacy is the only parameter that significantly predicts rehabilitation outcome at discharge and follow-up across outcomes such as ADL, gait and function. In our study we also demonstrated that falls-related self-efficacy is related with IADL after discharge, particularly with the domestic and outdoors domain of the FAI. Hence, prevention and treatment of FoF is an important clinical issue and therapists should be aware of the relation between FoF and the effects on recovery.[40] In addition, it is important to develop and study specific interventions which target falls-related self-efficacy, as a modifiable factor during rehabilitation, impacting on FoF and IADL after discharge. Since FoF can be rather persistent, such programmes need to be continued after discharge from the SNF.

The 1-item FoF instrument, which has been used in many earlier studies as a simple and reliable instrument to measure FoF, has some flaws.[14] When used dichotomous to distinguish between participants with no FoF and some kind of FoF, it does not allow for any variability in degrees of FoF. The 1-item instrument also does not differentiate between different types of activities for which FoF may be present. It is often used as an umbrella instrument for

FoF, not distinguishing between the different aspects of FoF, e.g. physiological, behavioral and cognitive elements.[12] Nevertheless this instrument has the advantage of being straightforward and its ease of generating prevalence estimates.[8]

A strength of our study is that FoF was measured at two different points in time, not only during admission but also after discharge. Also, FoF was measured by different instruments with good measurement properties. We found a strong relation between the different instruments for FoF; the Pearson's correlation was 0.765. The fact that these instruments may measure somewhat different constructs has been extensively discussed.[14] The short FES-I, which measures 'concern' about falling may focus more on the cognitive elements of FoF and less on emotional aspects.[12,13] IADL were also assessed with a validated and commonly used instrument, i.e. the Frenchay Activity Index.

Another strength of our study is that the included patients had different types of underlying conditions (e.g. trauma and stroke) and that we focused on vulnerable older patients who may be more susceptible for FoF. These patients are often excluded from studies on rehabilitation.[6] Furthermore, the 60% response to the questionnaires by the discharged participants is relatively high.

A weakness of the study is that not all patients could be followed-up. No further data were collected for patients who were still not discharged from a SNF after 17 weeks.

CONCLUSION AND FUTURE DIRECTIONS

FoF is highly prevalent and increased in older patients rehabilitating in a SNF. At 4 weeks after discharge, FoF was associated with IADL. Therefore, interventions are needed to reduce FoF and enhance IADL after discharge. Such interventions should be further developed and studied in older vulnerable persons who rehabilitate in SNFs.

Abbreviations

ADL = Activities of Daily Living; FAI = Frenchay Activity Index; FES-I = Falls Efficacy Scale – International; FoF = Fear of falling; GDS8 = Geriatric Depression Scale-8 Items; IADL= Instrumental Activities of Daily Living; ICF = International Classification of Function, Disability and Health; IQR = Interquartile range MMSE = Minimal Mental State Examination; SD = Standard deviation; SES = Self-Efficacy Scale; SNF = Skilled Nursing Facility; WHO = World Health Organization

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

WA, MC, RvB and EB designed the study. EB participated in data collection. MC had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. JV did the initial analysis. JV, WA, MC and RvB interpreted the data. JV prepared the manuscript. All authors critically revised the manuscript and approved the final version.

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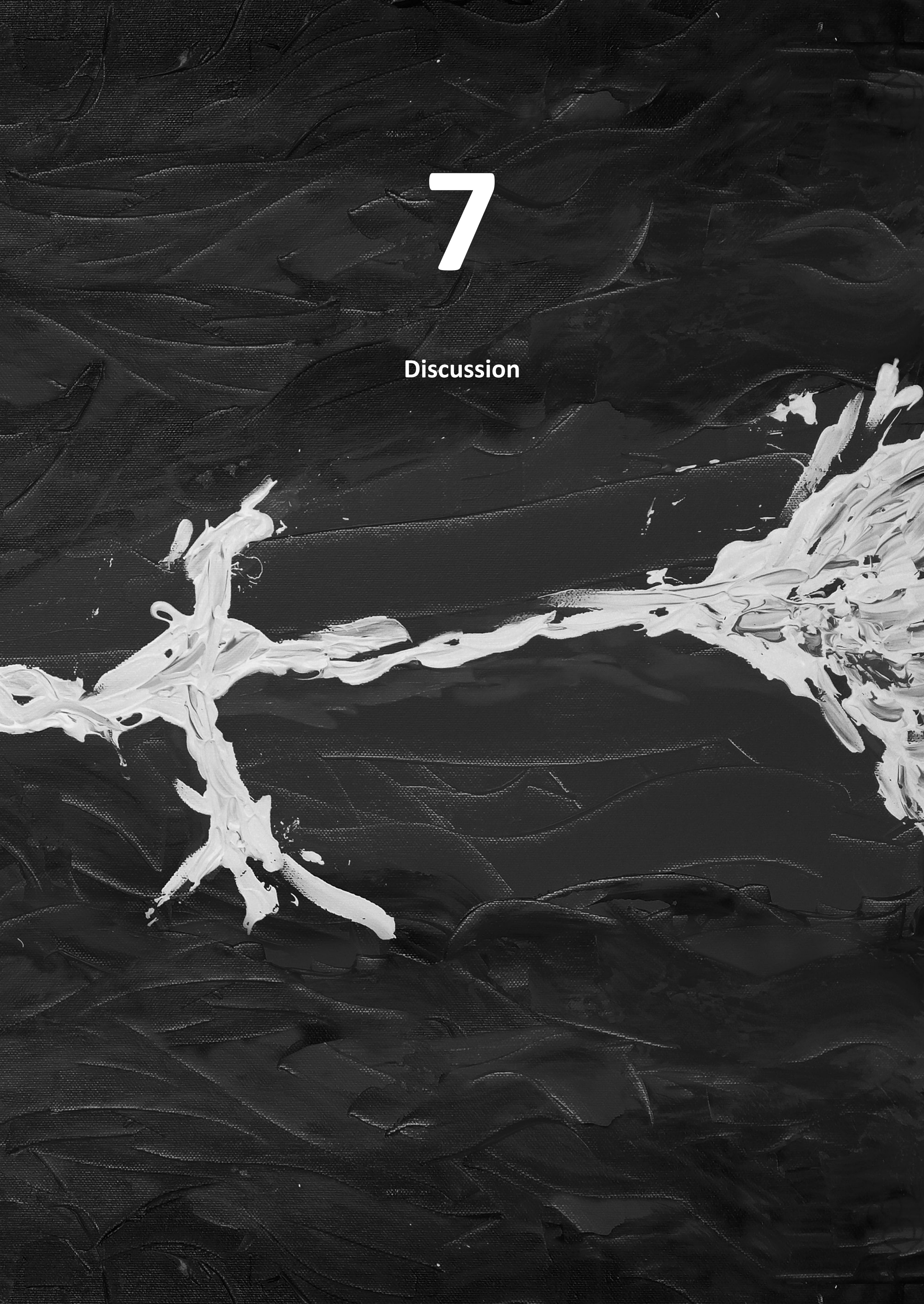
7

Discussion



The aim of this thesis is to study fear of falling (FoF) in vulnerable older people with a hip fracture who rehabilitate in a skilled nursing facility (SNF). More knowledge is needed to develop interventions to reduce FoF and to improve outcomes of the rehabilitation process. Therefore, six main research questions were formulated - these are addressed first. Then, issues related to the methods and concepts used in this thesis are discussed. Finally, some implications for clinical practice and future research are considered.

