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Longitudinal changes in physical activity levels and fear of falling after hip fracture

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Abstract

Background and purpose: Due to global ageing, more people will suffer from hip fracture in the future and many will be left with permanent physical impairments. The care burden for people post hip fracture is high. The aim of this study is to measure longitudinal changes in physical activity levels and fear of falling in people after hip fracture who return home after inpatient rehabilitation.

Methods: Longitudinal observational study. Participants were recruited from three rehabilitation centres in Victoria, Australia. Self-reported fear of falling (Short Falls Efficacy Scale – International) and physical activity levels (Human Activity Profile – Adjusted Activity Score and Frenchay Activity Index) were assessed at 2 weeks, 3 months and 6 months after discharge. Mobility (walking speed) and balance (Timed Up-and-Go test and Step Test) were measured at discharge from rehabilitation.

Results: Thirty-four participants (mean age 82 years (SD 8); 62% female) with unilateral hip fracture were recruited. Participants had moderately impaired balance and mobility at discharge compared to age-matched normative data; they were all discharged with a walking aid and were 40% slower in their walking speed. Participants had increased fear of falling and reduced physical activity 2 weeks after discharge, which improved significantly ($p < 0.01$) over the following six months, but scores were still lower than normative values. At six months, participants also had moderate to high levels of fear of falling and were less active than the general population of similar age.

Discussion: Although fear of falling and physical activity improved in the six months following discharge, both remained negatively affected compared to normative data. Rehabilitation post hip fracture should include routine assessment of fear of falling as a potential barrier for return of physical activities.

Keywords: fear of falling, hip fracture, activity level

Introduction

Epidemiological studies show the rate of hip fracture increases with age (Dhanwal, Dennison, Harvey, & Cooper, 2011; Kanis et al., 2012). Data from countries including Australia, Denmark, Japan and United States indicate hip fracture rates (% in population) have stabilised or started to decline in recent years (Abrahamsen & Vestergaard, 2010; Akushevich, Kravchenko, Ukraintseva, Arbeev, & Yashin, 2013; Brauer, Coca-Perraillon, Cutler, & Rosen, 2009; Crisp et al., 2012; Orimo et al., 2016). However, due to the ageing population, the actual number of patients admitted to hospitals for surgery following hip fracture continues to rise. For example, despite the stabilising hip fracture rate in Australia, the number of Australian sustaining hip fractures is projected to increase by 15% until 2036 (Sanders et al., 1999).

Hip fracture has a major impact on the individual, their family, and the wider community (Braithwaite, Col, & Wong, 2003; Hartholt et al., 2011; Tinetti & Williams, 1998). It often results in long term disability, reduced independence and quality of life, and increases the risk of death (Bertram, Norman, Kemp, & Vos, 2011; Dyer et al., 2016; Haentjens et al., 2010). The care burden of people after hip fracture is high. It impairs people's physical function and their quality of life as they have to cope with long term disability and loss of independence in daily life (Alexiou, Roushias, Varitimidis, & Malizos, 2018; Hartholt et al., 2011; Orive et al., 2015). Poor outcomes after hip fractures are magnified by pre-existing balance and mobility problems (O'Loughlin, Robitaille, Boivin, & Suissa, 1993; Stalenhoef, Crebolder, Konottnerus, & van der Horst, 1997) and co-morbidities. There is increased mortality and decreased function in older people after hip fracture (Braithwaite et al., 2003; Eastwood et al., 2002; Hannan et al., 2001; Jette, Harris, Cleary, & Campion, 1987; Koot, Peeters, de Jong, Clevers, & van der Werken,

2000; Magaziner et al., 2000; Magaziner, Simonsick, Kashner, Hebel, & Kenzora, 1990; Michel et al., 2000; Norton, Campbell, Lee-Joe, Robinson, & Butler, 1997), and the recurrent fall rate may be as high as 50% within the first six months after hospitalisation (Colon-Emeric et al., 2000; McKee et al., 2002; Shumway-Cook, Ciol, Gruber, & Robinson, 2005). Less than 40% of patients after hip fracture regain their pre-morbid function after one year (Eastwood et al., 2002; Jette et al., 1987; Koot et al., 2000; Magaziner et al., 1990).

