Article

Impact of falling on social participation and social support trajectories in a middle-aged and elderly European sample

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ARTICLE INFO

ABSTRACT

Whereas falls are frequent and traumatic events for the elderly, their long-term consequences in terms of the social lives of older fallers are understudied. This study aimed to identify the impact of falling on the trajectories of social participation and social support of older people in Europe. Our sample consisted of 16,583 people aged 50–95 years from 10 European countries who responded to the waves 1, 2 and 4 of the Survey of Health Ageing and Retirement in Europe. The impact of falling on the trajectories of social participation and social support was examined using generalised estimating equation (GEE) models. The effect of the interactions between falling and frailty and between falling and social support on social participation was assessed. Falls were negatively associated with social participation (OR=0.73, $p < 0.001$) and positively associated with social support (OR=2.20, $p < 0.001$). For social participation, this effect was moderated by frailty; the interaction term between frailty and fall highlighted the finding that frailty better explained the global trajectory of social participation compared with falling. Social support did not buffer the negative impact of falling on social participation. Falls can be considered stressful events that have implications beyond the health context. Frail people who have fallen should be targeted in prevention and rehabilitation programmes; specific attention should also be paid to the relatives of fallers, who appeared to be more intensively solicited after a fall.

1. Introduction

It is estimated that approximately one-third of people aged 65 years and older fall each year in developed countries (Bauer & Steiner, 2009). Falls are independent risk factors for injuries, hospitalisation, disabilities, and institutionalizations. They are associated with dramatic costs related to morbidity and early mortality (Heinrich, Rapp, Rissmann, Becker, & Konig, 2010). The psychological consequences of falling have been well explored; even when a fall does not occur, the fear of falling can reduce self-efficacy and increase anxious or depressive symptoms (Biderman, Cwikel, Fried, & Galinsky, 2002; Delbaere et al., 2010). Falls and the fear of falling are also significantly associated with a restriction in daily activities, mainly in those related to mobility, which may increase the subsequent risk of falling and of losing autonomy (post-fall syndrome) (Alarcon, Gonzalez-Montalvo, Barcena & Gotor, 2006; Chung et al., 2009).

Despite the numerous consequences of falls, the literature examining falls primarily consists of epidemiological studies, without explicit models or references to specific theories. In this study, we assumed that the stress models and the life course paradigm (Pearlin, 2010; Spini, Hanappi, Bernardi, Oris, & Bickel, 2013) may be useful for studying fall events and their psychosocial consequences. More specifically, this study analysed the relationships between falls and social dimensions of life using the stress proliferation model, which postulates that one stressful life event occurring in a specific life sphere (health, in this case) may have consequences in other life spheres, e.g., the family or the social relations of the person. While there is abundant evidence for the global positive effect of social ties on volunteering or social participation and the buffering effect of social support after life events (Smith & Christakis, 2008; Thoits, 2011), the impact of chronic or acute health conditions such as frailty or injuries on social dimensions has not been well studied. To our knowledge, the social consequences of falling itself have never been examined. By focusing on the impact of falling on both social participation and social support, this paper will fill this gap in the literature.

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2. Theoretical background

2.1. A fall's consequences on social relations

In addition to its physical consequences (Bauer & Steiner, 2009; Heinrich et al., 2010), falling has been found to be an independent predictor of depression (Biderman et al., 2002; Bosma et al., 2004; de Jonge et al., 2006; Scaf-Klomp, Sanderman, Ormel, & Kempen, 2003) and is associated with decreases in the well-being or quality of life of older people (Chang, Chi, Yang, & Chou, 2010; Ruthig, Chipperfield, Newall, Perry, & Hall, 2007). Even if the effect of falling is stronger when this event is followed by traumatic outcomes, there is also evidence that a fall without physical consequences in addition to the fear of falling without a previous fall are significant predictors of lower self-confidence in daily activities or lower quality of life (Alarcon et al., 2006). Data on falling are mainly from cohort studies of older adults, aged 65 years or older. However, according to Verma et al. (2016) and based on American data, in the previous three months, 2.0% of older people and 1.1% of people aged 45–64 reported a fall-related injury. The circumstances of falling differ significantly among age groups and reveal different risk profiles: middle-aged and active older people are more likely to fall outdoors while engaging in social or physical activities, whereas indoor falls tend to occur more frequently among older people and frail individuals (Li et al., 2006).

