Article

Journal of Aging and Health
2018, Vol. 30(6) 987–1008

DOI: 10.1177/0898264317704096
journals.sagepub.com/home/jah
SAGE

The Complex Association Between Fear of Falling and Mobility Limitation in Relation to Late-Life Falls: A SHARE-Based Analysis

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Abstract

Objective: This study examines fear of falling (FOF) in relation to falls in light of mobility limitation. **Method:** Data on community-dwelling older Europeans, aged 65+, were drawn from two consecutive waves of the Survey of Health, Ageing and Retirement in Europe (SHARE). The analysis regressed fall status in 2013 on reported FOF 2 to 3 years earlier, controlling for previous falls. **Results:** FOF predicted subsequent falls when mobility limitation was low to moderate. However, the effect of FOF on fall probability was reversed when mobility limitation was high. **Discussion:** The analysis underscores a complex association between FOF and mobility limitation in relation to late-life falls. People who are worried about falling tend to fall more. Those having high mobility limitation but lacking FOF are also more likely to fall. In cases of considerable mobility limitation, FOF may

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act as a protective buffer. The less worried in this group, however, may be subject to greater falling, and thus require greater attention.

Keywords
frailty, disability, Europe, falling

Introduction

Falls in late life are a growing health problem as populations around the world age. Falling constitutes a major cause of morbidity and mortality (Ambrose, Paul, & Hausdorff, 2013), as well as an antecedent of activity restriction and lower quality of life (Boyd & Stevens, 2009). A key factor within the fall domain is fear of falling (FOF; Choi & Ko, 2015). Whether defined as a phobic reaction to standing or walking (ptophobia), loss of confidence in balance abilities, low fall-related efficacy, or simply worry about falling (Legters, 2002), FOF is seen as an important concomitant of falls (Hadjistavropoulos et al., 2007). Some researchers view FOF as the result of previous falling (Bryant, Rintala, Hou, & Protas, 2015), while others identify it as an independent phenomenon (Clemson, Kendig, Mackenzie, & Browning, 2015). Further complicating the field is the fact that FOF and falls are often perceived as interrelated and part of a mutually reinforcing downward spiral (Friedman, Munoz, West, Rubin, & Fried, 2002). Thus, it is challenging to disentangle the respective effects.

FOF is also a somewhat elusive concept (Hadjistavropoulos, Delbaere, & Fitzgerald, 2011; Jung, 2008). Some researchers define it as a loss of confidence in one's balance abilities (Maki, Holliday, & Topper, 1991), while others describe it as an apprehension that precipitates the avoidance of activities (Tinetti & Powell, 1993). Early inquiry into the phenomenon saw FOF as the psychological reaction to having experienced a fall. It was believed that this "post-fall syndrome" leads to the development of intense fear as well as to walking disorders (Murphy & Isaacs, 1982). More recent works see FOF as a possible concomitant of increasing fragility (Kressig et al., 2001) or as being interrelated with activity avoidance (Bertera & Bertera, 2008).

The mutual occurrence of falls, FOF, and other related phenomenon has led some scholars to query what comes first. One study of the temporal relationship between falls and FOF among more than two thousand community-dwelling participants, aged 65 to 84, in Salisbury Maryland, found that baseline FOF indeed predicted falls at follow-up, 20 months later. However, falls at baseline also predicted FOF at follow-up in this same sample. The investigators concluded that persons who experience either of these phenomena are at risk for developing the other. That is, they discerned a "spiraling risk" of falls, FOF, and functional decline (Friedman et al., 2002). In contrast, a prospective cohort study among some 321 older primary care clients in Hong Kong found that while FOF at baseline predicted both falls and FOF at follow-up, falls at baseline were not predictors of subsequent FOF or falls (Chou & Chi, 2007). Based on these findings, the researchers concluded that a vicious cycle of falls and FOF was not present in that study sample.

Another factor that is important in understanding the FOF–falls nexus is mobility limitation, but the association among these variables is still unclear (Allison, Painter, Emory, Whitehurst, & Raby, 2013). Much of the research on this topic views mobility limitation as a predictor of FOF or of activity restriction due to FOF. Thus, for example, Vellas, Wayne, Romero, Baumgartner, and Garry (1997) found balance and gait abnormalities to predict FOF among prior fallers in New Mexico. Austin, Devine, Dick, Prince, and Bruce (2007) similarly revealed that impairments of balance and mobility predicted FOF among community-dwelling older Australian women. However, others have found that mobility limitation was not related to FOF (Trombetti et al., 2016). As for activity restriction due to FOF, Guthrie et al. (2012) have noted that difficulty in climbing stairs predicted this outcome. Similarly, Martin, Hart, Spector, Doyle, and Harari (2005) showed that difficulty in standing from an armless chair was associated with FOF limiting activity.