Although only 1% of falls result in a hip fracture, over 90% of hip fractures are caused by a fall (Nevitt, Cummings, & Hudes, 1991; Norton et al., 1997). Factors associated with an increased risk of falling, such as balance impairment, reduced physical activity, and fear of falling are prevalent in people after hip fracture. These factors also predispose this group to subsequent falls and risk of injuries in the longer term (Deandrea et al., 2010; Friedman, Munoz, West, Rubin, & Fried, 2002; Petrella, Payne, Myers, Overend, & Chesworth, 2000; Rubenstein, 2006).

Standard in-patient rehabilitation focuses on managing pain and regaining sufficient function to return to community living (Chong et al., 2013; Halbert et al., 2007; Lau, Fang, & Leung, 2013). Rarely are increased fear of falling and reduced physical activity in the community considered in the care pathways for patients after hip fracture (Petrella et al., 2000; Scheffers-Barnhoorn et al., 2017). Fear of falling, or fear avoidance of activities, have a negative impact on health and physical function, and could predict future falls in both the general (Boyd & Stevens, 2009; Delbaere, Crombez, Vanderstraeten, Willems, & Cambier, 2004) and post hip fracture populations (McKee et al., 2002; Petrella et al., 2000).

Having a better understanding of the natural progression of physical activity levels and fear of falling at each stage of recovery following hip fracture may assist clinicians to better understand the therapy needs of those who have sustained hip

fractures and to better plan rehabilitation management in collaboration with their patients.

The primary aim of this study was to investigate longitudinal changes in physical activity levels and fear of falling during the first six months of returning home to community living after in-patient rehabilitation for patients after hip fracture. A secondary aim was to describe participants' balance and mobility at discharge from in-patient rehabilitation.

Methods

Study design

A longitudinal observational study with convenience sampling was conducted between June 2011 and October 2012. Human Research Ethics Committees at the participating centres (Northern Health: A53/70; Barwon Health: 10/132) approved the study and all participants provided written informed consent.

Subjects

Participants were recruited from three inpatient rehabilitation centres in Victoria, Australia. Two centres were in metropolitan areas and one was in a regional area. Participants completed multidisciplinary inpatient rehabilitation after their hip fracture, which aimed to promote functional independence to adequately prepare them for community living. The emphasis during rehabilitation was on discharge planning and ensuring patients achieved independence in mobility and self-care tasks (Taylor, Harding, Dowling, & Harrison, 2010). All participants were referred for ongoing community-based rehabilitation after discharge.

Participants were eligible for inclusion in this study if they had sustained a hip fracture following a fall (Bergström, Björnstig, Stenlund, Jonsson, & Svensson, 2008), were aged 60 years or over, and were preparing for discharge from the rehabilitation centre to community living (either in their own home or a family home). Participants were excluded if they had low English proficiency, a cognitive impairment recorded in their medical record, or low level of pre-fracture mobility (unable to walk more than 10 meters indoors independently with or without a gait aid). Exclusion of low pre-morbid mobility was to prevent it as a confounding factor for reduced mobility level post hip fracture.

Procedure and materials

At discharge from rehabilitation, participants' balance and mobility were assessed by their treating physiotherapist using three standardized outcome measures: the Timed Up-and-Go Test (TUG) (Podsiadlo & Richardson, 1991), Step Test (Hill, Bernhardt, McGann, Maltese, & Berkovits, 1996), and walking speed (meters/second) using either six- or ten-meter walk test (Steffen, Hacker, & Mollinger, 2002) (the three sites used two different distances for measurement of gait velocity). Fear of falling, physical activity levels and the number of falls sustained using a falls diary were assessed, and data collected using questionnaires administered by post, at two weeks (to allow for a settling in period after returning to community), three months, and six months following discharge from rehabilitation. Fear of falling and physical activity levels were assessed using questionnaires administered by post at two weeks (to allow for a settling-in period after returning to community), three months, and six months following discharge from rehabilitation. The number of falls was assessed using a falls diary.

Fear of falling was measured by the Short Falls Efficacy Scale – International

(Short FES-I) (Kempen et al., 2008). This outcome comprises seven questions about how concerned the respondent is about falling when performing a range of activities, for example getting in and out of a chair. It is a validated measure of fear of falling in older populations (Kempen et al., 2008). Scores range from 7 to 28, with a higher score representing higher degree of concern.