Whereas the impact of falling on physical and mental health is well known, the possible consequences of such events within other life spheres are understudied. Some qualitative studies have indirectly examined the social consequences of falling (Borkan, Quirk, & Sullivan, 1991; Faes et al., 2010; Kong, Lee, Mackenzie, & Lee, 2002; Roe et al., 2009); for example, they have revealed that older people had chosen to reduce their outdoor activities, which thus reduced their social relationships with friends or family. Using prospective designs, researchers have also found that falls are significantly associated with a restriction in daily activities (e.g., Bertera & Bertera, 2008; Hill, Womer, Russell, Blackberry, & McGann, 2010; Kempen, van Haastregt, McKee, Delbaere, & Zijlstra, 2009) or with an increase in caregiver burden (Kuzuya et al., 2006). However, these researchers did not systematically examine the processes underlying falls, health status and social life; moreover they did not suggest any theoretical explanation for this impact of falling on functioning or social relationships. Finally, we did not find any study that compared the long-term impact of falling on social dimensions among middle-aged and older people, although activity-related falls are more prevalent among younger cohorts.

2.2. The relationships between health and social resources

The stress proliferation (Pearlin, 2010) or stress diffusion (Spini et al., 2013) theory offers a useful framework for understanding the social consequences of fall events. According to this theory, stressful life events very often have consequences in life spheres other than the spheres in which they occur. From this perspective, a health event, such as a fall, can be considered not only a stressor in the health trajectories of middle-aged and older people but also a stressor in other life spheres of individuals. In particular, falls significantly decrease the level of physical resources and thus increase the risk or level of frailty; in turn, this increasing frailty reduces one's ability to continue social activities, which is exacerbated by the higher likelihood of repeated falls and traumatic consequences (Fried et al., 2001; Nowak & Hubbard, 2009). Moreover, a fall can have an effect not only on the victim's life but also on the life on her or his relatives, for example by increasing the support provided by family members (Kuzuya et al., 2006). By analysing the interactions between fall events, frailty and the social sphere (i.e. social participation and social support), stress

proliferation theory might thus yield new insight into the relationship between health and social resources.

Social ties have a globally positive and direct effect on health (Seeman, 1996; Seeman & Berkman, 1988; Sirven & Debrand, 2008; Sirven & Debrand, 2012), even if the processes linking both spheres are not well identified (Smith & Christakis, 2008; Thoits, 2011). In contrast, the inverse relationships, i.e., the effect of health on social ties, have attracted relatively little attention. Good health was certainly found to be a precondition of being socially active (Goll, Charlesworth, Scior, & Stott, 2015; Leone and Hessel, 2015; Sirven & Debrand, 2012). Previous research has underlined the determinants of late-life social participation or volunteering, which are defined as involvement in interpersonal interactions outside the home, including social, leisure, or community activities. Increased age, low socio-economic status, low educational level, and the presence of illness or disabilities were among the strongest risk factors for reduced social participation (Goll et al., 2015). Therefore, their analyses did not take into account the long-term effects of health status on social participation nor the complex interplay between acute health events, health state and social outcomes.

Another series of studies examined the effect of life events on social resources. When unexpected life events (e.g., the loss of a relative or the divorce) occur, there is a decrease in the size of an individual's social network and a strengthening of his/her emotional function (Wrzus, Hanel, Wagner, & Neyer, 2013). A major life event may also transform the nature of daily invisible social support provided by relatives (Thoits, 2011). When social relatives were informed about a major life event occurring in the life of an older person, the social support became intentional, visible, and focused on changing the individual's situation and/or feelings (Thoits, 2011). Social ties did indeed provide active coping assistance, which decreased the stress related to the specific situation by alleviating both the instrumental and emotional consequences of the event. This stress-buffer effect of social support after a life event is well documented (Smith & Christakis, 2008; Thoits, 2011), even if the literature is still quite scarce regarding the health events (Thoits, 2011; Wrzus et al., 2013).

2.3. Aims and hypotheses

Assuming that falls may have a significant and long-term effect not only on the physical or mental health but also on the social life of people, we examined whether the negative effects of falls were diffused across individuals' social resources, i.e., whether stress proliferation processes can be observed. More precisely, considering the association between falls and frailty, we first analysed the impact of falls on both social participation and social support. We postulated the following:

(1) The likelihood of social participation should be lower among people who experienced at least one fall during the six-year follow-up (fallers) than among non-fallers.
(2) The likelihood of receiving social support should be higher among fallers than among non-fallers.
(3) Frailty may reduce the relationships between falling and social participation and/or social support.

Then, we examined the effects of the subjects' initial health status, as measured by frailty, and social support on the relationship between falling and social participation, assuming the following:

(4) Among fallers, frail people or people with low social support are more likely to subsequently report decreased social participation than people with more initial resources.