Other studies have considered the reverse association, namely that FOF predicts mobility limitation. Thus, for example, Viljanen et al. (2012) found that difficulties in walking 2 km was higher for people with FOF. A study that employed accelerometers among 1,680 British men, aged 71 to 92 years, revealed that those who were fearful of falling took fewer steps per day than those who were not (Jefferis et al., 2014). Among community-dwelling adults in Oregon and California, aged 60 to 97, those with FOF had slower gait speed and shorter stride length than those who were not fearful of falling (Chamberlin, Fulwider, Sanders, & Medeiros, 2005). A Canadian study found that self-reported anxiety was related to five out of six gait parameters (Hadjistavropoulos et al., 2012).

However, few studies specifically consider mobility limitation in relation to the interrelationship between FOF and falls. One Australian study did report slower gait speed to predict falls, but it did not predict FOF (Clemson et al., 2015). The aim of the current analysis, therefore, is to address the FOF–falls nexus in light of mobility limitation, given the gap in the literature in this domain.

FOF is but one potential risk factor among many in the domain of falling in later life. Another relevant factor in predicting falls is the effect of having experienced previous falls. An examination of the records of home care recipients linked to Emergency Department data in Ontario, Canada, revealed, for example, that persons with a greater number of recent falls had a higher risk of a future injurious fall (Poss & Hirdes, 2016). Prior falls as predictors of subsequent falls have also been found in studies in Mexico (Samper-Ternent, Karmarkar, Graham, Reistetter, & Ottenbacher, 2012) and Denmark (Vind, Andersen, Pedersen, Joergensen, & Schwarz, 2011). However, as noted earlier, a study in Hong Kong (Chou & Chi, 2007) did not find a similar association.

Other risk factors of note are age and gender. Advanced age is associated with greater propensity for falling (Ambrose et al., 2013; Clemson et al., 2015; Rossat et al., 2010), especially among women (Chang & Do, 2015). This may be due to an increase in the risk of sarcopenia as one ages and its association with falls (Scott et al., 2014). Female gender is related also to FOF, as has been documented in several settings (Filiatrault, Desrosiers, & Trottier, 2009; LeBouthillier, Thibodeau, & Asmundson, 2013; Zijlstra et al., 2007). However, the association of age with FOF is less certain. One study found no such association between age and activity-related FOF (Kressig et al., 2001).

Additional demographic confounders that need to be taken into account when considering the relationship of FOF to falls are marital status, socioeconomic status, and race or ethnicity. A study in Finland reported a risk for falls among the unmarried (Koski, Luukinen, Laippala, & Kivela, 1998). Similarly, a Korean study found living alone to be associated with a high risk of falls (Choi et al., 2014). It should be noted, however, that a study of older adults in Texas did not find an association between marital status and falls (Alamgir, Wong, Hu, Marshall, & Yu, 2015). On the contrary, the study by Filiatrault and others (2009) in the Province of Quebec, that was cited earlier, found support from a spouse to be a protective factor against FOF.

Income and education were not found to predict falls in the previously mentioned Texas study. However, a study in Korea did find lower educational level to be associated with FOF (Kim & So, 2013). Race (Friedman et al., 2002; Nicklett & Taylor, 2014) and/or ethnicity (Kalula, Ferreira, Swingler, & Badri, 2016) are also relevant factors in fall risk analyses.

Frailty is another factor that may be related to falls. A study of data from the first wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) found a higher degree of frailty in Southern European countries than in Northern European countries (Santos-Eggimann, Cuenoud, Spagnoli, & Junod, 2009). The data from that study suggest, moreover, that education was a key contributing factor behind these differential regional frailty rates. A frailty index was recently validated using SHARE data (Romero-Ortuno, Walsh, Lawlor, & Kenny, 2010). It is based on measures that objectively reflect physical capacity, such as grip strength. Inclusion of this index in the present study allows us to separate the effects of mobility limitation on falls from those of frailty.