7.1 MAIN FINDINGS

1. What is the prevalence of FoF in older patients with a hip fracture?

To determine the prevalence of FoF after hip fracture the literature was analysed by means of a systematic review (Chapter 2) and a cross-sectional study was carried out among 10 SNF in the Netherlands (Chapter 4). The review revealed that different instruments are used to measure FoF, thereby making comparisons difficult. Also, no evidence-based cut-off points are available to distinguish between a high and low level of FoF. A study by Muche et al.[1] indicated that 50% (68/135) of the patients aged ≥ 65 years who were admitted to a hospital after hip fracture had a high level of FoF. In a study by Ingemarsson et al.,[2] in which FoF was measured 25 days after surgery in patients aged ≥ 65 years admitted to a geriatric hospital, 65% had some kind of FoF. In our cross-sectional study (Chapter 4) we found that 37% were not at all concerned about falling, while 36% were somewhat concerned, 23% were fairly concerned and 4% were very much concerned about falling. More recent studies among older patients after a hip fracture also report high percentages of FoF, e.g. 58% in a study by Jellesmark et al.[3]

These high prevalence rates are comparable to rates in older persons who reside for long-term care in nursing homes, in which prevalence rates of FoF range from 40% to 75% with a mean prevalence of 63%.[4] FoF was also common among community-dwelling older people with a wide range of prevalence rates (21%-85%), depending on the instruments used and the characteristics of the study population.[5,6]

When focusing on the severity of FoF by using instruments such as the FES, a substantial level of FoF was found among older patients after a hip fracture. In the study by Ingemarsson et al. the mean score was 5.6 (SD ± 2.8) on a scale from 0-10 (0=no confidence at all, 10=full confidence not to fall).[2] In our cross-sectional study (Chapter 4) the mean score on the FES-I was 32.2 (range 16-64). Both studies indicate that, after a hip fracture, patients generally have a substantial level of FoF. Therefore, FoF may constitute a serious problem during rehabilitation and requires further research and actions.

7

2. Which factors are related with FoF?

If FoF is indeed an important problem in rehabilitation after a hip fracture, it is essential to select those patients who are at most risk for high levels of FoF. To identify such patients, factors correlated with FoF have to be identified. Therefore, our literature study (Chapter 2) and cross-sectional study (Chapter 5) present the most important correlates of FoF after hip fracture. The literature review revealed a relationship with two pre-morbid factors, i.e. a strong correlation with pre-fracture activity and a weaker but significant relationship with history of falls. FoF was also correlated with physical function, balance, mobility, exercise, falls after fracture, institutionalisation and even mortality (Chapter 2). In our cross-sectional study, the univariate regression analysis identified six factors related to FoF i.e. walking ability before fracture, number of complications, activities of daily living (ADL) before fracture, anxiety, ADL after fracture, and self-efficacy.

These results are comparable with recent studies in community-dwelling older people. In a cross-sectional study among 540 community-dwelling older people, female gender, limitations in ADL, and one or more falls in the previous six months correlated independently with severe FoF.[7] Univariate correlates in this study were old age, female gender, limitations in ADL, impaired vision, poor perceived health, chronic morbidity, falls, low general self-efficacy, low mastery, loneliness, feelings of anxiety, and symptoms of depression. In another study among community-dwelling older adults, female gender, physical function, the use of a walking aid, history of falls and poor self-related health were associated with FoF-related constructs.[8]

Studies in long-term care facilities showed that age, gender and poor self-rated health status were also correlated with FoF.[4] Other factors were psychological states, such as depression and anxiety. In our study, FoF was not related with depression but only with anxiety.

In the multivariate regression analysis (Chapter 5) only three factors were independently related with FoF, i.e. impaired walking ability before fracture, impaired ADL after fracture, and increased anxiety were associated with a higher level of FoF. Therefore, health professionals should be aware that older patients who have a history of problems with walking, or who have an anxious character, have a high risk for FoF. This risk is even higher if the Barthel Index (expressing basic ADL such as going to the toilet and (un)dressing) remains low during rehabilitation.

3. What is the course of FoF after a hip fracture?

No longitudinal studies are available to provide information on the course of FoF after a hip fracture (Chapter 2). However, our cross-sectional study shows that the percentage of patients with FoF is highest in phase 2 (29-56 days after fracture) of the rehabilitation process (Chapter 4). In phases 1 (≤ 28 days after fracture), 2 and 3 (≥57 days after fracture) the FES-I was 30.6, 35.6 and 29.4, respectively (P=0.025, Kruskal-Wallis test). Thus, FoF was

highest in the group that had rehabilitated for 4-8 weeks. Initially, patients may not realise the consequences of the fracture because the first exercises are usually done under close supervision and in a step-by-step manner. However, after a few weeks patients have to walk more independently and may then realise the consequences of their fracture for future functioning; this may result in an increase in FoF. In a later phase of rehabilitation, after further training, FoF may decrease again. However, since our study had a cross-sectional design, we have to be cautious about drawing any firm conclusions from these results.
Analysis of the longitudinal study (Chapter 6) revealed that up to 85.4% of the patients with a trauma, including hip fractures, had FoF 4 weeks after discharge (Chapter 6). Therefore, FoF is rather persistent in older patients rehabilitating in a SNF after a hip fracture.

4. Is the FES-I a suitable instrument to measure FoF after hip fractures?
The literature review in Chapter 2 shows that different instruments are used to measure FoF in patients after a hip fracture. Firstly, some instruments measure FoF directly; these are mostly one-item instruments with a single question, such as "How much fear of falling do you have?". Secondly, instruments focusing on balance and fall-related self-efficacy are used, such as the Falls-Efficacy Scales, of which several modifications have been developed. Other scales, such as the Activity-specific Balance Confidence (ABC) scale, are used but are less sensitive to change than the FES.[9] Furthermore, the FES is more suitable for use in vulnerable older persons than the ABC scale, which includes several more complex activities.[10]
Nowadays, the FES-I, which has been developed and validated in different countries by the Prevention of Falls Network Europe (ProFaNE) network, is regarded as the most suitable instrument for community-dwelling older people.[11] To assess whether the FES-I is also a suitable instrument to measure FoF after a hip fracture, the measurement properties of the FES-I were assessed in two groups of patients with a hip fracture (Chapter 3). The FES-I was unidimensional in patients with a hip fracture. The internal consistency was high (Cronbach's alpha was 0.94), although the construct validity was not optimal since only 4 of the 11 hypotheses could be accepted. The intra-class correlation coefficient was 0.72, which is considered fair.
Although Chapter 3 demonstrates that the FES-I can also be used to measure FoF in patients after a hip fracture, the construct validity requires further consideration. For older patients with hip fractures the FES-I may not capture all aspects of FoF. The FES-I seems more closely related to functional performance than to psychological concepts. It is likely that the FES-I is predominantly a rational self-assessment of an individual regarding whether he/she is capable of performing an activity without falling, and only to a lesser extent measures emotional aspects of FoF (such as embarrassment and fear for the consequences of a fall). Therefore, some researchers have recommended (as we did in our cross-sectional study) to use two instruments for FoF, e.g. a one-item instrument *and* the FES-I.[12]

Although in other studies the FES-I was administered through self-reporting,[13] in our cross-sectional study the FES-I was carried out through face-to-face interviews. This is supported by more recent research. For example, in a study in older persons with and without cognitive impairment, Hauer et al.[14] found that in vulnerable older persons, especially with cognitive impairment, an interview-based method is advisable. In an additional study we also found that the FES-I may have elements which are sometimes misinterpreted, indicating that a face-to-face interview in older and vulnerable people is the best option.[15] Items can be better explained, particularly when they concern an activity which currently cannot be performed by an older person.

