Predictors of long-term functional decline post-fall in older community-dwelling people

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ONDERGETEKENDE

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Bevestigt hierbij dat de onderhavige verhandeling mag worden geraadpleegd en vrij mag worden gefotokopieerd. Bij het citeren moet steeds de titel en de auteur(s) van de verhandeling worden vermeld.

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A review of predictors of long-term functional decline post-fall in older community-dwelling people

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Samenvatting

Aanleiding: Ouderen die wegens letsel na een val op de Spoedeisende Hulp worden gezien hebben een verhoogd risico op verminderd fysiek functioneren. De risicofactoren voor verminderd functioneren zijn echter grotendeels onbekend. Deze literatuurstudie geeft daarom een samenvatting van risicofactoren voor verminderd fysiek functioneren op de lange termijn. Het betreft risicofactoren voor ouderen na een val waarvoor geen ziekenhuisopname nodig is.

Methode: Cohortstudies gepubliceerd tot november 2008 zijn systematisch gezocht en geïdentificeerd in CINAHL, PsycINFO, MEDLINE, EMBASE en Social Sciences Index. Studies die predictoren beschrijven voor verminderd fysiek functioneren van ouderen op de lange termijn, na een val, zijn geïncludeerd. Resultaten zijn weergeven voor follow-up na 12 maanden en 36 maanden.

Resultaten: De 7 geïncludeerde studies beschrijven 4 samples, waarin 34 predictoren zijn getoetst. Sample grootte varieerde van 93 tot 832 deelnemers. De gemiddelde leeftijd was 70.2 tot 78.7 jaar. Het percentage vrouwen varieerde van 55 to 82%. De meeste predictoren werden in één enkele studie getoetst. Ongeveer 56% van alle risicofactoren was statistisch significant. Significante variabelen waren: vrouwelijk geslacht, leeftijd, beperkingen op baseline, een val met letsel, herhaald vallen en depressieve symptomen.

Conclusie: Significantie van de gevonden predictoren dient te worden bevestigd middels prospectief onderzoek in andere samples. Deze factoren kunnen worden gebruikt ter identificatie van groepen met verhoogd risico op verminderd fysiek functioneren op de lange termijn. Interventies om het fysiek functioneren te optimaliseren dienen te worden ontwikkeld en vervolgens te worden geëvalueerd.

Abstract

Background: Older people presenting to an Emergency Department after a fall are at high risk of functional decline. However, risk factors for functional decline in this group are relatively unknown. This review investigates the literature for predictors of long-term decline in physical function in older people who sustained a fall, not necessitating hospital admission.

Methods: Cohort studies published till November 2008 were identified through a systematic search in CINAHL, PsycINFO, MEDLINE, EMBASE and Social Sciences Index. Studies reporting on predictors of long-term decline after a fall in older people were included. Results were summarised for follow-up periods of 12 months and 36 months, respectively.

Results: The 7 studies included described 4 samples, testing 34 predictors. Sample size ranged from 93 to 832 subjects. Mean age of the study samples ranged from 70.2 to 78.7 years. The percentage of females varied from 55 to 82%. Most variables were evaluated in one sample only. About 56% of all factors were statistically significant. Variables predictive of long-term decline were female gender, age, baseline disability, sustaining an injurious fall or sustaining multiple falls, and depressive symptoms.

Conclusion: The predictors found to be significant should be confirmed in other samples, using a prospective design. These factors can be used to identify people at higher risk of long-term functional decline. Interventions to optimise level of physical function and to prevent further falls should be developed and evaluated.

Introduction

The proportion of people of 60 years and older is estimated to rise from 20.1% in 2005 to 32.6% in 2050 in the world's more developed countries [1]. Falls are one of a number of health problems that occur more commonly with increasing age [2-4]. With the ageing population, the number of older people sustaining a fall is becoming a growing problem. Approximately 30% of adults aged 65 years and older who are living in the community experience a fall at least once a year [2-4]. About 20% to 30% of those people suffer moderate to severe injuries [4, 5]. Experiencing at least one injurious fall has been found to be associated with decline in physical activity [6]. A prospective study found that pre-injury levels of functioning were not regained in community-dwellers one year after a fall [7].

In persons aged 65 years and older, falls account for 62% of all nonfatal injury emergency department (ED) visits [8]. Older people presenting to an ED with minor injuries (i.e. not necessitating admission to the hospital wards) have been found to be at risk of decline in functioning, with approximately 20% experiencing functional decline at 3 months follow-up [9].

Long-term reduction in mobility after an injury has been found to lead to reduced quality of life [10] and the onset of depression [11]. As such, knowledge of risk factors for long-term functional decline is required. This knowledge could be used to target interventions, aiming to optimise levels of physical function, to prevent long-term functional decline. However, predictors of long-term decline (i.e. 12 months post-fall) in community-dwelling older people after a fall are relatively unknown.

The objective of this study was to review the literature for predictors of long-term decline in level of physical function in older community-dwelling people who sustained a fall not necessitating hospital admission.

Materials and methods

For this review, both observational studies reporting predictors of long-term decline in physical function were considered, and studies reporting on data from a control group (not receiving an intervention) in randomised or clinical trials. Long-term was defined as reporting on follow-up periods of 12 months or longer. No language restrictions were made. Studies reporting on data about community-dwelling adults aged 60 years and older who sustained a fall were included. Both studies including people who sustained a fall, and studies comparing people who did and did not fall, were considered. The required dependent variable was self-reported or objectively measured decline in level of physical function. The ability or inability to perform ADLs, decline in ADLs, functional dependence or independence, decreased recovery of function, or functional decline were considered to be outcome measures of decline in physical function. Independent variables were classified as either 1) demographic and biological, 2) psychological, cognitive and emotional 3) behavioural, 4) social and cultural, or 5) physical environmental, as proposed by Sallis et al. [12]. Studies using a cross sectional design and studies reporting on in-patients or persons requiring hospital admission were excluded.

CINAHL, PsycINFO, MEDLINE, EMBASE and Social Sciences Index were searched. Reference lists in studies included and in reviews of relevant literature were screened for relevant articles. Key words (thesaurus terms, text words and truncated text words) that were used for the database searches were: recovery of function, functional decline, motor activity, human activities, activities of daily living, leisure activities, and physical activity. Key words to reduce findings to the aged population were: aged, frail elderly, elderly, old, geriatric, and frail. Key words to reduce findings to studies reporting risk factors were: risk factors and predictor.

The first reviewer assessed the titles and available abstracts of all studies identified by the cross-database search and irrelevant studies were excluded. Studies were considered irrelevant if it was clearly indicated that the design, participants, or outcome measures were different from the inclusion criteria. The abovementioned a priori defined inclusion and exclusion criteria were used to assess full-text copies of potentially relevant studies.