Several other health factors are related to falling as well, and they need to be controlled. These include measures of mental health, particularly cognition (Ambrose et al., 2013) and depression (Clemson et al., 2015). Cognition has also been found to relate to FOF (Choi & Ko, 2015), but the same was not found for depression (Chou & Chi, 2008). The markers of physical health that have been found to be associated with FOF, falls, or both, include body mass index (BMI; Koski et al., 1998), vision and hearing impairment (Ambrose et al., 2013; Kamil et al., 2016; Viljanen et al., 2013), number of medications (Doi et al., 2012; Kelly et al., 2003), extent of frailty (Bryant et al., 2015; Kojima et al., 2015; Samper-Ternent et al., 2012) and morbidity (Choi et al., 2014; Friedman et al., 2002; Guthrie et al., 2012; Jamison, Neuberger, & Miller, 2003).

Based upon this review of the literature, the present study seeks to examine the association between FOF and falls in a large sample of older European adults, taking into account the many other key risk factors. Our analysis considers two hypotheses:

Hypothesis 1: FOF is an independent risk factor for falling, beyond the effects of sociodemographic background, health/frailty, and having experienced a prior fall.

Hypothesis 2: Mobility limitation moderates the effect of FOF on falling.

Method

The analysis in the present study is based upon data that were collected in the SHARE Project (Börsch-Supan et al., 2013). SHARE is a biennial panel survey of persons aged 50 and older and their spouse of any age. It commenced in 2004 and now includes some 27 European countries (eight of which joined just recently in 2016) and Israel. Each country sample is a probability sample. Sixteen countries participated in Wave 4 (2011) and 15 countries in Wave 5 (2013). Thirteen of these countries participated in both Waves 4 and 5 and they constitute the sample in the present study: Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, the Netherlands, Slovenia, Spain, Sweden, and Switzerland. The fourth wave served as the baseline in the analysis. Combining data from Waves 4 and 5 facilitated the examination of baseline measures of falling, FOF, and several confounders and their relationship to falling and mobility limitation 2 years later.

The inquiry focused exclusively on community-dwelling Europeans aged 65 and older who participated in both the fourth (2011) and fifth waves of the survey (2013). The initial analytical sample numbered 22,533 persons (see Table 1 for the distribution by country). As may be seen, respondents from Germany and Denmark were somewhat underrepresented and those from Estonia, over-represented. Consequently, the country variable was controlled in the analyses. The sample in the first two of the multivariate analyses numbered 19,023 persons. This reflected a drop of 15.6% from the initial sample due to missing data on one or more of the variables (mostly on the frailty measure). We subsequently ran two additional multivariate analyses without the frailty measure included. This lowered the missing data rate to 8.3% and brought the sample up to 20,654 respondents.

Study variables

The dependent variable in the current study was a dichotomous measure that reflected whether or not the respondent had fallen in the 6 months that preceded the Wave 5 interview (2013). It was obtained from the following probe: For the past 6 months at least, have you been bothered by any of the health conditions on this card? (a) falling down; (b) fear of falling down; (c) dizziness, faints, or blackouts; and (d) fatigue. A corresponding measure from the Wave 4 interview (2011) was used to control for having fallen previously. In that question, phrased exactly as the one delineated above, "falling down" was included among 12 symptoms that were listed on the show card: (a) pain in your back, knees, hips, or any other joint; (b) heart trouble or angina, chest pain during exercise; (c) breathlessness, difficulty breathing; (d) persistent cough; (e) swollen legs; (f) sleeping problems; (g) falling down; (h) fear of falling down; (i) dizziness, faints, or blackouts; (j) stomach or intestine problems, including constipation, air, diarrhea; (k) incontinence or involuntary loss of urine; and (l) fatigue. The key independent variable—fear of falling—was obtained from the same list of Wave 4 symptoms just described. It, too, was employed in the analysis as a dichotomous baseline measure.

The domain of mobility limitation was measured from a list of 10 difficulties (0-10), such as getting up from a chair after sitting for long periods, climbing one flight of stairs without resting, and stooping, kneeling, or crouching. We employed the sum score on this variable from Wave 5 to reflect the most up-to-date self-assessment of mobility status. The higher the score on this measure, the more limited was one's mobility.

The sociodemographic background variables that were controlled as possible confounders in the present analysis were age at Wave 5, gender (female = 1; male = 0), marital status (married or partnered = 1; single, widowed,

Table 1. Study Variables: Univariate Description (Wave 5).