Until now, only a few studies have suggested cut-off points for the FES-I (range 16-64). Jellesmark et al. reported that a score of 22-64 indicates a high degree of FoF, resulting in 58% of their participants having a high level of FoF.[3] In a study by Delbaere et al. a score of 22 and over and of 20 and over, were used as cut-off points for low and high perceived fall risk, respectively, for persons with a low and high physiological fall risk.[16] In a validation study of the FES-I, in which cut-points were defined as the best trade-off between sensitivity and specificity, a score of 23 and over was regarded as a high concern of falling.[17]

In Chapter 5, which identifies factors that explain differences in patients with high and low levels of FoF, the median was the cut-off point. A FES-I score of 33 and over was regarded as a high level of FoF. It is likely that in our study group, including many vulnerable older people, the level of FoF is substantially higher. Therefore, the group of older persons with a low level of FoF also included persons that had a level of FoF which could be considered as a high level of FoF according to other standards. This may even have led to an underestimation of the outcomes. The most suitable cut-off points for the FES-I in these patients is still debated and requires further research. This may be important for the selection of patients who require a specific intervention, particularly when FoF leads to avoidance of activities.

In conclusion, we recommend to use the FES-I, using a face-to-face interview, and to measure FoF after hip fractures. The FES-I could also be useful for monitoring FoF during the rehabilitation period, particularly when interventions are implemented to reduce FoF.

5. Which interventions reduce FoF after hip fracture?

Unfortunately only four intervention studies aiming to reduce FoF after hip fracture could be found in our literature search (Chapter 2). Moreover, none of these studies included very vulnerable older patients.

In a home-based rehabilitation programme, Crotty et al.[18] found that the mean FES at 4 months was significantly better compared to usual treatment. Hauer et al.[19] started a 12-week programme of ambulatory training after hip surgery. Measurements were carried out at 3-4 weeks after admission to hospital, at the end of the training period, and again 3 months later; although there was a clear improvement related to FoF, it was not significant.

A community exercise programme, in which patients with a hip fracture were assessed after a 4-month intervention period, was evaluated by Jones et al.[20] The FES improved in the intervention group, but not significantly. Ziden et al.[21] studied a home rehabilitation programme focusing on balance confidence and ADL. The intervention group showed significantly higher confidence in performing daily activities as measured by the FES. When comparing changes one month after discharge with baseline data, the intervention group showed a larger increase in balance confidence on stairs and instrumental ADL.

Although some of these studies demonstrate that FoF can be modified, the results have to be interpreted with care. The studies only included relatively healthy patients, the sample sizes of the studies were small, and the follow-up period was generally rather short. Also, most programmes had FoF as a secondary outcome with (generally) the reduction of falls being the primary outcome. A recent Cochrane review on exercises for reducing FoF in community-dwelling older people concluded that these exercises probably reduced FoF to a limited extent immediately after the intervention, without increasing the risk for falling.[22] A recent literature review on interventions aimed at multi-factorial falls prevention and FoF rightfully concludes that, to reduce falls, FoF must be addressed in these interventions in addition to the physiological parameters.[23]

Interestingly, the regression analyses in Chapter 5 resulted in a final model consisting of three factors i.e. walking ability before fracture, activities of daily living after fracture, and anxiety. Since the latter two factors are modifiable, they also constitute aspects that interventions should focus on in order to reduce FoF.

6. What is the prevalence and what are the consequences of FoF in other patient groups who rehabilitate in a SNF?

FoF in patients rehabilitating in a SNF is not only restricted to patients with a hip fracture (Chapter 6). In patients who rehabilitate in a SNF of a nursing home the percentage of patients with FoF was 51.6%, 77.8%, 69.5% and 56.5% for patients with stroke, an elective orthopaedic procedure, trauma or other underlying disease, respectively. In patients that could also be followed-up after discharge 78.3% 77.8%, 85.4% and 83.3% of the patients with a stroke, an elective orthopaedic operation, a trauma of another disease, respectively, had FoF. Therefore, also in other groups not admitted due to a fall causing a severe trauma (e.g. a hip fracture), FoF is highly prevalent. This may indicate that FoF is more strongly associated with other characteristics of older persons rehabilitating in a SNF than the underlying condition itself. Also, a serious fall is apparently not necessary for the presence of a high level of FoF. Factors such as impaired functional capacity, restricted mobility and enhanced anxiety may be even more important. After discharge from hospital, FoF was relatively persistent in all patient groups and, among patients with a stroke, was even higher than directly after admission in a SNF. This indicates that FoF also has to be addressed after discharge, particularly since it reduces instrumental ADL after discharge (Chapter 6).

7.2 REFLECTIONS ON METHODS AND CONCEPTS

During the research described in this thesis, it became apparent that several methodological and conceptual issues need to be addressed.

Limited number of studies

Chapter 2 shows that the number of studies on FoF after hip fractures is relatively small. Only 15 studies were found that provided some information on the prevalence and impact of FoF in persons with a hip fracture. Recently, although more studies have been published which highlight the importance of FoF, they do not change the main conclusions of our literature review.[24-28]

An additional problem was comparing studies that had different designs, were carried out in different settings, used different instruments to measure FoF and, generally, also had different endpoints. Therefore, conclusions drawn from comparisons of these studies should be interpreted with some caution.

Selection bias

A strength of this thesis is the specific focus on vulnerable older patients. In the cross-sectional study in Chapters 3, 4 and 5 the inclusion criteria were purposefully kept broad to include vulnerable older persons. The average number of co-morbidities was 3.5: also, of all participants,19% had short-term memory impairment, 6% had long-term memory impairment and 27% had visual impairments, indicating that the participants were less healthy than in most other studies. Nevertheless, 13 patients had to be excluded from our cross-sectional study because they were not able to respond to questions due to severe cognitive problems. In our literature review (Chapter 2) no studies were found that specifically focused on these vulnerable older patients.

Since we studied vulnerable older patients rehabilitating in SNF in nursing homes, the included participants were necessarily carefully selected. Therefore, caution is required about generalising the results of our study to other patient groups. Nevertheless, in the Netherlands this group is substantial (estimated to be ≥ ⅓ of all patients with a hip fracture) and most likely represents the group of patients with the worst outcomes.

Selection of variables

In Chapters 3, 4 and 5 the type of information collected and the measurement instruments used are common in clinical practice. Therefore, based on the results of the regression analyses, it is relatively easy in clinical practice to collect data on variables closely related to FoF, such as anxiety, and scores on ADL (Barthel Index) and walking ability (Functional Ambulation Categories (FAC)). Subsequently, it may be relatively easy to identify persons that are particularly prone to have FoF.

In the cross-sectional study (Chapter 5) we asked relatively simple questions for cognitive status derived from the Cognitive Performance Scale from the Minimal Data Set of the nursing home resident assessment instrument.[29] An advantage of these questions, is that these data are easy to collect. However, other instruments, such as the Mini-Mental State Examination (MMSE), although more time-consuming, may be more suitable to provide information on the extent of cognitive impairment in older persons. For more understanding on the relation between cognition and FoF, studies are required that use instruments providing more detailed information on the cognitive status of older persons.

Cross-sectional study: strengths and weaknesses

A strength of our cross-sectional study was that it provided a reasonable representation of SNFs, since 10 different SNFs were included. The rehabilitation programmes of these SNFs were comparable in terms of intensity, disciplines involved and duration. Also, the targeted (and realised) number of 100 participants was sufficient for statistical analysis. Although a cross-sectional study is particularly suited to explore a topic and to generate hypotheses, it has some limitations. For example, since data are collected at only one moment in time, no causal relations can be proven. In Chapter 3, for instance, we could assess the course of FoF during rehabilitation by relating it to the time period after the fracture. However, a more accurate analysis can only be made in a longitudinal study in which FoF is measured in one individual at different points in time.