Design of the study, number of participants, characteristics of the participants and outcome measures (both independent and dependent variables) were extracted. Measures of relationships that were extracted included regression coefficients and their confidence interval, odds ratios and their confidence interval, relative risks and their confidence interval, and ANOVA's. Additionally, measures of significance were extracted. The first reviewer extracted the data using a tested modified version of the Renal Group Data Extraction Form [13]. An example of this data-extraction form is available from the author upon request. A second reviewer checked the data that were extracted. Disagreements between the two reviewers were discussed until consensus was reached. If necessary, the first author of a study was contacted for additional information.

No generally accepted tool to assess methodological quality of studies included is available [14]. Besides, it is unclear which items from checklists could be used to discriminate between high and low quality studies, due to the lack of evidence for bias or inferential error caused by the separate items [14]. Therefore, data from studies were coded and summarised, following a modified method published by Sallis et al. [12], irrespective of methodological quality. This method classifies variables regarding strength of evidence of association with physical activity. Modification consisted of reporting predictors of physical function rather than correlates of physical activity. The number of studies supporting a predictor was divided by the total number of studies reporting that potential predictor. If a significant predictor was found 0% to 33% of the time, no significant predictor was evident. This was indicated with a "-". If a significant predictor was found 34% to 59% of the time, the evidence for a predictor was inconsistent or

indeterminate, the "?" code was used. Finally, if a significant predictor was found 60% to 100% of the time, the evidence for the predictor would be considered consistent, and scored "+" [12].

Results

Searching databases up to November 2008 and screening reference lists yielded 352 articles. First, based on title and abstract, 336 irrelevant studies were excluded. Then full-text copies of the remaining 16 studies were screened, and 9 studies were excluded. Reasons for exclusion were: no measure of decline in physical function was used [15-17], a cross-sectional design was used to investigate predictors of short-term decline [18], participants were in-patients [19], no predictors were presented [7, 20], and the decline was not fall related [21, 22]. Screening of the reference lists yielded one more article [23]. This article was excluded after reading full-text, as the mean follow-up period was less than 12 months and some participants required hospitalisation. Therefore, seven studies were eligible for inclusion in this review.

Characteristics of the studies included are shown in table 1. All studies were cohort studies, and all but one [29] reported a prospective data collection. Sample size ranged from 93 to 832 subjects, with a mean of 257 (SD±255.4) subjects. Mean age of the study samples ranged from 70.2 to 78.7 years. One study [6] did not report demographic characteristics of the full sample, but included participants over 71 years of age. The mean age of all other participants included was 72.4 years. Percentage of females varied from 55 to 82%. All outcome measures were self-reported and four different measurement instruments were used. Of these instruments, two were validated. Follow-up was at 12 months [6, 24-28] and at 36 months [6, 29]. Two studies used univariate analysis (ANOVA) to investigate change in disability [24] and level of disability [27], respectively. Results were adjusted for confounders. The other studies [6, 25, 26, 28, 29] used a multiple regression model, including different sets of predictors. All four publications by Kempen et al. [24-27] described the same population, as confirmed by the first author, but used different analysis strategies, and different sets of predictors.

Between one and eight predictors were reported in each study, with a median of 3.5 (SD±2.6). Of 34 tested predictors, 19 were statistically significant (56%). Nine predictors at 12 months follow-up were each investigated in a single study only, and four of those predictors were statistically significant (44%). All eight predictors at 36 months follow-up were each tested in a single study. Five out of those eight predictors were statistically significant (63%).

Table 2 summarises the predictors of long-term decline at 12 months follow-up. The most often tested predictor was gender, reported in three studies [25-27].

Ten biological and demographical predictors were reported. Female gender was found to be a significant predictor in all three studies reporting this variable [25-27], hence there was consistent evidence for this variable. Age and baseline disability (i.e. pre-injury disability) were investigated in two studies [25, 26] and were both found to be consistently significant. Having sustained repeated falls, at least two non-injurious falls or at least one injurious fall were factors tested in one study each [6, 28]. These predictors were found to be significant. Evidence for severity of the injury was inconsistent with one study [26] reporting a non-significant effect and another study [25] reporting a significant effect. No evidence was found for the following factors: number of chronic conditions [25, 26], having sustained one fall [28] or one non-injurious fall [6]. The last two factors were each tested in a single study only.

Five psychological and cognitive factors were studied, with level of education being tested in two studies [24, 26]. The other factors were each reported in a single study. Depressive symptoms 8 weeks post-injury was the only significant psychological factor [25]. No evidence was found for the predictors depressive symptoms pre-injury [25], level of education [24, 26], cognitive functioning 8 weeks post-injury [25], and perceived control [26].

The only reported social factor was social support. This factor was investigated in two studies, with one study [24] reporting the factor to be a significant predictor, one study [26] finding it was non-significant. Hence, the evidence for this predictor was indeterminate.

Table 3 summarises the predictors of long-term decline in physical function at 36 months follow-up. Two studies [6, 29] reported follow-up data at 36 months. Seven demographic or biological predictors were tested, and one psychological factor. Each predictor was investigated in one of both studies.

Significant biological and demographic predictors were polypharmacy [29], sustaining at least two non-injurious falls [6], at least one injurious fall [6], or one non-injurious fall [6]. No evidence was found for the following factors: falls indoors [29], restricted physical activity [29] and lower performance test scores [29].

The psychological predictor depressive symptoms pre-injury was found to be significantly related to decline in physical function post-fall [29].

Discussion

This review identified predictors of decline in function post-fall in older community-dwelling people from seven (prospective) cohort studies. Biological and demographic factors were most often described, at both 12 and 36 months follow-up. One of the most notable results may be the high number of predictors at 12 months follow-up, 9 out of 16, being tested in a single study each. The remaining predictors were tested in multiple studies [24-27]. However, those articles used data from the same sample. Besides, at 36 months follow-up all predictors were tested in one of both studies included.

Significant predictors at 12 months follow-up were: female gender, age, baseline disability, depressive symptoms 8 weeks post-injury, sustaining either repeated falls, at least two non-injurious falls or at least one injurious fall. Consistent evidence was found for the following predictors at 36 months follow-up: polypharmacy, depressive symptoms pre-injury, and sustaining at least one non-injurious falls, or sustaining one injurious fall.