Variables	*n*	% *M* (*SD*)	Range
Sociodemographic background			
Age	22,533	74.37 (6.94)	65-104
Female	22,533	56.50	
Married/partnered	22,265	64.14	
Education	22,117		
Primary		46.91	
Secondary education		29.60	
Postsecondary education		23.50	
Country	22,533		
Austria	2,264	10.05	
Belgium	2,026	8.99	
Czech Republic	2,358	10.46	
Denmark	991	4.40	
Estonia	3,338	14.81	
France	2,170	9.63	
Germany	693	3.08	
Italy	1,689	7.50	
Netherlands	1,314	5.83	
Slovenia	1,078	4.78	
Spain	1,897	8.42	
Sweden	1,119	4.97	
Switzerland	1,596	7.08	
Mental health			
Cognition score	21,998	−0.21 (0.79)	−2.89-2.79
Depressive symptoms	21,840	2.56 (2.28)	0-12
Physical health			
BMI	21,844		
BMI–Underweight		1.33	
BMI–Normal		34.74	
BMI–Overweight		42.35	
BMI–Obese		21.58	
Poor eyesight	22,494	5.50	
Poor hearing	22,518	5.74	
Medications	22,507	2.15 (1.66)	0-11
Frailty (pre-frail or frail)	20,118	15.30	
Morbidity[a]	22,498		
Alzheimer's disease, dementia, senility		2.46	
Cataracts		12.03	

(continued)

Table 1. (continued)

Variables	*n*	% *M* (*SD*)	Range
Diabetes		15.53	
Heart attack		15.67	
Hip or femoral fracture		2.31	
Osteoarthritis/other rheumatism		21.91	
Parkinson		1.27	
Rheumatoid arthritis		11.70	
Mobility limitation	22,529	2.13 (2.63)	0-10
Falls			
Fell in W4	22,533	5.50	
Fell in W5	22,533	10.75	
FOF (W4)	22,533	12.26	

Note. BMI = body mass index; FOF = fear of falling.
[a]Conditions that existed before the fall-reporting period.

divorced, or separated = 0), and education. Three levels of education were considered, based on the coding of the International Standard Classification of Education (ISCED-97) that is utilized by SHARE: (a) primary schooling or less (ISCED-97 = 0-2), (b) secondary schooling (ISCED-97 = 3), and (c) postsecondary schooling (ISCED-97 = 4-6). In addition, country was taken into account by a series of dummy variables using effect coding, such that each country's respective score was its deviation from the mean of all the countries in relation to the same variable.

Health variables were also controlled in the analysis. Two measures of mental health were considered: cognition and depressive symptoms. The cognition variable was a summary score of three separate indicators: memory (immediate and delayed tests of verbal learning and information retention), numeracy (based on a serial sevens test), and fluency, measured by asking respondent to name distinct animals in a 1-min period. The score was standardized such that the mean centered at zero and deviations from the mean were either positive (higher than the mean) or negative (lower than the mean). Depressive symptoms (0-12) were measured by the Euro-D depression scale, a tool that was developed to enable cross-country comparisons in Europe (Prince et al., 1999).

Physical health at baseline was taken into account via several variables. BMI was measured at four levels: underweight, normal, overweight, and obese. Eyesight and hearing were ranked by respondents on measurement scales that ranged from poor to excellent. Two dichotomous variables were created for the purpose of the present analysis, to distinguish between those with poor eyesight and/or hearing (using a hearing aid as usual) and the rest of the respondents. The number of medications was calculated as a count of the health problems (e.g., diabetes, joint inflammation) for which drugs were taken at least once a week. Frailty was calculated using five dimensions (weight loss, exhaustion, grip strength, walking speed, and physical activity) according to Fried's definition (Fried et al., 2001) and its corresponding operationalization for SHARE (Romero-Ortuno et al., 2010). Based on these dimensions, three categories were created (non-frail = 0, pre-frail = 1, and frail = 2). Finally, morbidity was controlled by consideration of eight illnesses: Alzheimer's disease, dementia, senility; cataracts; diabetes; heart attack; hip or femoral fracture; osteoarthritis/other rheumatism; Parkinson; and rheumatoid arthritis. Respondents were asked the following probe to retrieve this information: Has a doctor ever told you that you had/Do you currently have any of the conditions on this card?