3. Methods

3.1. Participants

We used the data from the SHARE survey, which provides information on the health, socio-economic status, and social and family networks of individuals aged 50 and older. Details regarding the survey's sampling design, methodology, and questionnaires have been presented elsewhere (http://www.share-project.org). The sample in this study consisted of 16,583 individuals who responded to wave 1 and to at least one wave in 2006/2007 (wave 2) or 2010/2012 (wave 4). The sample was restricted to the ten countries that participated in the first four waves (Denmark, Sweden, The Netherlands, Austria, Germany, France, Belgium, Switzerland, Italy, and Spain).

3.2. Measures

3.2.1. Sociodemographic variables

Education was categorized into 3 categories: 1=*"Less than secondary"*; 2=*"Secondary"*; and 3=*"Tertiary"*. Wealth was measured using the median of the assets calculated by country (0=*"Assets equal to or greater than the median"* and 1=*"Assets less than the median"*). The 10 countries were grouped into three regions as follows: 1=*"North"* (Sweden, The Netherlands, and Denmark); 2=*"Continental Region"* (Austria, Germany, France, Switzerland, and Belgium); and 3=*"South"* (Spain and Italy). Living conditions involved whether people lived alone (1) or with a spouse or partner (0).

3.2.2. Health measures

We used a dichotomized variable to separate people who answered positively to two or more items in the following question: *"For at least the past six months, have you been bothered by any of the health conditions on this card?"* The list included a total of eight conditions (e.g., pain in the back, knees, hips, or any other joint; breathlessness; and sleeping problems). Depressive symptoms were measured by the Euro-D 12-item scale, which was validated in the first wave of the SHARE survey (Castro-Costa et al., 2008). The respondents were asked whether they had experienced any depressive symptoms, such as restless sleep or being unhappy, in the month prior to their interview. Those who reported four or more symptoms were classified as being depressed using a dichotomized indicator.

3.2.3. Frailty

According to Fried's definition and its operationalization for SHARE (Fried et al., 2001; Santos-Eggimann, Cuénoud, Spagnoli, & Junod, 2009), frailty was measured using five criteria. (1) Unintentional weight loss was built using two questions: *"What has your appetite been like?"* and/or *"So have you been eating more or less?"* Participants scored positive for this criterion if they answered either *"Diminution in desire for food"* in response to the first question or *"Less"* in response to the second question. (2) The exhaustion criterion was considered positive if the participant answered "yes" to the self-reported question *"In the past month have you had too little energy to do things you wanted to do?"*. (3) Low physical activity was operationalized using the question *"How often do you engage in activities that require a low or moderate level of energy such as gardening, cleaning the car or going for a walk?"* Participants who answered *"One to three times a month, hardly ever, or never"* were scored positive. (4) Muscle weakness was measured using the highest of four measurements (two from each hand) of handgrip strength after adjusting for gender and body mass index cut-offs as specified by Fried et al. (2001). (5) Slow walking speed was built using two questions: *"Because of health problems, do you*

have difficulty walking 100 m, or climbing one flight of stairs without resting?"* The criterion was met if participants responded affirmatively to either of the two questions. Respondents were then considered as follows: 1=*"Non-frail"* (0 criteria), 2=*"Pre-frail"* (one or two criteria), or 3=*"Frail"* (three or more criteria).

3.2.4. Falling

Based on a series of health conditions that bothered the respondents for the past six months, we selected *"falling down"* and used this variable as a dichotomous indicator, with 1 assigned to people who experienced a particular event and 0 to those who did not.

3.2.5. Social participation

Social participation was measured by the question *"Have you done any of these activities in the past month?"* The following list of activities was systematically explored: performed voluntary or charity work; cared for a sick or disabled adult; provided help to family, friends, or neighbours; attended an educational or training course; attended a sporting event or social or other type of club; participated in a religious organisation (e.g., church, synagogue, mosque); and participated in a political or community-related organisation. A binary variable was constructed to identify the respondents who performed at least one activity from the list. People who did not report any activity were considered to be not socially active.

3.2.6. Social support

We used a binary variable that combined the positive responses to both of the following questions: (1) *"Now, please think about the past twelve months. Has any family member from outside the household, friend, or neighbour given you any type of help?"* and, if "yes", (2) *"Is there someone living in this household who has helped you regularly during the past twelve months with personal care, such as washing, getting out of bed, or dressing?"*