Physical activity levels were measured by the Human Activity Profile Adjusted Activity Score (HAP-AAS) and Frenchay Activities Index (FAI) self-report measures (Daughton, Fix, Kass, Bell, & Patil, 1982; Wade, Legh-Smith, & Langton, 1985). The Human Activity Profile comprises 94 activity items ranging from light to strenuous activities, and ordered in terms of increasing energy expenditure. Participants report whether they are “still doing”, have “stopped doing”, or “never did” each of the activities listed. The Human Activity Profile Adjusted Activity Score (HAP-AAS) is calculated by subtracting the cumulative number of lower intensity activities the participant has stopped doing from the Maximum Activity Score, which is the item number of the highest listed activity the participant is still completing. A change in score greater than 14 is considered clinically meaningful (Davidson & de Morton, 2007). The Frenchay Activities Index comprises 15 items, covering domestic chores, leisure, work, and outdoor activities. The questionnaire asks participants to report on the frequency of their participation in each of the activities in the past three or six months. Tallied scores range from 0 to 45, with 0 – 15 indicating inactive, 16 – 30 moderately active and 31 – 45 very active (Anderson, Jamrozik, Broadhurst, & Stewart-Wynne, 1994; Holbrook & Skilbeck, 1983). A change in score greater than 6.7 is considered clinically meaningful based on a chronic stroke population (Lu, Chen, Huang, & Hsieh, 2012). Both tools have been shown to demonstrate moderate to good reliability and validity in a range of populations including older people, though none

were specific to people post hip fracture (Davidson & de Morton, 2007; Miller, Deathe, & Harris, 2004; Piercy, Carter, Mant, & Wade, 2000; Turnbull et al., 2000; Wade et al., 1985).

Participants in their initial survey were asked to recall the number of falls they had in the 12 months prior to the hip fracture. Participants used a falls diary to document the number of falls they sustained during the study period (Batchelor, Hill, Mackintosh, Said, & Whitehead, 2012). The definition of a fall, as described by Lamb and colleagues (2005) was used, whereby “*an unexpected event in which the participants come to rest on the ground, floor, or lower level.*” The falls diary included the definition of a fall and questions about the timing, location and potential causes of a fall, as well as physical injury and loss of function from the fall. A follow-up phone call was made to participants if their falls diary was incomplete after receiving returned questionnaires to minimise missing data (Lamb et al., 2005). If a participant could not be contacted by telephone, a copy of the missing questions was posted to the participant. Prospective use of a falls diary is the recommended gold standard approach to obtaining falls data over time (Lamb et al., 2005). After review of the falls diaries, participants were categorised as fallers (those who had sustained one or more falls in the six months following discharge) or non-fallers.

Primary Outcomes

The primary outcomes for the longitudinal analyses were fear of falling (Short FES-I) and activity level (HAP-AAS, and FAI).

Data analysis

Descriptive analyses were conducted for each measure at each time point.

Balance and mobility outcomes at discharge were compared to normative data for healthy older people of similar age (Hill et al., 1996; Steffen et al., 2002). Bi-variate regression analysis was conducted using baseline demographics, balance and mobility measures, and the primary outcomes at six-months to identify potential confounding variables for the primary outcomes. Those confounding variables were then included in the mixed model analysis as fixed effect variables. Mixed model analysis was adopted to compare the change of primary outcomes (Short FES-I, HAP-AAS and FAI) at each follow up time-point and to accommodate for missing data at each follow up, particularly due to small sample size. Missing data for the follow-up time-points were imputed using multiple imputation (Lee & Carlin, 2010) using chained equations (White, Royston, & Wood, 2011) with 20 imputed datasets (Graham, Olchowski, & Gilreath, 2007). The effect size of adjusted means for each of the three primary outcomes was compared between fallers and non-fallers. Due to the small sample size, participants were dichotomised into two groups (fallers and non-fallers) based on their falls history in the six months post discharge from rehabilitation.