Analyses

The statistical analysis began with univariate descriptions of the study variables and examination of the bivariate associations of the independent and control variables with the fall outcome in Wave 5. These associations were considered using unadjusted logistic regressions. Next, the Wave 5 fall outcome was regressed on all the study variables by means of adjusted logistic regressions. As noted above, we ran the regressions with and without the frailty measure. In the second and fourth models of the regressions, we entered a term for the interaction of baseline FOF and mobility limitation at follow-up.

Results

Table 1 presents the distributions of each of the study variables at follow-up (Wave 5), plus falls and FOF at baseline (Wave 4). It shows that the respondents ranged in age from 65 to 104. A small majority were women and almost two thirds were married or partnered. A bit less than half had primary schooling only. The mean of the measure of cognitive health was about zero, by design, and it ranged from the mean point by almost 3 points in each direction. Respondents reported some two and a half depressive symptoms, on average. About a third of the sample had normal BMI while only about 1% were underweight. Some 6% reported problematic vision and/or hearing. Medications taken at least weekly ranged from 0 to 11. Fifteen percent of the sample were pre-frail or frail, and the percentage of those with physical illness ranged from 1% (Parkinson) to 22% (osteoarthritis). Mobility limitation at follow-up ranged from 0 to 10 ($M = 2.1$). About 6% reported having fallen at baseline and some 11%, at follow-up. One eighth of the sample reported FOF at baseline.

Table 2 shows the unadjusted bivariate associations between the study variables and the dichotomous outcome variable—falling at follow-up. As may be seen, all the variables were significantly related. Fallers were more likely to be older and female, and less likely to be married and with secondary education or higher. Four countries (Austria, Slovenia, Sweden, and Switzerland) were more likely to have had lower than average fall rates while five other countries (Belgium, Czech Republic, Estonia, France, and Spain) were more likely to have had higher than average rates of falls. Having fallen was more likely among the more depressed and less likely among those with better cognition. Compared with those with normal BMI, those who were overweight had a lesser likelihood of falls, and both the underweight and the obese had a greater likelihood. Falling at follow-up was also more likely among those with poor eyesight, poor hearing, more medications taken weekly, frailty, and any of the eight illnesses considered. It was also somewhat more likely among those with mobility limitation at follow-up. Finally, falling at follow-up was more likely among those with FOF at baseline, and much more likely among those who had fallen at baseline.

Model 1 in the first set of multivariate logistic regression analysis (Table 3) reveals that about half of the confounding variables retained their prior bivariate associations with the outcome variable, albeit to lesser degrees, when all study variables were considered simultaneously. The education variable, however, reversed its prior direction of association. Model 1 also underscores that having fallen at baseline retained its significant bivariate effect on falling at follow-up. As for the independent variables of interest, mobility limitation at follow-up was related to a somewhat greater likelihood of having fallen at follow-up. FOF at baseline was not related.

Model 2 shows the results of the regression after entry of the interaction term. As may be seen, the effect of the confounders remained about the same. However, the interaction of baseline FOF and mobility limitation at follow-up was negative and significant. Moreover, with the entry of the interaction term, the association between mobility limitation and falls at follow-up increased in strength very slightly, while the effect of baseline FOF on falls at follow-up was strengthened considerably, and became statistically significant. Model 3 in the second set of analyses presents the same analysis as in Model 1, but without the frailty measure that was subject to a fair amount of

Table 2. Association of Study Variables With Falling in the Past 6 Months: Unadjusted ORs.

Variables	OR
Sociodemographic background	
Age	1.074***
Female	1.946***
Married/partnered	0.513***
Secondary education[a]	0.623***
Postsecondary education[a]	0.603***
Country[b]	
Austria	0.839*
Belgium	1.195*
Czech Republic	1.612***
Denmark	0.880
Estonia	1.338***
France	1.446***
Germany	0.856
Italy	0.900
Netherlands	0.899
Slovenia	0.602***
Spain	1.706***
Sweden	0.751**
Switzerland	0.680***
Mental health	
Cognition score	0.550***
Depressive symptoms	1.291***
Physical health	
BMI–Underweight[a]	1.838***
BMI–Overweight[a]	0.844**
BMI–Obese[a]	1.164**
Poor eyesight	3.260***
Poor hearing	2.556***
Medications	1.402***
Frailty (pre-frail or frail)[a]	3.308***
Morbidity	
Alzheimer's disease, dementia, senility	3.041***
Cataracts	2.045***
Diabetes	1.637***
Heart attack	1.912***
Hip or femoral fracture	3.518***

(continued)

Table 2. (continued)