3.3. Statistical analyses

We compared the sociodemographic characteristics, health, depressive symptoms, and social measures between fallers and non-fallers at wave 1 using Pearson's and chi-square tests for the nominal and categorical variables, respectively. We used generalised estimating equations (GEEs) with the log link function and Poisson's distribution to estimate the between-subject effects of the relationships between the occurrence of at least one fall and social participation/social support over the six years of follow-up (Ghisletta & Spini, 2004; Zeger, Liang, & Albert, 1988). We assumed that the within-subject association among the vectors of repeated outcomes would have an independent correlation structure, i.e., correlations fixed at 0. We tested other correlation structures with an exchangeable structure or based on a matrix of the effective correlations in the data (Table 1), and the best goodness-of-fit indices were found for the independent correlation structure (Ghisletta & Spini, 2004). As goodness-of-fit indices, we used the quasi-Akaike Information Criterion (QIC) (Pan, 2001), the Wald $\chi2$ test, and residual analysis performed to assess the presence of outliers and their random distribution (Evans & Li, 2005). To compare the models, we used both the QIC and the likelihood ratio test between the null, non-adjusted model and each of the other theoretically driven models.

We used a hierarchical approach to evaluate the relationship between falls and each independent variable (social participation and social support). First, we adjusted the models for the time (wave) and demographic variables, and models with a quadratic term for age were chosen after a comparison of the goodness-of-fit indices. Then, we added health variables (the presence of physical,

Table 1
Observed correlations between the repeated measures of social participation (A) and social support (B).

	Correlation coefficients		
	T1	T2	T3
(A) Social participation			
T1	1.00	0.46	0.43
T2		1.00	0.46
T4			1.00
(B) Social support			
T1	1.00	0.29	0.21
T2		1.00	0.24
T4			1.00

Note: T1=first wave of the survey (2004–2005); T2=second wave (2006–2007); T3=fourth wave (2010–2012).

chronic, and depressive symptoms). We separately introduced the subjects' frailty status to estimate its ability to moderate the relationship between falling and social participation/social support. We performed these three steps in parallel for the social participation and social support assessments. We finally tested the effects of the interactions between falls and frailty status at baseline and between falls and the social support received at baseline on the changes in social participation. Each interaction term was introduced separately in the model and controlled by the time, sociodemographic, and health variables. We conducted all analyses with Intercooled Stata 13.0 SE (StataCorp, 2013).

3.3.1. Attrition effect

To estimate the effect of attrition, we performed two series of sensitivity analyses. First, using multivariate multinomial regressions, we compared the baseline characteristics of the respondents in at least two waves ($n=16,583$) with those of the people who died ($n=1660$; 6.74%) or had left the survey due to dropout ($n=6387$; 25.93%). Second, we compared the results obtained from a complete case analysis with those obtained from two alternative methods for handling the missing values. Thus, we used multiple inputs from the chained equation technique and an inverse probability weighting procedure, and we repeated all analyses (Seaman & White, 2013; White & Carlin, 2010). A missing at random mechanism was assumed for the missing values. The results were essentially the same between the three data sets, with only a few differences in the standard deviations of the estimates, suggesting that attrition had a minimal impact on our results. Accordingly, we decided to perform complete case analyses.

4. Results

4.1. Sample attrition

The results of the multivariate multinomial regression analysis (not shown) indicated that the people who died were older ($\beta=0.08$; S.E.$=0.00$; $p < 0.001$) and more likely to be frail ($\beta=1.12$; S.E.$=0.12$; $p < 0.001$) at baseline than the respondents. The people who did not answer after the first wave were significantly less educated ($\beta=-0.19$; S.E.$=0.04$; $p < 0.001$) and more likely to be frail ($\beta=0.38$; S.E.$=0.07$; $p < 0.001$) than the respondents who participated in at least two waves. The probability of social participation at baseline was lower among people who were deceased ($\beta=-0.33$; S.E.$=0.07$; $p < 0.001$) or dropped out ($\beta=-0.27$; S.E.$=0.04$; $p < 0.001$), and the probability of social support was higher among those who dropped out ($\beta=0.29$; S.E.$=0.07$; $p < 0.001$) than among the respondents.

Table 2
Baseline characteristics of the sample according to fall status.

Indicators (%)	Any fall	At least one fall	χ^2 (d.f.)
Region			
Continental (vs North)	49.80	45.01	49.63 (2)***
South (vs North)	18.24	31.63	
Age groups			
65–79 years old (vs 50–64 years old)	36.42	45.50	151.39 (2)***
80–95 years old (vs 50–64 years old)	5.67	18.49	
Male (vs female)	45.78	20.92	99.67 (1)***
Educational level			
Secondary (vs lower than secondary)	28.35	21.65	49.97 (2)***
Tertiary (vs lower than secondary)	23.70	13.14	
Low household income	47.04	59.12	23.40 (1)***
Employment status			
Retired (vs employed or unemployed)	47.73	58.39	106.27 (2)***
Inactive (vs employed or unemployed)	17.04	29.44	
Living alone (vs living with a partner)	23.12	39.17	57.15 (1)***
At least two physical symptoms	30.25	77.86	418.96 (1)***
At least two chronic conditions	31.02	72.99	322.39 (1)***
At least four depressive symptoms	21.61	54.74	251.28 (1)***
Frailty status			
Pre-frail (vs non-frail)	40.72	48.18	602.42 (2)***
Frail (vs non-frail)	6.16	35.52	
Participating in at least one social activity	41.49	32.60	12.02 (1)***
Receiving social support	16.32	37.23	124.30 (1)***

Note: The number of respondents was 14,616, 14,205 of whom did not experience a fall during the time of the survey and 411 of whom reported at least one fall in one wave. d.f.=degrees of freedom.