The concept of FoF

The literature lacks one clear definition and conceptualisation of FoF.[12] Initially, FoF was regarded as the 'post-fall syndrome', i.e. excessive FoF after a fall.[30,31] Although FoF is indeed related to earlier falls, FoF is also reported by many older people who did not fall at all, suggesting a multi-factorial aetiology that includes other psychological factors, such as anxiety and depression.[5,31]

FoF has often been discussed in terms of conceptual and methodological aspects, e.g. whether the 'self-efficacy' definition used for FoF by Tinetti et al. relates to a functional or psychological status, or to both.[32] Fall-related self-efficacy has been used as a proxy for FoF, even though the two are increasingly regarded as different concepts. Fall-related self-efficacy focuses on a person's confidence in his/her ability to avoid falling while undertaking ADL. FoF can be regarded as a broader concept which includes physiological, behavioural and cognitive elements. FoF itself influences activity avoidance, functional performance, and falls indirectly through falls efficacy.[32]

When assessing the FES-I we found that our initial hypotheses, in which we thought that the FES was more closely related to psychological status than to motor assessments, were not correct (Chapter 3). The FES-I, assessing concerns about falling when performing certain

activities, appears to be more closely related to physical performance. This is in line with Hadjistavropoulos et al. who indicated that fall-related self-efficacy is related to FoF, but probably with less intensity and emotion.[32]
Also in more recent publications, e.g. by Denkinger et al.,[8] different FoF-related constructs are distinguished, i.e. i) fear of falling, ii) fall-related self-efficacy/balance, and iii) FoF-related activity restriction. These authors argue that FoF is often used as an umbrella term that should be divided into distinct psychological concerns such as the specific fall-related fear, fall-related self-efficacy, balance confidence, and other constructs.

Perceived versus physiological risk to fall
In this thesis we used the definition of Tinetti et al. to describe FoF: "…*a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing*".[33] In this definition FoF is regarded as an obstacle for persons to carry out certain activities. However, FoF is also a mechanism for persons to prevent them from undertaking high-risk activities for falling, particularly if they indeed have a high objective risk to fall. In a study by Delbaere et al. among community-dwelling older people, the researchers emphasise that many older persons may underestimate or overestimate their risk of falling, and that measures for both physiological and perceived fall risks should be used to assess fall risk and to prevent future falls.[16] In their study, a distinction is made between perceived and physiological risks of falling. While the physiological risk is based on a physiological profile assessment, i.e. tests for vision, proprioception, muscle strength, reaction time and postural sway, the perceived fall risk is assessed with the FES-I. Also, 31% of the participants had disparity between their physiological and perceived fall risk. Based on these tests four groups are distinguished: "anxious" (high perceived, low physiological), "vigorous" (low perceived, low physiological), "stoic" (low perceived, high physiological) and "aware"(high perceived, high physiological). Interestingly, the stoics had a significantly lower number of falls than the awares, indicating that a high perceived fall risk among older persons with a high physiological fall risk is not protective at all. According to the authors, possible explanations for this may be the active lifestyle of the stoics, the higher use of psychotropic drugs among the awares, and the fact that the stoics had experienced less falls resulting in less perceived fall risk.
Although it would be interesting to carry out a similar analysis among older persons after a hip fracture, it also demonstrates that (in general) FoF can be seen as an obstacle for older patients, whether or not such perceived fall risk is in line with more objectively measured fall risk. Therefore, it is essential not only to carry out more objective tests for physiological tests in fall analysis, but also to include tests for perceived fall risks, such as the FES-I, because higher levels of perceived fall risk result in future falls.

In this thesis FoF was also regarded as an obstacle in rehabilitation and not as a preventive mechanism. In most studies on FoF after hip fracture, this perspective is taken. Although based on clinical experience such a perspective may be logical, it would be useful to distinguish between physiological and perceived fall risk in future studies. Our own data can, to some extent, be analysed based on this perspective, e.g. by using 'objective' tests such as the Performance Oriented Mobility Assessment (POMA) as a proxy for physiological risks of falling.

7.3 IMPLICATIONS OF THIS THESIS

Implications for clinical practice

During the last decades, geriatric rehabilitation has evolved as an important discipline in elderly health care, both for clinical practice and research.[34] More research data are available, various instruments have been validated, and an increasing number of researchers are interested in rehabilitation in older persons.[35] Multidisciplinary rehabilitation and comprehensive geriatric hip fracture units have proven to result in better functional outcomes and reduction of poor outcomes, such as mortality or admission to a nursing home.[36-38] This thesis has revealed that, after hip fracture, the majority of patients has FoF and that FoF can be measured with the FES-I. The thesis also identified several factors that correlate with FoF. The most important consequences of these findings for clinical practice are summarized below.

7

Assess FoF in all patients rehabilitating in a SNF

FoF has been identified as a most important and potentially modifiable threat to autonomy in older individuals.[8] The number of studies on FoF is increasing annually and FoF is also regarded as an important negative aspect related to participation and quality of life in nursing homes.[4] Furthermore, FoF predicts delayed recovery in geriatric rehabilitation.[39] Therefore, FoF warrants more attention: this applies not only to community-dwelling older persons, but also to persons in nursing homes whether they be residents or patients who are rehabilitating.

This thesis demonstrates that FoF is not only common after hip fracture, but also in other patient groups rehabilitating in SNF. So far, FoF has rarely been routinely assessed during geriatric rehabilitation. To elucidate the role of FoF in the outcomes of rehabilitation, FoF needs to be assessed during rehabilitation and be included in protocols and guidelines for rehabilitation.

Measure FoF throughout the rehabilitation process and address FoF after discharge

When assessing FoF over time, this thesis (Chapter 3) found differences between patients related to the time after operation. In the Back Home study (Chapter 6), in some patient groups FoF increased even after discharge. Although data from a longitudinal study are necessary to determine the precise course of FoF after a fracture or other event, it is advisable to assess FoF at different points in time. Suitable moments may be shortly after start of rehabilitation, during rehabilitation, and after discharge home. Assessment at these moments enables health professional to identify older persons with a high level of FoF and to engage them in interventions to reduce FoF.

Chapter 6 also reveals that FoF is rather persistent over time. Therefore, rehabilitation should not stop after discharge from a SNF, especially because current guidelines recommend early discharge home.[40,41] Patients should be followed up at home and interventions addressing FoF need to be continued after discharge. Physiotherapists should be trained in geriatrics and be aware of the psychological factors involved in rehabilitation. Often, a broader geriatric assessment by the elderly care physician and a multidisciplinary approach with the involvement of a psychologist may be required.

Include FoF in fall analysis for all older people

Falls are regarded as a geriatric syndrome because the prevalence is high in older persons living in the community and in nursing homes, and falls have severe negative consequences. Nowadays, analysis of falls is regarded as an essential element in health care for older people and an important element in rehabilitation after hip fractures.[40] In the analysis of falls, FoF also needs to be assessed in order to prevent future falls. In the Netherlands, an assessment of FoF through the short FES-I has recently been added to the fall protocol.[42] The main challenge is to implement this protocol in a timely way and in all relevant settings, both at home and in nursing homes. For patients who reside in a nursing home, this assessment should be carried out at least at admission and after a fall. The focus of such an assessment should not be on identifying persons at risk (since almost all patients in a nursing home are at risk), but at interventions to reduce the risk to fall. For older persons admitted to a SNF a fall analysis should also be carried out, at least for all those who experienced a recent fall, such as patients with a hip fracture.

Use the FES-I to measure FoF

Chapter 3 of this thesis demonstrates that the FES-I is suitable to be used for hip fractures. Since it has been shown that the measurement properties of the short FES-I are comparable to those of the FES-I, this instrument may also be used.[43]

Chapter 3 indicates that the FES-I is closely related to motor performance and balance, e.g. measured with the POMA. Therefore, it can be argued that the POMA may also reflect some aspects of FoF or falls efficacy. Nevertheless, it is important to measure FoF separately, since special interventions focusing on the cognitive aspects of FoF may be necessary to reduce FoF. This may improve both measures for FoF (such as the FES-I), as well as functional tests (such as the POMA), which should be routinely measured after hip fracture.