Variables	OR
Osteoarthritis/other rheumatism	2.095***
Parkinson	3.679***
Rheumatoid arthritis	2.184***
Mobility limitation	1.339***
Falls	
Fell in W4[a]	5.293***
FOF (W4)[a]	3.722***

Note. OR = odds ratio; BMI = body mass index; FOF = fear of falling.
[a]Reference categories: Education = primary; BMI = normal; frailty = non-frail; falls = did not fall/was not afraid of falling.
[b]Effect coding (deviation from the country mean).
*$p < .05$. **$p < .01$. ***$p < .001$.

missing data. As may be seen, the results remained about the same. More importantly, as may be seen in Model 4, the entry of the interaction term into the larger sample (i.e., including those who had been missing data on frailty) further increased the effect of baseline FOF on falls at follow-up.

The effect of the interaction in Model 4 may be seen more clearly in Figure 1, which shows the relationship between mobility limitation and the adjusted probability of falling at follow-up, by FOF at baseline. It can be seen, first, that up through a high degree of mobility limitation, those with no FOF at baseline were less likely to have fallen at follow-up than those with FOF. This trend is reversed, however, at the highest level of mobility limitation. That is, those with FOF at baseline and the highest extent of mobility limitation at follow-up were less likely to have fallen at the time of follow-up than those with the same degree of mobility limitation but no prior FOF. Reversing the coding of the mobility limitations variable and rerunning the regression analyses underscored, moreover, that the differences at the two extremes were both significant.

Discussion

The present study sought to clarify whether FOF is indeed a risk factor for subsequent falling among older adults, independent of the effects of other factors. This is a difficult association to confirm because FOF is integrally related to other variables, particularly prior falls. Moreover, it is complicated to determine what comes first, falls or fear of falls, because both of these phenomena are part of the same downward spiral of functionality that increases one's vulnerability to falling in late life.

Table 3. Predictors of Falling in the Past 6 Months: Logistic Regression.

	Set 1		Set 2	
	(With frailty variable)		(Without frailty variable)	
	Model 1	Model 2	Model 3	Model 4
n	19,023	19,023	20,654	20,654
Variables	OR	OR	OR	OR
Sociodemographic background				
Age	1.024***	1.023***	1.023***	1.022***
Female	1.290***	1.274***	1.249***	1.235***
Married/partnered	0.765***	0.764***	0.789***	0.788***
Secondary education[a]	1.158*	1.159*	1.094	1.095
Postsecondary education[a]	1.283**	1.293**	1.259**	1.268**
Mental health				
Cognition score	0.862**	0.862**	0.881**	0.882**
Depressive symptoms	1.096***	1.095***	1.097***	1.096***
Physical health				
BMI–Underweight[a]	0.907	0.888	0.937	0.924
BMI–Overweight[a]	0.898	0.899	0.874*	0.874*
BMI–Obese[a]	0.862	0.862*	0.870*	0.870*
Poor eyesight	1.432***	1.434***	1.401***	1.407***
Poor hearing	1.131	1.126	1.084	1.082
Medications	1.094***	1.092***	1.091***	1.089***
Frailty[a]	1.213*	1.210*		
Morbidity				
Alzheimer's disease, dementia, senility	1.002	0.997	0.864	0.853
Cataracts	1.159*	1.158*	1.168*	1.167*
Diabetes	1.026	1.027	1.031	1.031
Heart attack	1.055	1.056	1.044	1.044
Hip or femoral fracture	1.845***	1.847***	1.732***	1.756***
Osteoarthritis/other rheumatism	1.202**	1.195**	1.169**	1.162*
Parkinson	1.622*	1.607*	1.751***	1.734***
Rheumatoid arthritis	1.151	1.155	1.137	1.143

(continued)

Table 3. (continued)

	Set 1		Set 2	
	(With frailty variable)		(Without frailty variable)	
	Model 1	Model 2	Model 3	Model 4
n	19,023	19,023	20,654	20,654
Variables	OR	OR	OR	OR
Mobility limitation	1.159***	1.184***	1.171***	1.195***
Falls				
Fell in W4[a]	2.400***	2.399***	2.280***	2.294***
FOF (W4)[a]	1.149	1.664***	1.172*	1.711***
FOF (W4) × Activity Reduction (W5)		0.918***		0.921***
Pseudo R^2	.144	.145	.150	.151

Note. Adjusted for county (results available on request). OR = odds ratios; BMI = body mass index; FOF = fear of falling.
[a]Reference categories: Education = primary; BMI = normal; frailty = non-frail; falls = did not fall/was not afraid of falling.
*$p < .05$. **$p < .01$. ***$p < .001$.