An a priori sample size calculation was conducted with an intended minimum sample size of $n=100$ in order to provide adequate power to include ten participants per variable (maximum of 10) in a multivariable logistic regression model. This sample size also accounted for a 20% loss to follow-up at each time point, and would have been sufficient to detect the clinically meaningful differences had they been observed.

Demographic and baseline data of participants who completed 6-month follow-up and those who did not were compared using t-test and Chi-square to ensure no systematic differences between groups.

Analyses were performed using Stata version 15.1 (StataCorp, College Station, Texas, USA), with a p-value of less than 0.05 indicating statistical significance.

Results

Of 192 patients with hip fracture admitted for rehabilitation during the study period, 75 met the inclusion criteria, 44 consented to participate, and 34 (44% of eligible participants) completed the two-week post discharge assessment. Enrolled participants had an average age of 82 years (± 8), 21 were female; 12 participants (35%) had sustained a fall in the 12 months prior to their hip fracture, and 22 participants (65%) required a four-wheeled walking frame in order to ambulate at discharge (Table 1). The age and gender of the patients who met the inclusion criteria but did not consent to participate (mean age 83 years (SD 7); 75% female) were not significantly different to those who participated ($p > 0.05$). The main exclusion criteria were unable to speak English (36%) and impaired cognition (26%). Eight participants (24%) were lost to follow up; four did not return questionnaires at three-months, and another four did not return questionnaires at six-months.

Twenty-six participants completed the six-month assessment. T-test and Chi-square showed no significant differences in the demographic and baseline mobility data of participants who completed 6-month follow-up and those did not (all p -values > 0.05), except for length of stay ($p = 0.03$), where participants who completed 6-month follow up had longer length of stay (median 33.5; IQR 27-44.3) than those who did not (median 24; IQR 21.8-32.5).

Balance and mobility at discharge

At discharge, participants' balance and mobility were substantially worse than age-matched normative data (Table 2) (Deandrea et al., 2010; Hill et al., 1996; Steffen et al., 2002). All participants were discharged home with a walking aid (Table 1). Their average walking speed was 40 per cent slower, the time to complete the TUG was twice as long, and the steps completed in the Step Test were less than half that reported for people of similar age living in the community (Deandrea et al., 2010; Hill et al., 1996; Steffen et al., 2002).

Falls, physical activity level and fear of falling over time

Overall, participants showed positive trends of improvement in fear of falling and activity levels over six months period post discharge (Table 3).

Participants showed significant improvements in fear of falling (FES-I) at three-months (-2.1, 95% CI: -3.6 to -0.6, $p=0.005$) and six-months (-3.0, 95% CI: -4.6 to -1.5, $p<0.001$). Participants also had significant improvements in activity levels at both time points when compared to discharge (Table 4). When comparing fallers and non-fallers, non-fallers maintained significant improvements in all outcome measures over time, whereas fallers showed significant improvements in fear of falling (3-months: $p=0.046$, 6-months: $p=0.007$), but not for physical activity. There was no statistical significance in improvement of all outcome measures found between fallers and non-fallers over time (all p -values ≥ 0.30).

Despite the statistically significant improvements in all outcome measures over time, at six-months, participants still demonstrated increased fear of falling and reduced activity levels compared to normative data for people of similar age living in community (Table 3). The adjusted mean score of 10.5 (95% CI: 9.1-12.0) for fear of falling demonstrates moderate to high concern about falling (Delbaere, Close, Mikolaizak, et al., 2010). Participants also demonstrated reduced physical

activity levels compared to older adults of similar age living in community, with both FAI and HAP-AAS scores about 20 to 30 percent lower than normative data (Jongjit, Komsopapong, Songjakkaew, & Kongsakon, 2003; Smith, Galea, Woodward, Said, & Dorevitch, 2008). As the changes in HAP-AAS and FAI scores over the six month period were 10 and 6.1 respectively, they were not considered clinically meaningful.

Seven participants (21%) reported having at least one fall during the six months after discharge with 12 falls in total. The recurrent fall rate (falling post discharge) was 13% within two weeks of discharge, 15% between two weeks and three months, and 21% between three and six months after discharge.