*** $p < 0.001$.

4.2. Characteristics of the sample

Table 2 displays the baseline characteristics of the participants according to their falling status. A total of 411 people (2.81%) reported at least one fall in the six months before the first interview, 429 (3.22%) before the second wave, and 447 (4.47%) in wave 4. Compared with the non-fallers, those who experienced a fall were more likely to be women (79.08% vs 54.26%, $p < 0.001$), to have a poorer education (65.11% vs 48.09%, $p < 0.001$) and financial status (59.12% vs 47.09%, $p < 0.001$), and to have poorer physical (77.86% vs 30.25% for physical symptoms, $p < 0.001$) and mental (54.74% vs 21.61% for depressive symptoms, $p < 0.001$) health. Fallers were less likely to report participation in social activities (32.60% vs 41.46%, $p < 0.001$) but were more likely to receive social support (37.23% vs 16.35%, $p < 0.001$).

4.3. Effects of falling on social participation and social support

Social participation tended to increase slightly with time and to decrease with age (Table 3, Model 1). We observed similar results when each social activity was considered separately. In the adjusted GEE models (not shown), the increase in participation with

Table 3
Multivariate GEE models estimating the effect of falls on social participation.

	O.R. (95% C.I.)					
	Social participation			Social support		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Time	1.25 [1.23, 1.28]***	1.26 [1.24, 1.28]***	1.26 [1.24, 1.29]***	0.94 [0.92, 0.97]***	0.92 [0.90, 0.94]***	0.92 [0.89, 0.94]***
Age	1.10 [1.06, 1.15]***	1.10 [1.05, 1.14]***	1.07 [1.02, 1.11]***	0.79 [0.76, 0.83]***	0.79 [0.76, 0.83]***	0.82 [0.79, 0.86]***
Age^2	0.99 [0.99, 0.99]**	0.99 [0.99, 0.99]***	0.99 [0.99, 0.99]***	1.00 [1.00, 1.00]***	1.00 [1.00, 1.00]***	1.00 [1.00, 1.00]***
At least one fall	0.79 [0.69, 0.90]***	0.86 [0.76, 0.99]*	0.96 [0.84, 1.10]	2.43 [2.12, 2.79]***	1.72 [1.50, 1.98]***	1.51 [1.31, 1.73]***
Region						
North	1.00	1.00	1.00	1.00	1.00	1.00
Continental	0.66 [0.62, 0.70]***	0.67 [0.63, 0.72]***	0.67 [0.64, 0.72]***	0.90 [0.84, 0.97]**	0.84 [0.78, 0.91]***	0.84 [0.78, 0.90]***
South	0.29 [0.27, 0.32]***	0.30 [0.27, 0.33]***	0.31 [0.29, 0.34]	0.69 [0.62, 0.76]***	0.61 [0.55, 0.68]***	0.55 [0.50, 0.62]***
Male	1.02 [0.96, 1.08]	0.98 [0.93, 1.04]	0.99 [0.94, 1.05]	0.87 [0.80, 0.92]***	0.98 [0.91, 1.05]	0.96 [0.90, 1.03]
Educational level						
Secondary	1.00	1.00	1.00	1.00	1.00	1.00
Secondary	1.33 [1.24, 1.43]***	1.32 [1.24, 1.42]***	1.30 [1.23, 1.40]***	1.05 [0.97, 1.13]	1.07 [0.99, 1.15]	1.10 [1.01, 1.19]*
Tertiary	2.20 [2.05, 2.37]***	2.18 [2.02, 2.34]***	2.15 [1.99, 2.31]***	1.06 [0.97, 1.15]	1.10 [1.01, 1.20]*	1.13 [1.03, 1.23]**
Low income	0.75 [0.71, 0.79]***	0.76 [0.72, 0.81]***	0.78 [0.74, 0.83]***	1.13 [1.06, 1.21]	1.06 [0.99, 1.13]	1.02 [0.95, 1.09]
Employment status						
Employed	1.00	1.00	1.00	1.00	1.00	1.00
Retired	1.08 [1.00, 1.17]*	1.10 [1.01, 1.19]*	1.09 [1.01, 1.18]*	1.11 [1.00, 1.23]*	1.04 [0.93, 1.15]	1.03 [0.93, 1.15]
Inactive	1.04 [0.96, 1.14]	1.07 [0.98, 1.16]	1.10 [1.01, 1.20]*	1.38 [1.23, 1.54]***	1.24 [1.11, 1.39]***	1.18 [1.05, 1.31]**
Living alone	1.05 [0.99, 1.13]	1.06 [0.99, 1.13]	1.06 [0.99, 1.14]	2.80 [2.61, 3.00]***	2.75 [2.57, 2.95]***	2.76 [2.57, 2.96]***
Social support	1.04 [0.98, 1.11]	1.08 [1.02, 1.15]*	1.16 [1.09, 1.24]***			
Social participation				1.04 [0.97, 1.10]	1.08 [1.02, 1.16]*	1.16 [1.09, 1.24]***
Physical symptoms		0.91 [0.86, 0.96]***	0.98 [0.93, 1.03]		1.68 [1.57, 1.79]***	1.51 [1.41, 1.61]***
Chronic conditions		0.99 [0.94, 1.04]	1.02 [0.96, 1.07]		1.31 [1.23, 1.39]***	1.25 [1.17, 1.34]***
Depressive symptoms		0.86 [0.76, 0.89]***	0.95 [0.89, 1.02]		1.55 [1.44, 1.66]***	1.20 [1.11, 1.29]***
Frailty status						
Not frail			1.00			1.00
Pre-frail			0.75 [0.71, 0.79]***			1.44 [1.35, 1.55]***
Frail			0.41 [0.37, 0.46]***			3.26 [2.91, 3.66]***
Goodness-of-fit indices						
Wald χ^2 (d.f.)	2,582.66 (14)***	2,637.91 (17)***	2,842.72 (19)***	2,269.52 (14)***	2,933.04 (17)***	3,244.82 (19)***
QIC	48,306.53	48,210.13	47,887.47	31,875.94	31,100.83	30,649.32
Deviance	48,263.57	48,160.20	47,833.10	31,839.38	31,058.43	30,602.88