Female gender was a significant predictor of long-term functional decline. Results of the present review are similar with results from a systematic review by Hoogerduijn et al. [30] on risk factors for functional decline in older hospitalised people. That review included one study [31] testing gender as a predictor for long-term functional decline, and finding it to be significant. This result is in contrast with a systematic review by Stuck et al. [32] assessing predictors of new onset disability in the general older community-dwelling population. The current review and the one by Hoogerduijn et al. [30] included participants experiencing precipitating events (i.e. a fall or hospital admission). The review by Stuck et al. [32] did not include these specific groups. Precipitating events have previously been found to independently predict functional decline [21]. This variation in samples and differences in outcome measures may explain the difference.

Age was found as a significant predictor of long-term decline. This supports earlier findings of systematic reviews describing older community-living [32] and hospitalised people [30] and a prospective study investigating long-term functional decline in older community-dwelling people who sustained a fall [7].

Baseline disability predicted decline in function. This is in line with findings of a review about risk factors of decline in older hospitalised people [30]. A review of risk factors in the older community-living population [32] did not comprise baseline disability. However, this study reported that a strong predictor of decline was functional limitation, which is seen as an early predictor of subsequent disability according to the disablement process theory [33]. Results from the current review can, therefore, be considered to support results from both earlier reviews.

Depressive symptoms as a predictor of decline has been tested in various ways and in two different samples. Depressive symptoms pre-injury were found to be predictive of functional decline in one study [29], but not in another study [25]. Depressive symptoms at 8 weeks was a predictor of decline at 12 months [25]. Depressive symptoms pre-injury was found to be a significant variable in a bivariate analysis [25]. This predictor was no longer significant in a multivariate model including depressive symptoms 8 weeks post-injury and disability at baseline [25]. In a multivariate model without those two variables it remained significant [29]. Depressive symptoms at baseline and 8 weeks follow-up were strongly correlated, which may explain why depressive symptoms at baseline were no longer significant in the multivariate analysis [25]. Another important reason may be the strong predictive value of the factor baseline disability in that analysis [25]. The importance of baseline disability has been demonstrated previously [30, 32] and may have considerably influenced significance of depressive symptoms at baseline.

Sustaining falls as a predictor of decline has been tested in two studies [6, 28]. When sustaining one fall was compared with sustaining repeated falls, only the latter was

significant, at 12 months follow-up [28]. However, when falls were categorised into non-injurious and injurious falls, one non-injurious fall was not predictive whereas one injurious fall was predictive of decline [6]. This suggests a dose-response relationship, confirmed by the findings that also sustaining repeated falls [6, 28], and multiple injurious falls predicted functional decline [6].

Polypharmacy was a variable tested in only one of the studies included [29], and predicted functional decline at 36 months follow-up. No other studies, reviews or otherwise, including this predictor have been found. It is therefore unclear to what extent this factor significantly predicts functional decline in older people who sustained a fall, or the general population of older people.

The results of the current review showed indeterminate evidence for the predictor social support. Social support was found to be a significant predictor of recovery in a univariate analysis [24]. In a multivariate model assessing the same sample [26] age, gender and particularly baseline disability were significant predictors. Social support was no longer significantly predicting disability at 12 months follow-up when tested in a model comprising these factors. Therefore, social support may be a predictor of less importance than the factors age, gender and especially baseline disability.

Evidence for the predictive value of severity of the injury was indeterminate. Severity of the injury was a significant predictor in one multivariate model [25] and non-significant in another multivariate model [26] describing the same sample. The composition of the models in these studies partially differed. One study [26] included level of education, social support and perceived control. Another study [25] tested cognitive functioning, depressive symptoms at baseline and depressive symptoms 8 weeks post-injury. The varying composition of the models probably caused the differences in significance of severity of the injury, as regression coefficients of all predictors incorporated in both analyses differed between the models.

Clinical implications

The clinical implications of this study are that increased age, female gender and pre-injury disability, can be used to identify people at higher risk of long-term functional decline. Interventions can therefore be offered to those groups. Depression is a possibly modifiable factor predictive of decline. Screening for depressive symptoms might therefore be recommended to address interventions to this high-risk group. Furthermore, apart from aiming to optimise level of physical function, interventions should aim at preventing further falls, as this factor was found to predict long-term decline.

Future research

Further research using a prospective design preferably focuses on several aspects. Firstly, testing new possible predictors, as the number of risk factors investigated is relatively small. Secondly, further investigating significant predictors already identified, in other samples of older people who sustained a fall. Thirdly, developing and evaluating interventions to prevent long-term functional decline post-fall in older people.

Limitations

There are several limitations to this review. Firstly, four articles [24-27] described analyses of data from the same sample, though slightly varying in sample size. Therefore, this review included data from only four unique populations, which limits the generalisation of the conclusions. Secondly, only two studies [6, 29] reported follow-up periods of 36 months, and each study investigated different variables. In studies reporting on results at 12 months follow-up, 9 out of 16 predictors were tested in a single study. Caution is needed when interpreting predictors tested in a single study only. A single unidentified study testing the same variable could strongly influence the results. Thirdly, bias may have occurred due to methods used to obtain data [34]. The search has been designed and performed by only one reviewer [35] who was not blinded for

authors of studies or journals [36]. However, extracting data has been checked by and discussed with a second reviewer which may have decreased possible bias [34].

CONCLUSION

Most predictors were tested in a single study only, therefore additional studies in various samples are warranted to confirm these observations. In future research, the use of a validated measure of functional decline, preferably a generally accepted and used instrument, is recommended to enhance comparability across studies. Another factor allowing comparisons is the use of similar analytic strategies in various samples. The non-modifiable demographic and biological factors female gender, higher age and pre-injury disability show the possible high-risk groups for long-term functional decline post-fall. Another high-risk group is people reporting the modifiable factor depressive symptoms. These factors could be used by clinicians to identify those in need of additional interventions. This review also highlights the importance of preventing further falls injuries in this group of people at high risk of falls to prevent long-term decline.