Discussion

Despite statistically significant improvements in the first six months after discharge, the changes in participants' physical activity levels were not clinically meaningful and remained substantially reduced compared to normative data (Brouwer, Walker, Rydah, & Culham, 2003; Davidson & de Morton, 2007; Jongjit et al., 2003). According to Davidson and de Morton's systematic review (2007), our participants showed statistically significant improvement (>6.8 points for HAP-AAS) in energy-taxing activity level in the first three months, with further gradual but insignificant improvement in three to six months; despite the improvement, the overall result at six month demonstrated the hip fracture participants were clinically meaningfully (> 14 points for HAP-AAS) less active compared to normal population of similar age. The participants were also only moderately active in completing instrumental activities of daily living as measured by FAI compared to their very active age-matched counterparts in community (Anderson et al., 1994;

Holbrook & Skilbeck, 1983). This is consistent with other studies, showing that, regardless of their pre-morbid mobility, less than 50% of older adults returned to their pre-morbid physical function in activities of daily life (ADLs), mobility and stair climbing one year post hip fracture (Tang et al., 2017). These results highlight the importance of understanding the barriers to recovery for older adults post hip fracture. Additionally, the potential value of longer-term or more intensive community rehabilitation, including a focus on fear of falling and physical activity optimisation is evident, given the slow nature of recovery, in order to maximise function and reduce the long-term care burden on individuals, families and society.

Despite improvement over the follow-up period, participants had increased fear of falling six months post discharge compared to normative data. It has been shown that increased fear of falling later in the recovery period may be more predictive of poor functional recovery than that assessed immediately after hip fracture (Voshaar et al., 2006), highlighting the importance of exploring and dealing with such fears throughout the recovery journey. Although not everyone with reduced physical function would experience fear of falling, as many as 50% of patients after hip fracture had increased fear of falling (Visschedijk, Achterberg, van Balen, & Hertogh, 2010), and it is commonly associated with activity avoidance and disability in older people recovering from a hip fracture (Jellesmark, Herling, Egerod, & Beyer, 2012). Fear of falling also affects people with high pre-morbid physical function. Bower and colleagues (2016) found increased fear of falling at 12 weeks post fracture is predictive of poor functional recovery at one year, particularly in people with high pre-morbid physical functioning. Delbaere and colleagues (2010) also found that compared to those with low fear of falling, community dwelling older adults with increased fear of falling had higher injurious

fall rates. Therefore, fear of falling should be routinely assessed and managed after hip fracture as it is predictive of functional recovery and has been identified as a barrier to physical activity participation (Tang et al., 2017; Voshaar et al., 2006).

Participants with hip fracture in this study were discharged home with impaired dynamic walking balance (Table 2). Based on the predictive value of a TUG score of greater than 24 seconds in the post hip fracture population (Kristensen, Foss, & Kehlet, 2007), more than half of the participants in this study were at risk of a subsequent fall within the six months following their hip fracture. Seven participants (21%) did experience one or more falls, highlighting the importance of adequate falls prevention education and strategies prior to discharge and routine community follow up post discharge to address increased falls risk.

With less than half of hip fracture patients returning to their pre-morbid physical function after one year (Bernhardt et al., 2005; Tang et al., 2017), longer-term community or home-based services should be explored to maximise recovery in people after hip fracture. Studies have explored the effect of extended therapy, both in the centre or at home post standard hip fracture rehabilitation services and showed positive results for improving and maintaining physical function (Binder et al., 2004; Latham et al., 2014). A year-long multicomponent home-based rehabilitation program, aiming to replace the weekly centre-based community rehabilitation, showed positive results in functional recovery (Salpakoski et al., 2014), that were preserved at one year follow up (Turunen et al., 2017).

Limitations

Due to sampling resource constraints with two of the three recruitment sites have a large non-English speaking background community, data collection was slower

than expected. The study closed with a smaller than expected sample size ($n=34$), when the time and resources to complete the study were exhausted. As stated in the discussion, the differences in outcome measures observed at 3 months and 6 months reached statistical significance for the non-fallers with this lower than intended sample size, but failed to reach statistical significance for the fallers. Given these results fell well short of a level that would be considered to be clinically meaningful (>14 for HAP-AAS and >6.7 for FAI) there was no need to consider any post-analysis power calculations.