Note: O.R.=odds ratio. 95% C.I.=95% confidence interval. QIC=quasi-Akaike information criterion. d.f.=degrees of freedom. Models 1 and 4 were adjusted by the time, age, and sociodemographic variables. Health indicators were added to Models 2 and 5. Models 3 and 6 were controlled by the frailty status. Complete case analyses were performed (n=37,927).

*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.

time was also significant for conducting volunteer or charity work (O.R.=1.20; S.E.=0.01; $p < 0.001$), attending educational or training courses (O.R.=1.29; S.E.=0.02; $p < 0.001$), attending a sporting event or social or other type of club (O.R.=1.26; S.E.=0.01; $p < 0.001$), participating in a religious organisation (O.R.=1.14; S.E.=0.01; $p < 0.001$), and participating in a political or community-related organisation (O.R.=1.11; S.E.=0.01; $p < 0.001$). Falling significantly decreased the probability of social participation in each of these activities and of participation in at least one of them, but only before frailty was introduced into the models (Table 3, Models 2 and 3). Frailty is indeed a strong confounder in the relationship between falls and social participation. When it is taken in consideration in multivariate models, the size of the effect for falling decreased and was no longer significant.

In contrast, the probability of receiving social support decreased with time and increased with age. Even if the size of the effect decreased after the introduction of frailty, falling was significantly associated with a higher level of social support in the final model (Table 3, Model 3).

For both of the final models, the residual analysis did not reveal the presence of outliers or a non-random distribution of social participation or social support. The quasi-AIC was lower in the final models than the previous models without adjustment, and the Wald test result was significant, indicating a good fit of our models.

4.4. Frailty, but not social support, moderate social participation

A second round of analyses examined the relationship between falls and social participation by examining the interaction between falls and initial frailty status on the one hand and that between falls and social support on the other. The interaction between initial frailty status and falling was significant (Table 4, Model 7a). Contrast analyses revealed that the probability of social participation was less among frail people than among people who did not meet any of the frailty criteria in both fallers (χ^2 (1)=6.93; $p < 0.01$) and non-fallers (χ^2 (1)=41.21; $p < 0.001$). However, among fallers, no difference was found between people that did not satisfy any criteria of frailty and people with pre-frail status, who reported the same probability of social participation (χ^2 (1)= 0.38; p=0.538) (Fig. 1). The interaction between social support at baseline and falling was not significant (Table 4, Model 7b).