The first hypothesis in our study posited that FOF is an independent risk factor for falling, beyond the effects of sociodemographic background, health/frailty, and having had experienced a prior fall. The multivariate analyses confirmed that, indeed, baseline FOF was predictive of reported having fallen 2 years later, beyond the respective effects of the other study variables. In the first and third regression models that examined this hypothesis, the effect of FOF was significant, albeit weak. The amount of explained variance in this model was also modest. The strength of FOF as a predictor increased considerably in the final model, however, which is discussed next.

The second hypothesis maintained that mobility limitation moderates the effect of FOF on falling. This hypothesis was confirmed as well. In the final model, both the mobility limitation variable and the FOF measure were significant. Moreover, as mentioned in the previous paragraph, the strength of FOF as a predictor increased meaningfully with the entry of the interaction term between these two variables. The strength of mobility limitation as a predictor in the respective models, on the contrary, remained about the same with and without the interaction.

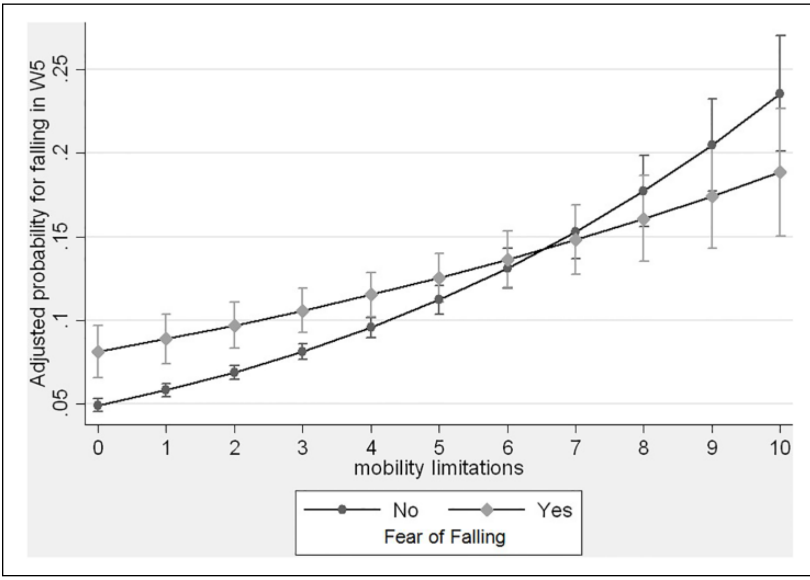

Figure 1. The association of activity reduction and the adjusted probability of falling by FOF.
Note. FOF = fear of falling; W5 = Wave 5.

The graph of the respective effects shed light on the dynamics that are behind the association between FOF and mobility limitation in relation to overall fall probability. The graph showed that FOF predicted subsequent falls when mobility limitation was low to moderate. It was only when mobility limitation was at a high level that the effect of FOF on fall probability became reversed. That is, when mobility limitation was high, it was lack of FOF that was a stronger predictor of subsequent falls. The graph thus underscores that there is a complex association between FOF and mobility limitation in relation to late-life falls.

Our study, which sought to disentangle the effect of FOF through a number of ways, had several advantages. First, the analysis was based upon two consecutive waves of data from SHARE, a major research infrastructure for the analysis of important late-life phenomena. The two waves of data took place 2 years apart, allowing us to consider the effect of FOF at one point in time on the actual reporting of having fell a relatively close period afterwards. In addition, the study design allowed us to control for prior falls, a well-known risk factor for subsequent falling. By controlling for prior falls we were able to examine more accurately the unique effect of FOF.

A third advantage of the present research was its inclusion of the variable of mobility limitation as a moderator. Both falls and FOF are related to mobility limitation, which in turn may increase vulnerability for future falls. Hence, we included in the analysis a count of limitations of 10 key physical mobility functions to capture and to account for this domain. Furthermore, we interacted FOF at baseline with current mobility limitation to better understand the dynamics between the two phenomena. Yet another asset of the current analysis is that it also controlled for baseline frailty in part of the analyses.