Another limitation of this study is in the comparison to normative data. The normative data used as a comparison for the Step Test had participants with a mean age approximately 10 years younger than the average age of those recruited for this study. There may be some age-related changes that account for the differences noted between groups. Additionally, the results may not be generalisable to patients with hip fractures of all causes, especially those who were excluded from this study with poor pre-morbid mobility, cognitive impairment, those discharged to low or high level care, or those excluded due to a lack of proficiency in English. Almost 25 per cent of participants were lost to follow-up at the 6-month assessment. To account for this, mixed model analysis was used to maximise statistical power and accommodate for loss to follow up, with no indication that data were missing in a non-random manner. While the outcome measures for activity levels were self-report measures, and perhaps may not reflect a participant's true capacity, the measures do indicate participants' views on their health status, and provide valuable information on physical activities they are engaging in at home, following hip fracture.

The analysis and comparison between fallers and non-fallers was retrospective due to small sample size. It might not be reflective of real-time differences

between fallers and non-fallers at each time point but provides an overview of the changes over time as a cohort. Further, best practice guidelines (Lamb et al., 2005) recommend that data from fall diaries should be supplemented by phone calls every 2-4 weeks to ensure accurate reporting or by interviewing participants. Although efforts were made to minimise missing data about falls by contacting participants by telephone at each follow up time point if returned data was incomplete, it is possible that falls were not optimally recorded.

Conclusion

We tracked the self-reported physical activity of patients with hip fracture after rehabilitation and returning home. At the time of discharge home from rehabilitation, patients after hip fracture have impaired balance and mobility, reduced activity levels and increased fear of falling. Although fear of falling and activity levels improved significantly over the subsequent six months, they remained moderately reduced at six-month post discharge. More attention should be paid to fear of falling as a potential barrier for physical activity progression and participation in rehabilitation post hip fracture. Longer-term or more intensive rehabilitation might be necessary to address these deficits, minimise falls risk and maximise functional independence; evaluating the effectiveness of modified rehabilitation strategies in patients following hip fracture will be necessary.

Implications for Physiotherapy Practice

- Physiotherapists working in subacute and community settings should consider fear of falling as part of their routine assessment for patients post hip fracture to explore possible psychological factors preventing them from

achieving their activity goals.

- Community Physiotherapists should consider offering longer-term community rehabilitation programs to patients post hip fracture who are still significantly below their pre-morbid physical activity levels and have elevated fear of falling.

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Table 1. Demographic information at discharge from rehabilitation.

Characteristics	n= 34
Age (<i>years</i>), mean (SD)	82 (8)
Gender, n female (%)	21 (62)
Participants who fell more than once in past 12-month ^a , n (%)	12 (35)
Type of fracture	
- Subcapital, n (%)	18 (53)
- Intertrochanteric, n (%)	8 (23.5)
- Others ^b , n (%)	8 (23.5)
Total length of stay (<i>days</i>) ^c , median (IQR)	30.5 (25.5-40.5)
Number of other medical conditions, median (IQR)	2.5 (1-4)
Number of prescribed medications at discharge, median (IQR)	7 (6.5-9)
Walking aid	
- Four-wheeled walking frame, n (%)	22 (64.7)
- Single point stick, n (%)	6 (17.6)
- Two-wheeled walking frame, n (%)	4 (11.7)
- Two forearm crutches, n (%)	2 (6)

^a Fall(s) in addition to the fall causing hip fracture.

^b Others included transcervical, pertrochanteric and subtrochanteric fractures.

^c Total length of stay included the length of stay in an acute hospital and in rehabilitation.

Table 2. Balance and mobility at discharge from rehabilitation compared to normative data.