5. Discussion

Based on a very large sample of Europeans aged 50–95 years, this study aimed to examine the effect of fall events on the long-term trajectories of social participation and social support.

First, we found that fall events, even when they occurred only one time during the survey and regardless of their physical

Table 4
Multivariate GEE models estimating the effect of the interactions between falling and initial resources on the changes in social participation and social support.

	O.R. (95% C.I.)	
	Model 7a – frailty	Model 7b – social support
Fall × frailty		
Non-faller, non-frail	1.00	
Faller, non-frail	0.81 [0.62, 1.05]	
Non-faller, pre-frail	0.83 [0.78, 0.88][***]	
Faller, pre-frail	0.86 [0.72, 1.04]	
Non-faller, frail	0.54 [0.47, 0.62][***]	
Faller, frail	0.43 [0.31, 0.58][***]	
Fall × social support		
Non-faller, no social support		1.00
Faller, no social support		0.90 [0.77, 1.06]
Non-faller, social support		1.07 [0.98, 1.16]
Faller, social support		0.84 [0.66, 1.07]
Goodness-of-fit indices		
Wald χ^2 (d.f.)	2,646.31 (18)[***]	2,638.29 (19)[***]
QIC	47,363.74	48,211.74
Deviance	47,308.24	48,156.55

Note: O.R.=odds ratio. 95% C.I.=95% confidence interval. QIC=quasi-Akaike information criterion. d.f.=degrees of freedom. Each model was adjusted by the time, sociodemographic status (age, age^2, gender, employment status, income level, and living conditions), and health indicators (physical and depressive symptoms, chronic conditions, frailty status). Complete case analyses were performed ($n=37,927$).

[***] $p < 0.001$.

consequences, were independent, direct predictors of increased social support. This result was consistent with stress proliferation theory, which postulates that an event may have effects beyond the sphere in which it occurred and even in the lives of relatives (Pearlin, 2010; Spini et al., 2013). Our findings underlined the

stronger involvement of relatives when a fall occurred; after adjustment for the sociodemographic and health variables, the probability of receiving social support was significantly higher among fallers than among people who did not experience any falls throughout the survey period. A few qualitative studies have suggested that falling may cause fear, anxiety, and feelings of powerlessness among relatives, mainly spouses and children (Faes et al., 2010; Liddle & Gilleard, 1995). Falls may also increase the burden of caregivers, especially when they take care of people with complex needs or dementia (Davey, Wiles, Ashburn, & Murphy, 2004; Kuzuya et al., 2006). After a stressful life event, the social support indeed changed in nature (Thoits, 2011). When a stressful life event occurred and relatives were informed about this occurrence, social support became visible and directly aimed at providing both instrumental and emotional support to the victim. Previous studies suggested that this form of reactional support should be short in duration, as the level of such social support should decrease after the people have dealt with the consequences of the life event (Wrzus et al., 2013). However, our research underlined the long-term and independent effects of falling on social support.

Then, we demonstrated the major role of frailty in the relationship between falling and social participation. The construction of the frailty phenotype (Fried et al., 2001; Santos-Eggimann et al., 2009) was based on its physical component. In this manner, frailty and falling were very close constructs. They shared similar risk factors, such as mobility disorders or bone density, and they had similar consequences in terms of disability or mortality. Moreover, we showed that they had similar consequences in terms of social participation. Thus, it may be difficult to distinguish between the two concepts and to identify a specific impact of falling (Nowak & Hubbard, 2009). However, our analyses showed that the continuity in or disengagement from social activities was due to a long-term process that was amplified by health events, rather than by the falls themselves. In this stress proliferation process, falls can
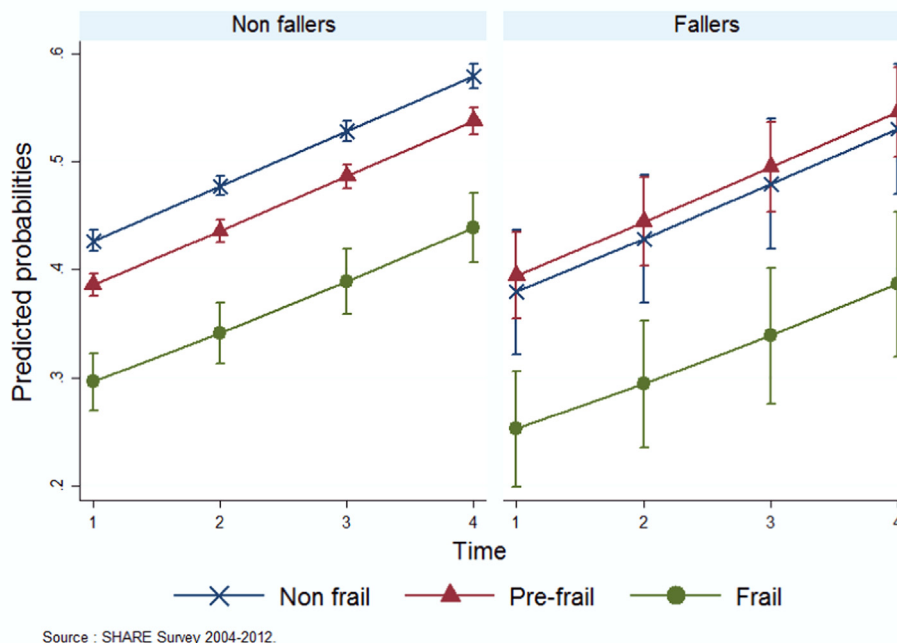