Implications for research

In geriatric rehabilitation many challenges remain for further research.[44,45] The American Geriatric Society has formulated a research agenda for geriatric rehabilitation based on three cross-cutting needs.[35] One of them is the disablement process itself in older persons, and another is the identification of the most important factors which influence the rehabilitation process. Hip fractures and falls were identified as two of the eight conditions requiring more research in older persons. This thesis, by dealing with falls, hip fractures and FoF during the rehabilitation process, aims to offer additional knowledge to address the research agenda. Since research is a learning process, several lessons can be drawn from our study, while new issues and challenges emerged when answering the research questions. These are summarized below.

- Because the study on FoF after hip fractures had a cross-sectional design, caution is required about drawing firm conclusions on the course of FoF and causal relations between demographic, functional and psychological factors. Longitudinal studies are needed to provide more knowledge on the exact course of FoF, by measuring FoF at different points in time. Such studies are also useful in establishing the temporary and causal relations between different factors and FoF. Chapter 5, and a study by Denkinger et al.,[8] report the most important parameters that can be used for such a longitudinal study on FoF after hip fracture.

- Although some longitudinal studies, also on hip fractures, are available, none have included FoF over a longer time period, particularly not after hospital discharge. Also, in the study in Chapter 6, we could only assess FoF during admission or shortly after discharge. Since FoF seems rather persistent, it is important to assess FoF over a longer time period, e.g. one year after the actual hip fracture, and to assess its impact on participation and quality of life. This requires a longitudinal study in which the patients are followed on the longer term after discharge.

- This thesis focused on vulnerable older people rehabilitating in SNF and shows that FoF is widespread among all patients groups. FoF may be more strongly related to different aspects of vulnerability than to the underlying disease itself. Therefore, more research is required to unravel the relations between vulnerability and FoF. This applies to patients rehabilitating in SNFs, as well as to older community-dwelling persons.

- Particularly the literature review (Chapter 2) showed a strong selection bias. In most studies, older persons with high levels of co-morbidity or cognitive problems were excluded. Although including such participants will cause some methodological challenges, the increasing numbers of vulnerable older persons demand more evidence-based knowledge for these groups, also in relation to intervention studies. It is possible that these older people may benefit most from interventions targeting, for instance, FoF.

- Although the concept of FoF is still being debated and different FoF-related constructs exist, the measurement properties of the FES-I were suitable to measure FoF in patients after hip fracture. The FES-I may not measure all aspects of FoF, but it is the most frequently used instrument for FoF-related constructs. For reasons of comparability it is advisable to use (at least) this instrument in studies in FoF. In order to encompass the broader concept of FoF another instrument, such as the one-item instrument, can be added. Also, tests for physical performance, such as the POMA, which are commonly used in clinical practice and are related to the FES-I, should be included in future research. Using these tests may also provide information to measure objective fall risk (physiological risk to fall) more adequately.

- The intention of our cross-sectional study was to focus on vulnerable older people and to include as many of them as possible. However, for their participation, these individuals need to be able to answer questions, to complete interviews, and to perform various tests. As a result we could not include all patients with a hip fracture, particularly those with severe cognitive problems which are often associated with poorer prognosis.[46] Although such patients may suffer from FoF, they are often not able to complete a FES-I, even in a face-to-face interview. Therefore, instruments for FoF need to be developed and validated for these patients; observational instruments might prove to be useful for this.

- This thesis provides new knowledge on FoF in patients with hip fracture to develop interventions to reduce FoF resulting in better outcomes of rehabilitation. During the last decades, several interventions (particularly targeted at community-dwelling elderly) have been developed and evaluated to reduce FoF.[47,48] Using the knowledge from this thesis and these interventions, studies should be designed and implemented for vulnerable older patients in geriatric rehabilitation. Until now, no intervention programmes to reduce FoF associated avoidance of activities have been carried out in SNFs, while in community-living older adults such programmes have proven to be effective. [47,48] An example is the multi-component intervention 'A Matter of Balance'.[49] This programme focuses on i) restructuring misconceptions about falls and controlling the risk of falls, ii) setting realistic goals for increasing activity, iii) changing the home environment to reduce risk of falls, and iv) promoting physical exercise to increase strength and balance. The principles of this programme can be translated into intramural settings for patients with hip fracture. Such a behavioural multi-component intervention, in which both physiotherapist and psychologist should be involved, will enhance self-efficacy and daily functioning and should be evaluated in terms of effectiveness and costs. Recently, based on our research, a randomised controlled trial was formulated using these principles; this study will be carried by the department of Public Health and Primary Health Care of the Leiden University Medical Centre and the Department of Health Services Research of the Maastricht School of Public Health and Primary Care.

Finally; what actually happened to Mrs. V. who underwent rehabilitation in our SNF?

Mrs. V. did not make much progress in the first weeks of rehabilitation. Although motivated, on several occasions she was reluctant to train with the physiotherapist. She pointed out that she was very much afraid of falling, risking a new hip fracture and severe embarrassment when falling in the training hall. She scored 38 on the FES-I, indicating a high level of FoF. The FES-I also indicated that she not only had a high level of FoF for activities outside (such as walking on uneven surfaces) but also for activities in the home, such as taking a bath or shower.

In order to reinforce the rehabilitation process and to achieve the goal to function independently at home, her FoF had to be decreased. Although no special intervention programme for FoF existed at that time, the physiotherapist spent extra hours with her, encouraging her and emphasising the progress she had made. Together with the occupational therapist she visited her house and discussed which adaptations should be made to reduce to her risk of falling at home.

On October 21st, 2014, Mrs V. was discharged home. She walked independently with a walker. Even though she still experienced some FoF, she indicated that she felt more self-confident when walking. At home she received home care for a few weeks and continued physiotherapy for six more weeks. She was able to carry out most activities of daily living and managed to do her shopping by herself.

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Appendices

APPENDIX 1

FES-International (FES-I) – English version

Now we would like to ask some questions about how concerned you are about the possibility of falling. For each of the following activities, please indicate the opinion closest to your own to show how concerned you are that you might fall if you did this activity. Please reply thinking about how you usually do the activity. If you currently don't do the activity (e.g. if someone does your shopping for you), please answer to show whether you think you would be concerned about falling IF you did the activity.

		Not at all concerned	Somewhat concerned	Fairly concerned	Very concerned
1	Cleaning the house (e.g. sweep, vacuum or dust)	1	2	3	4
2	Getting dressed or undressed	1	2	3	4
3	Preparing simple meals	1	2	3	4
4	Taking a bath or shower	1	2	3	4
5	Going to the shop	1	2	3	4
6	Getting in or out of a chair	1	2	3	4
7	Going up or down stairs	1	2	3	4
8	Walking around in the neighbourhood	1	2	3	4
9	Reaching for something above your head or on the ground	1	2	3	4
10	Going to answer the telephone before it stops ringing	1	2	3	4
11	Walking on a slippery surface (e.g. wet or icy)	1	2	3	4
12	Visiting a friend or relative	1	2	3	4
13	Walking in a place with crowds	1	2	3	4
14	Walking on an uneven surface (e.g. rocky ground, poorly maintained pavement)	1	2	3	4
15	Walking up or down a slope	1	2	3	4
16	Going to a social event (e.g. religious service, family gathering or club meeting)	1	2	3	4

APPENDIX 2

FES-Internationaal (FES-I) – Nederlandse versie

We willen u graag enkele vragen stellen over hoe bezorgd u bent dat u zou kunnen vallen. Het gaat er hierbij om hoe u gewoonlijk deze activiteit uitvoert. Als u tegenwoordig deze activiteit niet doet (bijvoorbeeld omdat iemand anders voor u de boodschappen doet) willen we u vragen aan te geven hoe bezorgd u zou zijn om te vallen als u de betreffende activiteit toch zou willen doen. Wilt u voor elk van onderstaande activiteiten het antwoord aankruisen dat het beste weergeeft hoe bezorgd u bent om te vallen als u deze activiteit zou doen.