	People after hip fracture (n=34)	Normative data
Timed up-and-go test (s), mean (SD)		
Male (n=13)	21.7 (5.5) (mean age 81.4, SD 8.6)	10 (1) (Steffen et al., 2002) (age range 80-89)
Female (n=21)	29.1 (7.7) (mean age 81.5, SD 7.3)	11 (3) (Steffen et al., 2002) (age range 80-89)
Step test (no of steps), mean (SD)		
Operated leg up (n=33) ^a	8 (2)	Right leg: 18 (3) (Hill et al., 1996) Left leg: 17 (3) (Hill et al., 1996) (mean age 72.5, SD 4.1)
Operated leg supporting (n=32) ^b	7 (3)	Right leg: 18 (3) (Hill et al., 1996) Left leg: 17 (3) (Hill et al., 1996) (mean age 72.5, SD 4.1)
Walking speed (m/s), mean (SD)		
Male (n=13)	0.8 (0.3) (mean age 81.4, SD 8.6)	1.2 (0.2) (Steffen et al., 2002) (age range 80-89)
Female (n=21)	0.6 (0.2) (mean age 81.8, SD 7.0)	1.2 (0.2) (Steffen et al., 2002) (age 80-89)

^a Missing data due to one participant being discharged without completing discharge assessment.

^b Missing data due to one participant being discharged without completing discharge assessment, and one participant was on protected weight bearing and excluded from analysis.

Table 3. Outcome measures at 2 weeks, 3 months and 6 months after discharge from rehabilitation compared to normative data.

Measure	Group	Timepoint ^a			Normative data
		2 weeks	3 months	6 months	
Short FES-I	Overall	13.6 (12.3-14.8)	11.4 (10.1-12.8)	10.5 (9.1-12.0)	9.4 (SD 3.0) (Delbaere, Close, Mikolaizak, et al., 2010) (mean age 78.0, SD 6.1)
	Non-Fallers	11.9 (10.5-13.3)	10.0 (8.6-11.5)	9.5 (7.9-11.1)	
	Fallers	16.5 (14.6-18.3)	13.9 (11.8-16.0)	12.4 (9.8-15.0)	
HAP-AAS	Overall	30.8 (26.4-35.2)	37.6 (32.8-42.4)	40.0 (34.3-45.7)	58 (IQR 17) (Brouwer et al., 2003) (mean age 80.1, SD 5.8)
	Non-Fallers	33.8 (28.8-38.8)	41.6 (36.2-47.1)	44.8 (38.8-50.8)	
	Fallers	25.3 (18.6-32.1)	30.2 (22.7-37.8)	31.1 (22.3-39.9)	
FAI	Overall	20.1 (17.1-23.2)	24.5 (21.3-27.7)	26.1 (22.8-29.4)	31.0 (6.0) (Jongjit et al., 2003) (mean age 75.7, SD 9.0)
	Non-Fallers	21.7 (17.9-25.4)	26.9 (22.9-30.9)	28.4 (24.2-32.5)	
	Fallers	17.3 (27.1-22.6)	20.1 (14.5-25.7)	22.0 (15.6-28.3)	

^a Mean (95% Prediction Interval)

Note: Variables included in mixed model analysis for each outcome measure are as follows:

for FES-I – number of medications, walking aid used, ability to perform Step Test with operated stepping up;

for HAP-AAS – nil variables identified;

for FAI – other medical conditions and walking aid used.

Table 4. Effect size of outcome measures over six month including fallers and non-fallers.

Measure	Group	Change over time ^a			
		2 weeks to 3 months		2 weeks to 6 months	
		Change	p-value	Change	p-value
Short FES-I	Overall	-2.1 (-3.6 to -0.6)	0.005	-3.0 (-4.6 to -1.5)	<0.001
	Non-Fallers	-1.9 (-3.7 to -0.1)	0.041	-2.4 (-4.4 to -0.5)	0.014
	Fallers	-2.5 (-5.0 to 0.0)	0.046	-4.1 (-7.1 to -1.1)	0.007
HAP-AAS	Overall	6.8 (2.2 to 11.5)	0.004	9.2 (3.6 to 14.8)	0.002
	Non-Fallers	7.9 (2.2 to 13.5)	0.007	11.0 (4.8 to 17.2)	0.001
	Fallers	4.9 (-3.0 to 12.8)	0.221	5.8 (-3.3 to 14.9)	0.213
FAI	Overall	4.3 (1.2 to 7.5)	0.007	5.9 (2.6 to 9.3)	<0.001
	Non-Fallers	5.2 (1.3 to 9.2)	0.009	6.7 (2.6 to 10.7)	0.001
	Fallers	2.7 (-2.6 to 8.1)	0.314	4.6 (-1.5 to 10.7)	0.136

^a Effect Size of Mean Change (95% confidence interval)

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