Fig. 1. Predicted probabilities of social participation among fallers and non-fallers according to frailty status at baseline. This figure represents the predicted probabilities and 95% confidence intervals of social participation at each time point of the survey among people who reported at least one fall during the time of the survey ($n=411$) and people who did not report any such event ($n=14,205$). The proportions were predicted from a GEE model adjusted by the time, sociodemographic status, and health indicators and included an interaction term between falls and frailty status at baseline.

also be considered secondary stressors in the relationship between frailty and social participation; fallers indeed exhibited lower odds of long-term social participation than non-fallers, and this effect was even more marked among fallers with initial frailty than among fallers classified as non-frail or pre-frail.

Our study included both middle-aged and older people and revealed, after controlling for age, significant effects of falling on social participation and on social support. Although the objective of our paper was not to distinguish the differential effects of falling among age groups, we also tested the interaction effect between falling and age (not shown), which was not significant. There was evidence that the circumstances of falls are different for middle-aged and active people, who are more often affected by outdoor falls and falls during social or physical activities, than for older and frail people, who fall more frequently at home (Li et al., 2006). Such studies, and our own findings, have highlighted the necessity to take into account criteria other than age for analysing the consequences of fall events.

Finally, while social support is often described as buffering the stressful effect of life events (Smith & Christakis, 2008; Thoits, 1995; Thoits, 2011), we did not find a similar result for the relationship between falling and social participation. Our results differed from previous studies that showed that social relationships (Mortimore et al., 2008) or social support (Kempen et al., 2003; Kempen, Scaf-Klomp, Ranchor, Sanderman, & Ormel, 2001) buffered the effect of fall-related injuries on the recovery process. In addition to the differences in the measurements of falling and social dimensions, the strong interaction between falling and frailty may also explain this difference, as falls were signs of the frailty process, which causes a progressive and irreversible reduction of social activities. The increased social support provided to fallers may, therefore, be aimed at addressing their losses in mobility and functional health, but it was not able to alleviate the social disengagement.

This study has several limitations. First, we used the existing measures from the SHARE survey and were not able to add some measures that may be more appropriate for estimating the impact of falling. For example, we could not explore the stressful characteristics of this event or the coping strategies of the respondents. Moreover, the reports of falls did not correspond to validated and recommended assessments. Falls were to be reported over a period of six months, along with other physical symptoms, such as dizziness and urinary incontinence. The Prevention of Falls Network Europe (PROFANE) recommended that the question of whether the respondents experienced a fall during the past year should be asked (Lamb, Jörstad-Stein, Hauer, & Becker, 2005). Consequently, the prevalence of falls in the SHARE survey was significantly lower than that in other epidemiological studies in community-dwelling older people. However, the relationships between falls and physical indicators were consistent with previous findings. Another limitation was the small number of follow-up cases and the difference in time intervals between waves. These analyses should be replicated with surveys performed at shorter time intervals and/or with a larger number of follow-up cases to distinguish between the short- and long-term effects of falling on different life spheres.

6. Conclusion

Despite its limitations, this research addressed several aspects of fall prevention and rehabilitation. First, it showed that frailty and falls were closely interrelated; falls may be a reliable indicator of frailty and may be systematically researched by professionals as a screening tool (Ensrud et al., 2008; Kiely, Cupples, & Lipsitz, 2009). Second, our research demonstrated that falling caused a decrease in social participation and an increase in social support. This social impact of falls may become an outcome for preventive or rehabilitative interventions. In a few cases, the social benefits of the interventions were highlighted as determinants of retention (Kwok, 2008; Nyman, 2011). However, to our knowledge, such interventions did not measure the effect of social participation on changes in the caregivers' burden or in the intensity or nature of social support. Our research underlined the fact that falls not only have consequences in terms of physical and mental health but also have social impacts, which should be better assessed in future studies and in prevention and rehabilitation programmes.

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