Finally, our utilization of a very large sample, which is uniquely provided by SHARE, allowed us to control for the possible effects of a wide range of confounders. The large sample gave sufficient statistical power to take these many variables into account. Moreover, the data on such a large sample of community-dwelling older adults from a wide range of countries offered an unprecedented opportunity to examine the association between FOF and subsequent falls among older adults living at home.

A few limitations of the present analysis should also be noted. First, falls were reported for a given period on a single item. Some research in the domain of late-life falling addresses the nature and extent of falls in a more specific and nuanced manner. This was not the case in the SHARE survey, which utilizes a comprehensive questionnaire addressing a wide range of topics. The amount of time that can be devoted to each topic in SHARE is limited. This is indeed a shortcoming, but is offset by the fact that the SHARE database provides a great number of variables for analysis and a very large number of respondents from nationally representative random samples.

Second, the rate of reported falls in this study is a bit low, about 12% at follow-up and even fewer at baseline. One review has maintained that between 30% and 40% of patients over 65 fall yearly (Ambrose et al., 2013). A study of community-dwelling older adults in the United States, a population that is closer to that of the present study, found that falls were reported by 24% (Bertera & Bertera, 2008). One explanation for the lower rates reported in SHARE is that the period for which information was solicited referred to the previous 6 months. Indeed, one American study that related to falls in the previous 3 months estimated that about 10% of people aged 65 and over reported falling at least once (Boyd & Stevens, 2009). Thus, the lower reported rate of falls in the SHARE data could well stem from the shorter reference period that was used, presumably, to provide greater accuracy to the responses.

A word needs to be said, also, about the increase in the percentage of reported fallers at follow-up. This may be partly due to the fact that falling down was one of only four symptoms queried in the Wave 5 questionnaire compared with 12 symptoms at baseline, in Wave 4. The greater number of symptoms in the baseline probe may have lead to the overlooking of various items, yielding a lower rate of falls. However, it must also be taken into account that all respondents were 2 years older at follow-up, and age is known to be related to a higher degree of falling.

A final limitation concerns the period of measurement that was considered. As falls were reported in each wave of SHARE for the previous 6 months, falls that may have occurred in the interim may not have been reported. Thus, it could be that the real number of fallers is underreported and that some of them are included among the nonfallers at follow-up. This concern requires that the results of the present study be considered cautiously. This limitation notwithstanding, the fact that the SHARE data allow longitudinal analysis is a strong advantage, as it minimizes concerns of reverse causality that are frequent in cross-sectional analysis.

The findings from our study have several important implications. First, we underscored that FOF is an independent risk factor for falling. Stated differently, we find support for the probability that people who are worried about falling tend to fall more often than those who are not similarly worried. There seems to be, therefore, a self-fulfilling prophecy at work. This observation stresses the importance of addressing the self-confidence of older people as a preventive factor in the attempt to reduce falling among older populations. Self-confidence is a malleable feature that can certainly be strengthened through appropriate interventions.

Second, our finding that those who have a high level of mobility limitation but lack FOF are more likely to fall highlights another group at risk, one that has, perhaps, received less attention in the literature. In the case of considerable mobility limitation, it may well be that FOF acts as a protective buffer, limiting the most vulnerable from taking actions that may precipitate falls. The less worried in this group, however, may not be as careful and, as a result, may be subject to greater falling. This topic requires more research and greater professional attention.

In conclusion, we have found that the association between FOF and mobility limitation in relation to late-life falls is a complex dynamic. We believe that with proper understanding of these dynamics, the downward spiral of FOF and falling might be altered to some degree. For this purpose and given the potential benefits that can ensue, continued inquiry into this domain is indeed warranted.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The SHARE data collection has been funded by the European Commission through the 5th framework programme (Project QLK6-CT-2001-00360 in the thematic programme Quality of Life). Further support by the European Commission through the 6th framework programme (Projects SHARE-I3, RII-CT-2006-062193, as an Integrated Infrastructure Initiative; COMPARE, CIT5-CT-2005-028857, as a project in Priority 7; Citizens and Governance in a Knowledge Based Society; and SHARE-LIFE [CIT4-CT-2006-028812]) and through the 7th framework programme (SHARE-PREP No. 211909, SHARE-LEAP No. 227822, and M4 No. 261982) is gratefully acknowledged. Substantial co-funding for add-ons such as the intensive training programme for SHARE interviewers came from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11, and OGHA 04-064). Substantial funding for the central coordination of SHARE came from the German Federal Ministry for Education and Research (Bundesministerium für Bildung und Forschung, BMBF).

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