		Helemaal niet bezorgd	Een beetje bezorgd	Tamelijk bezorgd	Erg bezorgd
1	Het schoonmaken in huis (zoals vegen, stofzuigen of afstoffen)	1	2	3	4
2	Het aan- of uitkleden	1	2	3	4
3	Het klaarmaken van eenvoudige maaltijden	1	2	3	4
4	Het nemen van een bad of douche	1	2	3	4
5	Het doen van boodschappen	1	2	3	4
6	Het in of uit de stoel komen	1	2	3	4
7	Het op- of aflopen van een trap	1	2	3	4
8	Het maken van een wandeling in de buurt	1	2	3	4
9	Het reiken naar iets boven uw hoofd of naar iets op de grond	1	2	3	4
10	Het beantwoorden van de telefoon voordat deze ophoudt met overgaan	1	2	3	4
11	Het lopen op een gladde ondergrond (bijvoorbeeld nat of bevroren)	1	2	3	4
12	Het bezoeken van een vriend(in), kennis of familielid	1	2	3	4
13	Het lopen op een plek waar veel mensen zijn	1	2	3	4
14	Het lopen op oneffen ondergrond (zoals kinderkopjes of slecht onderhouden trottoir)	1	2	3	4
15	Het op- of aflopen van een helling	1	2	3	4
16	Het bezoeken van een sociale gelegenheid (zoals kerkdienst, familiebijeenkomst of verenigingsactiviteit)	1	2	3	4

APPENDIX 3

Short FES-International

Now we would like to ask some questions about how concerned you are about the possibility of falling. For each of the following activities, please indicate the opinion closest to your own to show how concerned you are that you might fall if you did this activity. Please reply thinking about how you usually do the activity. If you currently don't do the activity (e.g. if someone does your shopping for you), please answer to show whether you think you would be concerned about falling IF you did the activity.

		Not at all concerned	Somewhat concerned	Fairly concerned	Very concerned
1	Getting dressed or undressed	1	2	3	4
2	Taking a bath or shower	1	2	3	4
3	Getting in or out of a chair	1	2	3	4
4	Going up or down stairs	1	2	3	4
5	Reaching for something above your head or on the ground	1	2	3	4
6	Walking up or down a slope	1	2	3	4
7	Going to a social event (e.g. religious service, family gathering or club meeting)	1	2	3	4

A

SUMMARY

Most older patients with a hip fracture undergo a surgical procedure in the hospital. Many of them are, after a short admission period in the hospital, discharged to a skilled nursing facility (SNF) in a nursing home for rehabilitation. In the SNF a multidisciplinary plan is made by the elderly care physician to outline the rehabilitation process. Unfortunately only a minority of the older people regain their previous level of functioning after rehabilitation. FoF has been identified as possibly one of the most important factors for these poor outcomes. However, FoF in older patients with a hip fracture has rarely been studied. Therefore, the aim of this thesis, is to give more insight into FoF in older patients after a hip fracture. The main research questions focus on the prevalence of FoF, factors related to FoF, the course of FoF during the rehabilitation process, possible interventions to reduce FoF and instruments to properly measure FoF.

Chapter 1 offers a general introduction about FoF in older patients after a hip fracture. It provides, based on recent literature, basic information on falls and hip fractures in older persons. Subsequently, chapter 1 discusses the rehabilitation process in general and fear of falling in particular. It presents a definition of FoF and elaborates on some conceptual issues, related to FoF and terms such as fall-related self-efficacy, which are also reflected in the instruments used to measure FoF.

Chapter 2 provides a systematic literature review about fear of falling in patients after a hip fracture. It focusses 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 assessment of the literature by searching several databases including PubMed, Embase, PsychINFO and CINAHL. These studies indicated that 50% or more of the older patients suffer from FoF after a hip fracture. However, these figures have to be interpreted with caution since the instruments used were not validated for older patients with hip fractures. The literature review demonstrated that FoF was associated with negative outcomes, such as loss of mobility, institutionalization and mortality. FoF was also related to reduced training time and an increased number of falls. Knowledge about risk factors and the course of FoF over a longer time period was limited. Furthermore, the review revealed that most studies suffer from a selection bias, because patients with physical and cognitive disorders were mostly excluded.

The Falls Efficacy Scale-International (FES-I) is mostly used to measure FoF. The FES- I is an instrument with 16 items and reflects concern about falling when somebody carries out 16 activities of daily living, such as taking a shower or going to the shop. The response to the FES-I consists of 4 levels from “not at all concerned” to “very concerned”. Chapter 3 explores the measurement properties of the FES-I in patients aged ≥ 65 years rehabilitating in 10 SNF in the Netherlands after a hip fracture. The measurement properties indicate whether the FES-I is a suitable instrument to measure FoF in this population. In a sample of 100 patients from a cross-sectional study important properties of the FES-I, such as the structural validity and construct validity, were studied. For the structural validity a so-called confirmatory factor analysis was carried out and for construct validity predetermined hypotheses were tested. The factor analysis yielded strong evidence that the FES-I is uni-dimensional in patients with a hip fracture. When assessing the construct validity, the FES-I was more closely related to functional performance constructs than to psychological constructs. Though there was a strong correlation between the FES-I and the 1-item fear of falling instrument, it also suggests that the concept measured by the FES-I may not capture all aspects of fear of falling. Finally, in another sample of 21 older patients the inter-rater reliability of the FES-I was evaluated. The intraclass correlation coefficient was 0.72, which indicates that the reliability was good.

The prevalence of FoF in older patients after a hip fracture and the relation of FoF with time after a fracture is studied in chapter 4, as well as the relation between FoF and other psychological factors, such as depression, anxiety and self-efficacy. The same sample from the cross-sectional study of 100 older patient rehabilitating in 10 SNF was used. The study demonstrated that 36% had a little FoF, and 27% had quite a bit or very much FoF. The scores of the FES-I were 31 [range 16-64] in the first 4 weeks after hip fracture, 36 in the second 4 weeks, and 29 in the period of ≥8 weeks after hip fracture. A higher/lower score indicates more/less FoF. In these 3 periods, the prevalence of FoF was quite high, 62%, 68%, and 59% respectively. The study demonstrated that FoF is common in patients after a hip fracture and is correlated with anxiety and self-efficacy. Furthermore, FoF was highest in the second 4 weeks after hip fracture.

Chapter 5 examines the factors which explain differences in patients with high and low levels of FoF after a hip fracture. The same cross-sectional study sample as in chapter 3 was used. Patients were divided in 2 groups, those with low and those with high level of FoF. Data on factors that could be correlated with FoF were collected, such as demographic variables, aspects of functioning, psychological factors and comorbidities. The study demonstrated that walking ability before fracture, activities of daily living after fracture, and anxiety were independently associated with FoF. Particularly because the last two factors are modifiable, this information is useful for the development of specific interventions for older persons with high levels of FoF.

FoF is also regarded as a major constraint for successful rehabilitation in other groups of older rehabilitating patients. Hence, chapter 6 studies FoF in older people with different types of underlying diseases. Data on FoF were derived from a longitudinal study in which patients who rehabilitate in a skilled nursing facility were assessed at admission, at discharge and 4 weeks after discharge. With these data the prevalence of FoF could be measured during and after rehabilitation. In addition, differences between those with and without FoF were assessed, as well as the relation between FoF and participation after discharge. Based on the answer to an one-item instrument patients were divided in a group with no FoF and in a group with FoF. To study FoF after discharge the one-item instrument as well as the short Falls Efficacy Scale-International (FES-I) were used. Participation after discharge was assessed with the Frenchay Activities Index (FAI). The study revealed significant differences between the group with and the group without FoF for age, gender, diagnosis, average number of falls per week, depressive symptoms and self-efficacy. The analysis also reveals that four weeks after discharge 82% of the participants had FoF. When measuring participation after discharge the FAI was respectively 27 and 35 for participants with and without FoF. Hence it can be concluded that FoF is common among older persons who rehabilitate in a SNF, irrespectively of the underlying disease. FoF seems to be quiet persistent and may even increase during and after rehabilitation, hampering participation after discharge.