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Table 1: Studies reporting on predictors of long-term decline in function post-fall in older community-dwelling people

Study	Design	Sample size	Mean age in years (SD)	Females in %	Outcome measure (instrument)	Follow-up in months	Analysis	Predictors
Kempen (2001) [24]	CS, p	171	70.3 (7.7)	81.9	Change in disability in ADLs (GARS)§	12	ANOVA	level of education social support covariates: age disability at baseline depressive symptoms cognitive functioning chronic medical morbidity severity of injury
Kempen (2003) [25]	CS, p	168	70.2 (7.8)	81.5	Difficulties with ADLs (GARS)§	12	HMRA	age gender disability at baseline number of chronic medical conditions level of injury depressive symptoms at baseline cognitive functioning 8 wk depressive symptoms 8 wk
Kempen (2003) [26]	CS, p	165	70.2 (7.8)	82.4	Difficulties with ADLs (GARS)§	12	HMRA	age gender disability at baseline number of chronic medical conditions severity of injury level of education social support perceived control
Kempen (2003) [27]	CS, p	171	70.3*	81.9	Level of disability (GARS)§	12	ANOVA	gender covariates:

								age baseline levels of BADL number of chronic medical conditions severity of injury social support time baseline-injury
Laird (2001) [28]	CS, p	93	74.5*	65.6	Functional decline (NHIS)¶	12	MRA	sustained one fall sustained repeated falls covariates: age
Stel (2004) [29]	CS	204	78.7 (6.3)	55	Functional decline (OECD)§	36	MRA	baseline functional status medication use depression physical activity performance test score falls inside covariates: age
Tinetti (1998) [6]	CS, p	832/696†	> 71‡	approx 70‡	Change in ADLs (14-item questionnaire)¶	12/36	HMRA	gender one non-injurious fall at least two non-injurious falls at least one injurious fall covariates: demographic factors # health related factors ** cognitive factor (MMSE) physical performance tests psychological factors††

SD: standard deviation, CS: cohort study, p: prospective, GARS: Groningen Activity Restriction Scale, ANOVA: analysis of variance, HMRA: hierarchical multiple regression analysis, 8 wk: 8 weeks post-injury, NHIS: functional status items of the National Health Interview Survey, MRA: multiple regression analysis, OECD: OECD indicator of chronic functional limitations, MMSE: Mini-Mental Status Examination
*:SD unknown, †:at 12 months and at 36 months, ‡:characteristics not specified per sample, §:validated, ¶:non-validated, #: age / gender / race / education / marital status / housing type, **: number of chronic conditions / body mass index / visual impairment / hearing deficit / number of noninjury hospitalisations during follow-up, ††: depression / anxiety

Table 2: Summary of predictors of long-term decline in function post-fall in older community-dwelling people at 12 months follow-up

Predictor	**Study**	**Summary code**
Demographic and biological factors		
Female gender	Kempen[25]* Kempen[26]* Kempen[27]*	+
Baseline disability	Kempen[25]* Kempen[26]*	+
Sustained repeated falls	Laird[28]*	+
Sustained at least two non-injurious falls	Tinetti[30]*	+
Sustained at least one injurious fall	Tinetti[30]*	+
Age	Kempen[25]* Kempen[26]*	+
Severity of the injury	Kempen[25]* Kempen[26]ns	?
No. of chronic conditions	Kempen[25]ns Kempen[26]ns	-
Sustained one non-injurious fall	Tinetti[30]ns	-
Sustained one fall	Laird[28]ns	-
Psychological and cognitive factors		
Depressive symptoms 8 wk post-injury	Kempen[25]*	+
Depressive symptoms pre-injury	Kempen[25]ns	-
Level of education	Kempen[24]ns Kempen[26]ns	-
Cognitive functioning 8 wk post-injury	Kempen[25]ns	-
Perceived control	Kempen[26]ns	-
Social and cultural factors		
Social support	Kempen[24]* Kempen[26]ns	?

*: significant, ns: non-significant
+: consistent evidence, ?: inconsistent or indeterminate evidence, -: no evidence

Table 3: Summary of predictors of long-term decline in function post-fall in older community-dwelling people at 36 months follow-up

Predictor	**Study**	**Summary code**
Demographic and biological factors		
Polypharmacy	Stel[29]*	+
Sustained at least two non-injurious falls	Tinetti[30]*	+
Sustained at least one injurious fall	Tinetti[30]*	+
Sustained one non-injurious fall	Tinetti[30]*	+
Falls indoors	Stel[29]ns	-
Restricted physical activity	Stel[29]ns	-
Lower performance test scores	Stel[29]ns	-
Psychological and cognitive factors		
Depressive symptoms pre-injury	Stel[29]*	+

*: significant, ns: non-significant
+: consistent evidence, ?: inconsistent or indeterminate evidence, -: no evidence

Predictors of long-term post-fall decline in older community-dwelling people

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Samenvatting

Achtergrond: Ouderen die met letsel na een val naar de Spoedeisende Hulp (SEH) komen hebben een verhoogd risico op verminderd fysiek functioneren. De risicofactoren zijn echter grotendeels onbekend. Deze studie onderzoekt predictoren van verminderd fysiek functioneren op de lange termijn, bij ouderen die na een val op de SEH zijn behandeld en vervolgens zijn ontslagen.

Methode: Een cohortstudie binnen een gerandomiseerd gecontroleerd onderzoek naar valpreventie interventies, is uitgevoerd in Melbourne, Australië. De sample bestond uit 607 zelfstandig wonende ouderen die na een val behandeld zijn op de SEH en vervolgens ontslagen zijn. Follow-up metingen waren na 12 maanden. Exclusiecriteria: niet in staat simpele instructies te volgen of binnenshuis te lopen. Fysiek functioneren werd gemeten met de Human Activity Profile na ontslag van de SEH, en na 12 maanden. Risicofactoren zijn geanalyseerd middels multivariate regressie.

Resultaten: Gemiddelde leeftijd was 75.1 (SD±8.4) jaar, 427 (70.3%) vrouwen. Hogere leeftijd (β=-0.40 [95%CI -0.54, -0.27], een CVA hebben gehad (β =-3.58 [95%CI -6.93, -0.22]) of artrose (β =-5.61 [95%CI -10.15, -1.07]) op baseline, perifere fracturen (β =-8.20 [95%CI -14.36, -2.04]) of ander valgerelateerd letsel (β =-3.81 [95%CI -6.24, -1.38]) tijdens de 12 maanden follow-up periode, voorspelden verminderd functioneren. Beenletsel (β =5.04 [95%CI 2.79, 7.29]) en verminderde ADL-zelfstandigheid na de val (β =10.73 [95%CI 8.32,13.13]) voorspelden herstel van fysiek functioneren.

Conclusie: Chronische aandoeningen en herhaald letsel voorspelden slecht herstel van functioneren. Screening op de SEH met deze risicofactoren en gericht verwijzen van ouderen na een val kunnen uitkomsten voor deze hoogrisicogroep verbeteren.

Abstract

Background: Older people presenting to an Emergency Department (ED) after a fall are at high risk of functional decline. However, risk factors for functional decline in this group are relatively unknown. This study investigates predictors of long-term decline in physical function in older people who presented to an ED after a fall, and were discharged directly home.

Methods: A cohort study nested within a randomised controlled trial assessing the effectiveness of a falls prevention intervention was carried out in Melbourne, Australia. The sample included 607 community-dwelling people presenting to an ED after a fall, who were discharged directly home and completed a 12 month follow up assessment. Exclusion criteria were: unable to comply with simple instructions and unable to walk independently indoors. Physical function was measured with the Human Activity Profile post ED discharge and at 12-months follow-up. Multivariate regression was used to investigate predictors of long-term decline in physical function.