In chapter 7 the major findings are presented and discussed. This chapter also reflects on important methodological and conceptual issues in this thesis. It indicates that the number of studies on FoF in patients after a hip fracture is still limited and that most research on FoF in these patients suffers from selection bias, because vulnerable older persons with high level of comorbidity are mostly excluded. In that sense, our cross-sectional study gives more insight in FoF among older vulnerable patients after a hip fracture. Also the variables used in this study are mostly routinely administered instruments used by professionals to monitor rehabilitation of older persons. Hence, in clinical practise it will be rather easy to identify older persons at risk for FoF.

In the literature, but also in clinical practise, different definitions are used for FoF. Since we have used Tinetti's definition, which describes FoF, as "*a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing",* and we have used the FES-I as measurement instrument for FoF, some aspects of FoF, e.g. the physiological or emotional, may have been addressed only superficially.
Nevertheless, the findings in this thesis have important implications for both future clinical practise and research. The study underlines the importance to measure FoF in all patients during rehabilitation. Measurements should be carried out not only at the start, but also during the rehabilitation process and after discharge. The FES-I can be regarded as a suitable instrument for these measurements.

This thesis also stresses the need for longitudinal studies to identify the real determinants of FoF and to measure FoF over a longer time period to study the course of FoF. Furthermore, more research is needed to get a better understanding of the relation between FoF and vulnerability. This requires that research also has to focus on older patients with higher levels of comorbidity and on patients with cognitive disorders, which may require new instruments to measure FoF for these patients. But maybe even more important, intervention studies are required to study whether FoF can be reduced and better outcomes can be established by identifying older persons with FoF and offering them a special programme to reduce FoF.

SAMENVATTING

De meeste ouderen met een gebroken heup worden in het ziekenhuis geopereerd. Een groot aantal van deze patiënten wordt, na een korte opname in het ziekenhuis, ontslagen naar een revalidatie-afdeling van het verpleeghuis. Op de revalidatieafdeling wordt een multidisciplinair behandelplan opgesteld door de Specialist Ouderengeneeskunde om het revalidatieproces aan te sturen. Helaas komen slechts weinig van deze oudere patiënten na revalidatie terug op het oorspronkelijke niveau van functioneren. Valangst speelt hierbij mogelijk een belangrijke rol. Daarom is meer inzicht nodig in valangst bij ouderen met een gebroken heup. Valangst bij ouderen met een gebroken heup is echter nog nauwelijks onderzocht. De belangrijkste studievragen in deze thesis richten zich daarom op hoe vaak valangst voorkomt, de factoren die met valangst gerelateerd zijn, het verloop van valangst gedurende de revalidatie, mogelijke interventies om valangst te verminderen en geschikte meetinstrumenten om valangst te meten.

Hoofdstuk 1 geeft een uitgebreide introductie over valangst bij oudere patiënten met een gebroken heup. Op basis van recente literatuur wordt algemene informatie over vallen en heupfracturen gegeven. Vervolgens wordt in hoofdstuk 1 ingegaan op het revalidatieproces voor ouderen in een verpleeghuis. Ook wordt daarbij verder ingegaan op valangst, waarbij een definitie voor valangst wordt gegeven en het begrip valangst verder wordt uitgediept. Ook worden instrumenten die valangst kunnen meten kort besproken.

Hoofdstuk 2 bevat een systematische literatuurstudie over valangst bij patiënten met een gebroken heup. Deze literatuurstudie richt zich vooral op meetinstrumenten die geschikt zijn om valangst te meten, de prevalentie van valangst, factoren die gerelateerd zijn met valangst, en interventies die valangst kunnen verminderen. Vijftien relevante studies zijn in de literatuur gevonden door het systematisch doorzoeken van diverse databases zoals PubMed, Embase, PsychINFO en CINAHL. Deze studies geven aan dat na een gebroken heup 50% of meer van de oudere patiënten valangst heeft. Echter, deze cijfers moeten wel met enige voorzichtigheid worden geïnterpreteerd omdat van de meetinstrumenten die in deze studies gebruikt zijn nog niet voldoende onderzocht is of ze wel goed valangst meten bij ouderen met een gebroken heup. De literatuurstudie laat ook zien dat er een relatie bestaat tussen valangst en verlies van mobiliteit, opname in een verpleeghuis en sterfte. Valangst is ook gerelateerd aan het aantal uren dat patiënten oefenen en aan het aantal vallen. Informatie over risicofactoren en het verloop van valangst gedurende een langere periode is beperkt. De literatuurstudie maakt ook duidelijk dat er bij de meeste studies sprake is van een selectie bias, omdat ouderen met fysieke en cognitieve problemen vaak van deelname aan het onderzoek worden uitgesloten.

S

De Falls Efficacy Scale-International (FES-I) wordt vaak gebruikt om valangst te meten. De FES-I is een meetinstrument dat de bezorgdheid over vallen weergeeft bij 16 activiteiten van het dagelijks leven, zoals bijvoorbeeld een douche nemen of naar de winkel gaan. De bezorgdheid om te vallen kan op 4 niveaus worden uitgedrukt, variërend van "helemaal niet bezorgd" tot "erg bezorgd". Hoofdstuk 3 onderzoekt de meeteigenschappen van de FES-I in patiënten boven de 65 jaar die revalideren in 10 verpleeghuizen in Nederland na een gebroken heup. Meeteigenschappen laten zien of een instrument zoals de FES-I geschikt is om valangst in deze groep patiënten te meten. Met behulp van een steekproef van 100 patiënten uit een cross-sectionele studie (dwarsdoorsnede onderzoek) zijn de belangrijkste meeteigenschappen van de FES-I onderzocht. Deze analyses laten zien dat de FES-I eendimensionaal is in patiënten met een gebroken heup. Als beoordeeld wordt of de FES-I inderdaad wel goed het concept valangst meet blijkt dat de FES-I een sterkere relatie heeft met functionele uitkomsten, bijvoorbeeld met testen die de balans en loopvaardigheid meten, dan met psychologische concepten, zoals angst en depressie. Hoewel er wel een duidelijk verband is tussen de FES-I en ander veelgebruikt instrument voor valangst dat slechts uit 1 item bestaat, suggereert dit ook dat het concept dat met de FES-I wordt gemeten mogelijk niet alle aspecten van valangst omvat. Tenslotte, is in een aparte steekproef van 21 oudere patiënten de betrouwbaarheid van de FES-I geëvalueerd. Deze analyse laat zien dat deze betrouwbaarheid goed is. De FES-I is dus een geschikt instrument om valangst bij ouderen na een heupfractuur te meten.

De prevalentie van valangst in oudere patiënten met een gebroken heup en de relatie tussen valangst in de periode na de breuk worden onderzocht in hoofdstuk 4. Ook het verband tussen valangst en andere psychologische factoren, zoals depressie, angst een zelfvertrouwen wordt in dit hoofdstuk beschreven. Dezelfde steekproef uit de cross-sectionele studie van 100 ouderen die revalideren in het verpleeghuis is gebruikt. De studie laat zien dat 36% van de ouderen een beetje en 27% tamelijk veel of erg veel valangst hebben. De scores van de FES-I zijn 31 in de eerste 4 weken na een gebroken heup, 36 in de tweede 4 weken, en 29 in de periode van meer dan 8 weken na een gebroken heup. Een hogere/lagere score betekent meer/minder valangst. In deze drie periodes is de prevalentie van valangst tamelijk hoog, namelijk achtereenvolgens 62%, 68% en 59%. Het onderzoek geeft aan dat valangst veel voorkomt bij patiënten met een gebroken heup en is gecorreleerd met angst en zelfvertrouwen. Verder blijkt dat valangst het hoogste is tussen vier en acht weken na een gebroken heup.