Results: Participants had an average age of 75.1 (SD±8.4) years and 427 (70.3%) were female. Increased age (β=-0.40 [95% CI -0.54, -0.27] and reporting a history of stroke (β=-3.58 [95% CI -6.93, -0.22]) or having osteoarthritis (β=-5.61 [95% CI -10.15, -1.07]) at baseline, and sustaining peripheral fractures (β=-8.20 [95% CI -14.36, -2.04]) or other fall-related injuries (β=-3.81 [95% CI-6.24, -1.38]) during the 12-month follow-up period predicted long-term decline. Sustaining a leg injury (β=5.04 [95% CI 2.79, 7.29]) and post-fall decline in independence in activities of daily living (β=10.73 [95% CI 8.32, 13.13]) predicted recovery of function at 12 months.

Conclusion: Chronic medical conditions and ongoing falls injury predicted poor recovery of function. Screening for these risk factors for older people presenting to Emergency Departments after a fall, and appropriate referral and management may improve outcomes for this high-risk group.

Introduction

The proportion of people of 60 years and older is estimated to rise from 20.1% in 2005 to 32.6% in 2050 in the world's more developed countries [1]. Falls are one of a number of health problems that occur more commonly with increasing age [2-4]. With the ageing population, the number of older people sustaining a fall is becoming a growing problem. Approximately 30% of adults aged 65 years and older who are living in the community experience a fall at least once a year [2-4] and 20% to 30% of those people suffer moderate to severe injuries [4, 5]. Experiencing at least one injurious fall has been found to be associated with decline in physical activity [6]. A prospective study found that pre-injury levels of functioning were not regained in community-dwellers one year after a fall [7].

In persons aged 65 years and older, falls account for 62% of all nonfatal injury emergency department (ED) visits [8]. Older people presenting to an ED with minor injuries have been found to be at risk of decline in functioning, with approximately 20% experiencing functional decline at 3 months follow-up [9]. A visit to the ED may thus be an opportunity to identify people at higher risk of functional decline [9].

Previous research has found that sustaining a fracture, functional independence before the fall, being female, depression, and slower Timed Up and Go-scores are risk factors for short-term (one month after the fall/ED presentation) functional decline in older people sustaining a fall, who were discharged home from an ED [10]. Long-term reduction in mobility after an injury has been found to lead to reduced quality of life [11] and the onset of depression [12]. As such, knowledge of risk factors for long-term functional decline is required, and could be used to target interventions, aiming to optimise levels of physical function, to prevent

long-term functional decline. However, predictors of long-term decline (i.e. 12 months post-fall/ED presentation) in community-dwelling older people after a fall and presentation to the ED are relatively unknown.

The objective of this study was to identify risk factors for long-term decline in physical function in community-dwelling older people who presented to an ED after a fall, and were discharged directly home.

Materials and methods

Study design and sample

The current study was a cohort study nested within a randomised controlled trial (RCT) assessing the effectiveness of a falls prevention intervention [13].

Participants were recruited from seven acute hospitals in Melbourne, Australia. The ED staff identified potential participants. Inclusion criteria were living in the community, being aged 60 years or older, presenting to an ED after a fall, and being discharged home directly from the ED (i.e. not admitted to the wards). Exclusion criteria were the inability to comply with simple instructions and the inability to walk independently indoors (with or without a walking aid). Participants with cognitive impairment were included if they had a carer who consented to participation. Written informed consent was obtained from all participants, and the Ethics Committees of the participating hospitals approved the study.

Data collection

Data collection was performed between January 2003 and December 2006.

Baseline assessment

Baseline assessment took place at the participant's home a median of 20 days (interquartile range [IQR] 12-33) after presentation at the ED. In this assessment a range of measures were taken [14], however, the data collected relevant to this study included:

- Age;
- Gender;
- Body parts injured (head/neck, spine, abdominal/thoracic, leg or arm) and type of injuries (fracture, dislocation, laceration, sprain/strain, abrasion/contusion, concussion/internal) sustained in the fall resulting in the ED presentation (the index fall). Data were self-reported and confirmed by review of medical records;
- Level of physical function, measured with the Human Activity Profile (HAP) [15], see outcomes section below for more details;
- Balance deficit measured with the Step Test [16] and the Functional Reach test (FR) [17];
- Gait impairment measured with the Timed Up and Go test (TUG) [18] and gait velocity over a 5m walkway [19];
- Depressive symptoms, assessed with the Geriatric Depression Scale–Short Form (GDS-SF) [20];
- Falls efficacy, measured with the Modified Falls Efficacy Scale (MFES) [21];
- Cognitive impairment, measured with the Abbreviated Mental Test (AMT) [22];
- Falls in the previous year (categorized as sustaining only the fall resulting in the presentation to the ED *versus* the fall resulting in the presentation to the ED plus additional falls in the previous year), recorded in Question 1 of the Falls Risk for Older People in the Community (FROP-Com) assessment tool [14];
- Number of medical conditions, recorded in Question 7 of the FROP-Com [14];
- Self-reported osteoarthritis, history of stroke, cardiovascular disease, chronic obstructive pulmonary disease, and diabetes mellitus, recorded in Question 7 of the FROP-Com [14];
- Living alone or with others;

- Self-reported decrease in the ability to independently perform personal or domestic Activities of Daily Living (ADLs) after the index fall, recorded in Questions 20 and 22 of the FROP-Com [14];
- Polypharmacy, recorded in Question 5 of the FROP-Com [14];
- Total FROP-Com score [14].

Intervention

Participants from both groups could be referred to physiotherapy, occupational therapy, or a falls and balance clinic as part of either the usual care from the ED or as part of the program implemented to the intervention group of the RCT, based on findings from the comprehensive falls risk assessment tool [14].

Follow-up period

Participants were monitored for falls and fall injuries for 12 months by use of a falls diary, with each month's information sheet returned to the research team monthly, in a reply paid envelope. Participants who had a fall received a follow up phone call from one of the research team to clarify details about the fall. Falls data was also checked against a medical record review for the hospital the participant attended for their initial fall, at the end of the project. Injuries sustained in any falls were recorded and classified using the Abbreviated Injury Scale (AIS2) [23]. Injuries rated as two and above were classified as serious injuries for the purpose of this research.