Hoofdstuk 5 onderzoekt welke factoren de verschillen verklaren tussen veel en weinig valangst na een gebroken heup. Dezelfde steekproef uit de cross-sectionele studie, die ook in hoofdstuk 3 is gebruikt, is hier geanalyseerd. Patiënten zijn verdeeld in twee groepen, een groep ouderen met weinig valangst en een groep ouderen met veel valangst. Gegevens omtrent factoren die gerelateerd zouden kunnen zijn met valangst zijn verzameld, zoals demografische gegevens, gegevens omtrent functioneren, psychologische factoren en co-morbiditeit. De analyse laat zien dat het loopvermogen voor de heupfractuur, activiteiten van het dagelijks leven na de fractuur en angst onafhankelijk van elkaar geassocieerd zijn met valangst. Met name omdat de laatste twee factoren te beïnvloeden zijn, kan deze informatie behulpzaam zijn bij het ontwikkelen van specifieke interventies bij ouderen met veel valangst.

Valangst wordt ook beschouwd als een belangrijk obstakel voor succesvolle revalidatie bij andere groepen van ouderen die revalideren in een verpleeghuis. Vandaar dat hoofdstuk 6 valangst onderzoekt in oudere patiënten met andere onderliggende ziektes, zoals een beroerte of na een orthopedische operatie. Hiervoor zijn patiënten onderzocht bij opname, bij ontslag en 4 weken na ontslag van de revalidatieafdeling. Met deze gegevens kon de prevalentie van valangst worden bepaald gedurende en na het revalidatietraject. Ook zijn verschillen tussen ouderen met en zonder valangst bestudeerd, evenals de relatie tussen valangst en participatie, dat wil zeggen het blijven doen van allerlei activiteiten na ontslag. Op basis van het antwoord op een 1-item instrument voor valangst zijn de patiënten ingedeeld in een groep zonder valangst en een groep met valangst. Voor de evaluatie van valangst na ontslag zijn zowel het 1-item meetinstrument gebruikt als de verkorte versie van de FES-I. Participatie werd beoordeeld met de Frenchay Activities Index (FAI). De studie laat significante verschillen zien tussen de groep van ouderen met en zonder valangst, ten aanzien van leeftijd, geslacht, diagnose, gemiddeld aantal vallen per week, depressieve symptomen en zelfvertrouwen. De analyse toont ook aan dat 4 weken na ontslag 82% van de patiënten valangst heeft. Als participatie na ontslag wordt gemeten, blijkt dat de FAI aanzienlijk lager is voor ouderen met valangst ten opzichte van ouderen zonder valangst. Daarom kan geconcludeerd worden dat valangst, onafhankelijk van de onderliggende ziekte, veel voorkomt bij ouderen die in een verpleeghuis revalideren. Valangst lijkt dus vrij persistent en kan gedurende het revalidatietraject soms toenemen, hetgeen participatie na ontslag in weg staat.

In hoofdstuk 7 worden de belangrijkste bevindingen nog eens opgesomd en besproken. Dit hoofdstuk gaat ook in op enkele methodologische en conceptuele zaken die in deze thesis aan de orde komen. Het laat zien dat het aantal studies over valangst nog steeds beperkt is en dat het meeste onderzoek naar valangst bij ouderen gebukt gaat onder een selectie bias, vooral omdat kwetsbare ouderen met veel co-morbiditeit bij deze studies meestal worden uitgesloten. In ons onderzoek zijn deze kwetsbare ouderen, die vaak in verpleeghuis revalideren, wel zoveel mogelijk meegenomen. Daarom ook geeft ons cross-sectioneel onderzoek meer inzicht in valangst bij ouderen na een gebroken heup. Bovendien worden de gegevens die in ons onderzoek geanalyseerd zijn vaak routinematig verzameld door behandelaren om de vooruitgang in de revalidatie te monitoren. Vandaar dat het relatief eenvoudig is om ook in de dagelijkse praktijk ouderen te identificeren die een hoger risico op valangst hebben.

Niet alleen in de literatuur, maar ook in de praktijk worden verschillende definities gebruikt voor valangst. Wij hebben de definitie van Tinetti gebruikt die valangst omschrijft als een "aanhoudende bezorgdheid over vallen die tot gevolg heeft dat een persoon activiteiten vermijdt die hij/zij nog steeds zou kunnen uitvoeren". Omdat we daarbij de FES-I als meetinstrument hebben gebruikt, kan het zijn dat sommige aspecten, zoals bijvoorbeeld de fysiologische en emotionele, slechts oppervlakkig zijn meegenomen in het onderzoek. Desalniettemin hebben de uitkomsten van deze thesis belangrijke consequenties voor zowel de klinische praktijk als voor toekomstig onderzoek. Deze thesis onderstreept bovendien het belang om valangst te meten bij alle patiënten gedurende de revalidatie. Metingen van valangst zouden daarbij niet alleen moeten plaatsvinden bij het begin van de revalidatie, maar gedurende het gehele revalidatieproces en na ontslag. De FES-I is hiervoor een geschikt meetinstrument.

Deze thesis benadrukt de behoefte aan longitudinale studies om de werkelijke determinanten van valangst te identificeren. Bovendien is het belangrijk om valangst gedurende een langere tijdsperiode te meten om het verloop beter te analyseren. Daarnaast is meer onderzoek nodig om de relatie tussen kwetsbaarheid en valangst beter te begrijpen. Dit vereist dat onderzoek zich meer moet richten op oudere patiënten met veel co-morbiditeit en op patiënten met cognitieve problemen. Mogelijk dat voor de laatste categorie van patiënten nieuwe meetinstrumenten nodig zijn. Echter het meest belangrijk is dat interventiestudies worden ontwikkeld en uitgevoerd om te bepalen of valangst verminderd kan worden. Betere resultaten kunnen dan worden behaald door het identificeren van ouderen met valangst en het aanbieden van een speciaal programma dat erop gericht is om valangst te reduceren.

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CURRICULUM VITAE

Jan Visschedijk was born on 4 september 1960 in Enschede, The Netherlands. He graduated in 1978 from Gymnasium-β of Jacobus College in Enschede. After one year Public Administration at the University of Twente, he was admitted at the Medical School of the University of Groningen. After his graduation as Medical Doctor in 1986 he started his preparation for medical doctor in Tropical Health. From 1989 onwards he worked for more than two years in surgical and obstetric departments of hospitals in Helmond and Apeldoorn. Subsequently he started working in African countries. First as a general medical officer in Serowe, Botswana, and later on as District Medical Officer in Senanga, Zambia.

From 1995-1996 he studied at the Harvard School of Public Health in Boston and graduated as Master in Public Health in International Health and Health Care Management. Subsequently he was active in international and tropical health at the World Health Organization, Geneva, Switzerland (1996-1998) and as public health consultant for the Royal Tropical Institute in Amsterdam (1998-2003). He continued to be active in international and tropical health, as a consultant for the Netherlands Leprosy Relief (2003-2007) and as treasurer and member of the board of the Netherlands Society for Tropical Medicine and International Health (2008 -2014).

In 2003 his career revolved into another direction: health care for older people. He completed his training for elderly care physician at the VU University Medical Centre, Amsterdam, while working for the Carinova-group in Deventer, The Netherlands. After graduation in 2005 he started working for Zorggroep Solis, Deventer, particularly focusing on geriatric rehabilitation. He successfully completed the special training (Kaderopleiding) for Geriatric Rehabilitation. Early 2011 he became first-responsible medical officer for Zorggroep Solis. By the end of 2013 he moved to the centre of Rotterdam to work for Zorggroep Laurens.

Since 2009 Jan is a junior researcher; initially at the Department of General Practice & Elderly Care Medicine of the VU University Medical Centre, Amsterdam, later on at the Department of Public Health and Primary Care of Leiden University Medical Center. In this capacity he did his research on fear of falling in older people after hip fracture.

Jan is married to Marique Belder. They have three children: Annabel, Christian and Rebecca.