Outcome measure

The outcome measure selected to reflect change in level of physical function was the self-reported HAP [15]. It comprises 94 items from low to high-intensity activities. The participant was asked to grade each activity as either 'still doing' , 'stopped doing' , or 'never did this activity'. Two scores were then calculated: the Maximum Activity Score (MAS), representing the most demanding activity the participant is able to perform, and the Adjusted Activity Score (AAS), calculated by subtracting the number of lower numbered activities the participant scored as 'stopped doing' from the MAS. HAP-AAS scores were used as the outcome measure since these scores are considered to be a more stable estimate of the daily activities than the HAP-MAS scores [24]. The intra-rater correlation coefficients of the HAP range between 0.79 and 0.97, and levels of correlation with ojective and self reported measures of physical function are moderate to strong [25]. At 12-months follow-up, all baseline measures were repeated. These measures included the HAP.

Statistical analysis

Multiple linear regression was used to examine associations between potential risk factors at baseline, and change in level of physical function as measured by change in the HAP-AAS (delta HAP-AAS) scores, from baseline to one-year follow-up.

Prior to analysis, normality and linearity of all data were checked. Non-normally distributed continuous variables were log-transformed (TUG) or cube-transformed (MFES), and data were checked for outliers. Simple linear regression was performed to assess associations between all independent variables and delta HAP-AAS. The distributions and P-P plots of the residuals were checked. Independent variables were checked for multicollinearity and statistically

significant variables ($p \leq 0.1$) were then used to build a multiple regression model. All analyses were performed including data from the full sample, control group and intervention group, respectively.

Potential risk factors included in the analysis were self-report of dependency in ADLs [26], falls in the previous year [6, 26], type/severity of injury sustained in the index fall [27], body part injured in the index fall [28], polypharmacy [29], falls-efficacy score (MFES) [30], depressive symptoms (GDS-SF) [29, 31, 32], self report of restricted physical activity post-fall [29], comorbidities including osteoarthritis, stroke, cardiovascular disease, chronic obstructive pulmonary disease, and diabetes mellitus [31], having had a hip or knee replacement, cognitive impairment, living alone, total FROP-Com score, gait deficits (TUG and gait velocity) and balance deficits (Step Test and FR). Group assignment within the RCT, and referral to physiotherapy, occupational therapy, or falls and balance clinics during the trial were also investigated as predictors. Age [7, 27] and gender [6] were considered to be potential confounders and/or predictors.

To further investigate the predictors of long-term decline, the analysis was repeated with only those participants reporting functional decline in the baseline assessment. The purpose of only performing the analysis with this subgroup was to investigate predictors of recovery in the group most affected by the index fall. To identify people experiencing functional decline at the baseline assessment (a median of 20 days post ED presentation), FROP-Com questions about self-reported decrease in the ability to independently perform personal or domestic ADLs after the index fall were used [14]. For all analyses, Statistical Package for the Social Sciences (SPSS 12.0) was used.

Results

Study sample

From the 712 participants assessed at baseline, 610 (85.7%) participants completed follow up at 12 months. The 102 participants, who did not complete the 12-month assessment, were significantly more likely than those continuing in the study to be cognitively impaired or depressed, have more medical conditions, a higher FROP-Com score, a slower TUG, lower MFES and have their balance during walking and turning rated as unsteady, or require assistance with ADLs. Three further participants completed the 12-month follow up assessments but did not have HAP data available (1 unable to complete, 1 missing, 1 refused to complete the HAP).

The characteristics of the 607 participants included in the final sample for this study are shown in Table 1. The mean age of the participants was 75.1 years (Standard deviation [SD]±8.4), 427 (70.3%) were female. The mean HAP-AAS score increased from baseline (44.04, SD±19.23), to one-year follow-up (48.09, SD±19.65). The mean delta HAP-AAS was 4.05 (SD±15.87).

Predictors of long-term decline in physical function

Univariate analysis showed that potential risk factors at baseline for 12-month decline in physical function were having sustained lacerations or injuries to head or neck in the index fall, increased age, having had a knee or hip replacement, having one or more comorbidities, specifically self report of arthritis or stroke, pre-fall dependency in personal or domestic ADLs, living alone, repeated falls prior to the index fall, higher MFES score, and cognitive impairment. The factors

predictive of recovery in physical function in the long term were a self-reported decrease in the ability to independently perform personal or domestic ADLs after the index fall, sustaining a fracture or leg injury in the index fall, being female, and depressive symptoms at baseline. The only univariate predictor for recovery of physical function over the 12-months follow-up period was referral to physiotherapy. Predictors from the 12-months follow-up period of decline at 12-months were sustaining peripheral fractures or other injuries, and recurrent falls (Table 2).

Multiple regression revealed that the following factors at baseline continued to be predictors of long-term decline: having a history of stroke, and higher MFES score. A self-reported decrease in the ability to perform personal or domestic ADLs after the index fall remained the strongest predictor of recovery of physical function, followed by sustaining leg injuries in the index fall. Factors measured during the 12-month follow-up that continued to be predictive of long-term decline included sustaining peripheral fractures and any other injuries (Table 2). All factors were adjusted for the a priori defined confounders age and gender. The risk factors explained 24.90% of the variance in delta HAP-AAS scores.

Analysis of data of intervention and control groups separately, revealed that predictors in the multiple regression model were similar to those for the full sample (data not shown).

Subgroup analysis: participants with self-reported decline in functioning at the baseline assessment

The subgroup of participants with self-reported functional decline due to the fall included 216 people. The characteristics of this group are shown in Table 1. The mean age of this group was 74.17 years (SD±8.7), 183 (84.7%) were female. The mean HAP-AAS score at baseline was lower than for the full sample (36.6, SD±16.9) and follow-up scores were similar to those for the full sample (48.52, SD±17.80). The mean delta HAP-AAS was 11.96 (SD±18.54).

Predictors of long-term decline in physical function

Potential risk factors at baseline for long-term decline in physical function in this subgroup in the univariate analysis were increased age, having osteoarthritis, having sustained head or neck injuries or lacerations in the index fall, repeated falls prior to the index fall, having one or more comorbidities, and having had a hip or knee replacement. The factors predictive of recovery in physical functioning were sustaining a leg injury or fracture in the index fall. Predictors of functional decline from the measures collected over the 12-month follow-up period were sustaining a peripheral fracture or serious injury, sustaining any injury, and repeated falls during the 12-month follow-up period (Table 3).

Multiple regression revealed that having osteoarthritis was the only factor at baseline that continued to be a predictor of long-term decline. As for the full sample, sustaining a leg injury in the index fall remained a predictor of recovery of physical function. The remaining factor measured during the 12-month follow-up period predicting long-term decline was sustaining a serious injury (Table 3). All factors were adjusted for age and gender. The factors explained 20.50% of the variance in delta HAP-AAS scores in participants with functional decline.

Discussion

This study showed the following risk factors for long-term decline in physical function after a fall resulting in ED presentation: increased age, having a history of stroke, higher falls-efficacy score at the baseline post-ED assessment, and sustaining peripheral fractures or any other injuries during the 12-month follow-up period. Predictors of recovery were injury to the leg in the index fall, and decreased independence in ADLs due to the index fall. For the subgroup that reported a decline in function in the month following the index fall, predictors for decline were having osteoarthritis and sustaining serious injuries during the 12-month follow-up period. Sustaining a leg injury in the index fall was predictive of recovery.

Having a history of stroke or having osteoarthritis were found to predict long-term decline for the total sample, and the subgroup that reported a decline in function in the month following the index fall, respectively. Both comorbidities have been found to impact on functional recovery from disability in older people [33] and are, therefore, important in identifying persons at higher risk of decline in function after a fall. Both of these chronic health conditions are prevalent in older people living in the community, and both having a history of stroke [34] and having osteoarthritis [35] are associated with high rates of falls.

Sustaining leg injuries in the index fall and subsequent loss of function from the fall/injuries was associated with better long-term recovery. Sustaining a leg injury has been found to be a predictor of recovery in previous research in older community-dwelling people [7, 28]. In general, people who reported the steepest decline in function post-injury experienced the largest recovery [7]. This confirms the data from the current study showing that decreased ADL-independence post-fall predicts better recovery. However, people sustaining leg injuries or other

injuries causing decline may require assistance in ADLs after discharge from the ED, despite the better long-term recovery.

Higher falls efficacy scores (i.e. high confidence in performing activities without falling following ED presentation for a fall) were found to be a risk factor for long-term decline, contrary to previous research demonstrating that people with lower falls efficacy had greater decline in physical function [30]. Given this was a high falls risk sample [10], it is possible that that some participants over-rated their confidence relative to their balance capacity. If these participants took excessive risks relative to capacity, a fall and associated functional decline would have resulted.

Sustaining peripheral fractures and injuries in general during the one-year follow-up period predicted long-term decline. This would be expected as these injuries have been found to impact on physical function in older community-dwelling people [7], and in older people presenting to an ED [9]. This may delay recovery from the injuries due to the index fall. This finding highlights the importance of identifying those at high risk of falls post ED discharge so interventions can be put in place and further falls and subsequent injuries prevented.

There are several limitations to the current study. Firstly, levels of pre-index fall function could not be measured since baseline assessment took place after the ED presentation. Secondly, only data from people presenting to an ED were used. This group may not reflect the entire population sustaining injuries after a fall for which no hospitalisation is required. Thirdly, the total explained variance is rather low. A factor that may have increased the explained variance is newly diagnosed comorbidities, which are likely to compromise recovery [6].

The clinical implications of this study are that increased age, and having had a stroke or having oseoarthritis, measured at the time of the index fall, can be used to identify people at higher risk of longer term functional decline, and target interventions to those people who are most likely to benefit. Furthermore, apart from aiming to optimise level of physical function, interventions for people who present to the ED after a fall should aim at preventing further falls and injury, as these factors were found to increase the risk of long-term decline.

Conclusion

In summary, the factors predictive of decline in physical function at 12 months post-fall and ED presentation were increased age, reporting a history of stroke or having osteoarthritis, and sustaining peripheral fractures or other injuries during the 12-month follow-up period. The factors predictive of recovery were sustaining a leg injury in the index fall and post-fall decline in independency in activities of daily living. These factors could be used by clinicians to identify those in need of support or additional intervention post-ED discharge. This study also highlights the importance of preventing further falls injuries in this group of people at high risk of falls to prevent long-term decline.

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Table 1: Characteristics of participants.

Characteristic	All participants n=607	Participants with functional decline n=216
Index fall factors/ baseline factors		
Age in years, mean (SD)	75.1 (8.4)	74.2 (8.7)
Female (%)	427 (70.3)	183 (84.7)
One or more falls in the previous 12 months, in addition to the index fall (%)	314 (51.7)	102 (47.2)
Fracture sustained in the index fall (%)	223 (36.7)	124 (57.4)
Dependency in personal ADLs at baseline (%)	42 (6.9)	7 (3.0)
Dependency in domestic ADLs at baseline (%)	252 (41.5)	76 (35.3)
Polypharmacy (> 3 medications) (%)	447 (73.6)	159 (73.6)
No. of comorbidities, mean (SD)	1.6 (0.9)	1.5 (0.9)
Physical function (HAP-AAS), mean (SD)	44.0 (19.2)	36.6 (16.9)
Referrals to potential falls prevention interventions		
Referral to physiotherapy (%)	255 (42.0)	115 (53.2)
Referral to occupational therapy (%)	156 (25.7)	80 (37.0)
Referral to falls and balance clinic (%)	73 (12.0)	28 (13.0)
Factors measured during the 12-month follow-up period		
Sustaining one or more falls (%)	175 (28.8)	51 (23.6)
Peripheral fracture due to falls (%)	23 (3.8)	10 (4.6)
Any injuries due to falls (%)	219 (36.1)	68 (31.5)
Serious injuries due to falls (%)	45 (7.4)	17 (7.8)

HAP-AAS: Human Activity Profile Adjusted Activity Score

Table 2: Predictors of long-term decline in physical function, in all participants.

Predictor	Univariate regression n=607 β value and 95% CI	Multivariate regression n=607 β value and 95% CI
Index fall factors		
Fracture	7.51 (4.95, 10.07)*	
Laceration	-6.01 (-8.85, -3.17)*	
Dislocation	3.17 (-2.58, 8.91)	
Sprain or strain	1.42 (-1.51, 4.35)	
Contusion or abrasion	0.29 (-2.26, 2.84)	
Internal or concussion	1.66 (-5.81, 9.12)	
Injury to the leg	6.74 (4.24, 9.24)*	5.04 (2.79, 7.29)
Injury to the head/neck	-4.64 (-7.27, -2.05)*	
Injury to the thorax/abdomen	-2.02 (-5.89, 1.85)	
Injury to the spine	1.57 (-3.54, 6.67)	
Injury to the arm	1.40 (-1.14, 3.94)	
Self-report of pre-fall dependency in ADLs	-3.77 (-6.32, -1.22)†	
Change in ADL independence after the index fall	12.27 (9.82, 14.73) *	10.73 (8.32, 13.13)
Factors measured at baseline		
Age	-0.53 (-0.68, -0.39)*	-0.40 (-0.54, -0.27)
Gender (female=1)	3.88 (1.13, 6.64)†	-0.75 (-3.29, 1.78)
Living alone	-3.17 (-5.76, -0.58)†	
Sustaining one or more falls in the previous 12 months, in addition to the index fall	-2.68 (-5.21, -0.16)†	
Level of physical activity	0.22 (-2.99, 3.43)	
No. of medications	-0.15 (-0.52, 0.21)	
No. of medical conditions	-0.94 (-1.66, -0.23)†	
Osteoarthritis	-2.91 (-5.45, -0.37)†	
History of stroke	-3.82 (-7.53, -0.11)†	-3.58 (-6.93, -0.22)
Hip or knee replacement	-4.38 (-7.94, -0.82)†	
Respiratory disease	-1.19 (-4.24, 1.86)	
Parkinson's Disease	-2.97 (-12.06, 6.13)	
Diabetes mellitus	-0.73 (-4.06, 2.61)	
Cardiovascular disease	-1.19 (-3.89, 1.50)	
Total FROP-Com score	0.01 (-0.17, 0.20)	
Depressive symptoms (GDS-SF) §	0.46 (0.09, 0.84)†	
Cognitive impairment (AMT) ¶	-6.24 (-12.85, 0.38)‡	
Falls efficacy (MFES) #	-0.01 (-0.01, 0.00)†	-0.01 (-0.01, -0.00)
TUG** (sec)	1.92 (-3.96, 7.80)	
Gait velocity (m/min)	-0.02 (-0.08, 0.05)	
Step Test (steps/15 sec)	-0.19 (-0.43, 0.04)	
FR (cm)	-0.07 (-0.21, 0.08)	
Group allocation (intervention=1)	0.08 (-2.45, 2.62)	
Referrals to potential falls prevention interventions		
Physiotherapy	2.42 (-0.14, 4.98)‡	
Occupational therapy	2.36 (-0.53, 5.25)	
Falls and balance clinic	1.14 (-2.75, 5.03)	
Factors measured during the 12 month follow-up period		
No. of falls	-5.66 (-8.42, -2.90)*	
Peripheral fracture due to falls	-11.49 (-18.06, -4.92)†	-8.20 (-14.36, -2.04)
Any injuries due to falls	-6.02 (-8.61, -3.43)†	-3.81 (-6.24, -1.38)
Serious injuries due to falls	-7.67 (-12.45, -2.87)†	

CI: Confidence interval, GSD-SF: Geriatric Depression Scale Short Form, AMT:Abbreviated Mental Test, MFES: Modified Falls Efficacy Scale, TUG: Timed Up and Go test, FR: Functional Reach test, FROP-Com: Falls Risk for Older People in the Community assessment tool
*: $p < 0.001$, †: $p < 0.05$, ‡: $p < 0.10$, §: dichotomised: scores of ≥ 6 reflect depressive symptoms, ¶: dichotomised: scores of < 7 reflect cognitive impairment, #: cube-transformed, **: log-transformed

Table 3: Predictors of long-term decline in physical function, in participants with self-reported short-term functional decline after ED presentation for a fall.

Predictor	Univariate regression n=216 β value and 95% CI	Multivariate regression n= 216 β value and 95% CI
Index fall factors		
Fracture	7.64 (2.68, 12.61)†	
Laceration	-8.27 (-15.39, -1.16)‡	
Dislocation	-2.83 (-12.07, 6.42)	
Sprain or strain	0.31 (-5.52, 6.14)	
Contusion or abrasion	-0.47 (-5.48, -4.55)	
Internal concussion	4.14 (-12.42, 20.70)	
Injury to the leg	7.80 (2.91, 12.70)†	5.90 (1.83, 10.43)
Injury to the head/neck	-6.92 (-12.41, -1.43)†	
Injury to the thorax/abdomen	-5.99 (-14.55, 2.57)	
Injury to the spine	-1.00 (-10.02, 8.02)	
Injury to the arm	0.50 (-4.72, 5.72)	
Pre-fall dependency in ADLs	-4.15 (-9.33, 1.02)	
Factors measured at baseline		
Age	-0.73 (-1.00, -0.46)*	-0.60 (-0.87, -0.33)
Gender (female=1)	-2.23 (-9.2, 4.69)	-3.52 (-9.88, 2.85)
Living alone	-3.28 (-8.39, 1.84)	
Sustaining one or more falls in the previous 12 months, in addition to the index fall	-5.40 (-10.34, -0.46)†	
Level of physical activity	-5.09 (-11.29, 1.12)	
No. of medications	-0.01 (-0.83, 0.81)	
No. of medical conditions	-1.68 (-3.06, -0.30)†	
Osteoarthritis	-7.50 (-12.41, -2.59)†	-5.61 (-10.15, -1.07)
History of stroke	-5.96 (-13.45, 1.53)	
Hip or knee replacement	-6.68 (-14.05, 0.68)‡	
Respiratory disease	-2.53 (-8.35, 3.29)	
Parkinson's Disease	-8.03 (-34.03, 18.00)	
Diabetes mellitus	-0.01 (-6.25, 6.23)	
Cardiovascular disease	-1.18 (-6.81, 4.44)	
Total FROP-Com score	0.10 (-0.74, 0.07)	
Depressive symptoms (GDS-SF) §	2.53 (-3.08, 8.14)	
Cognitive impairment (AMT) ¶	-8.17 (-21.32, 4.98)	
Falls efficacy (MFES) #	-0.00 (-0.01, 0.01)	
TUG** (sec)	1.44 (-10.13, 13.01)	
Gait velocity (m/min)	-0.01 (-0.15, 0.12)	
Step Test (steps/15 sec)	-0.24 (-0.71, 0.23)	
FR (cm)	0.12 (-0.20, 0.42)	
Group allocation (intervention=1)	-1.63 (-6.62, 3.37)	
Referrals to potential falls prevention interventions		
Physiotherapy	-1.81 (-6.80, 3.18)	
Occupational therapy	-0.41 (-5.57, 4.75)	
Falls and balance clinic	-3.36 (-10.76, 4.05)	
Factors measured during the 12 month follow-up period		

No. of falls	-9.37 (-15.10, -3.64)†	
Peripheral fracture due to falls	-21.98 (-33.46, -10.49)*	
Any injuries due to falls	-10.56 (-15.63, -5.28)*	
Serious injuries due to falls	-18.92 (-27.81, -10.02)*	-14.80 (-23.18, -6.41)

CI: Confidence interval, GSD-SF: Geriatric Depression Scale Short Form, AMT:Abbreviated Mental Test, MFES: Modified Falls Efficacy Scale, TUG: Timed Up and Go test, FR: Functional Reach test, FROP-Com: Falls Risk for Older People in the Community assessment tool

*: $p < 0.001$, †: $p < 0.05$, ‡: $p < 0.10$, §: dichotomised: scores of ≥ 6 reflect depressive symptoms, ¶: dichotomised: scores of < 7 reflect cognitive impairment, #: cube-transformed, **: log-transformed