

Fear of Falling is More Important Than Previous Falls in Terms of Limiting Activities: A Longitudinal Study

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Abstract

Background: Fear of falling and previous falls are both risk factors that affect daily activities of older adults. However, it remains unclear whether they independently limit daily activities accounting for each other. This study aims to examine whether previous falls and fear of falling independently predict limited daily activities among older adults.

Methods: We used the data from Round 1 to Round 5 of the National Health and Aging Trends Study. We included a total of 866 community-dwelling participants who provided data on previous falls, fear of falling and limited activities from Round 1 to Round 5 and had no limited daily activities at Round 1 in this study. Previous falls and fear of falling were ascertained by asking participants whether they had fallen in the past year and whether they had worried about falling in the last month. Limited daily activities included any difficulties with mobility (e.g., going outside), self-care (e.g., eating), and household activities (e.g., laundering). Generalized estimation equation models were used to examine whether previous falls and fear of falling independently predicted development of limited daily activities adjusting covariates.

Results: Participants were mainly between 65 and 79 years old (83%), male (57%), and non-Hispanic White (79%). Among participants who fell in Round 1, 13.2%-27.6%, 29.0%-52.0%, and 18.4%-32.9% developed limitations in mobility, self-care, household activities during Round 2 to Round 4, respectively. Among those who had fear of falling in Round 1, 22.5%-41.3%, 30.0%-55.0%, and 18.8%-36.3% developed limitations in mobility, self-care, and household activities during Round 2 to Round 4, respectively. Fear of falling independently predicted limitations in mobility (Incidence rate ratio [IRR]: 1.86, 95% CI: 1.50, 2.31), self-care (IRR: 1.32, 95% CI: 1.11, 1.62) and household activities (IRR: 1.34, 95% CI: 1.11, 1.62) after adjusting for previous falls and covariates. Previous falls only independently predicted limitations in mobility (IRR: 1.30, 1.08, 1.56) and household activities (IRR: 1.27, 95% CI: 1.05, 1.54) after adjusting fear of falling and covariates.

Conclusions: While recognizing the risk factor of previous falls, fear of falling can be a more critical factor to intervene to reduce limited daily activities.

Introduction

About 18 million United States older adults have daily activity limitations, and this number is expected to increase rapidly in the coming decades [1, 2]. Activity limitations arise when older adults have difficulty or need help performing daily activities. Limitations in performing daily activities are common in areas such as mobility, self-care, and household activities. For example, about 18% of United States older adults have difficulty for mobility or self-care activities, and 25% need help with household activities [1]. Activity limitations can have adverse effects on older adults' health, and it has been a major limitation to social participation and disability [3].

Fear of falling and previous falls are two important and different predictors of activity limitations in older adults [4–6]. Fear of falling is a persistent concern about falling, which may lead older adults to avoid activities that they are still able to do [7]. About 20–60% of community-dwelling older adults have fear of falling, and 20–55% report activity limitation due to fear of falling [8]. About 30–50% of independently living older adults fears of falling whether or not they have previous falls [9]. In the short term, fear of falling may seem to reduce the occurrence of falls by avoiding activities, but by reducing strength and balance, in the long run, it may limit the ability of older adults to perform daily activities, resulting in physical function decline [10–12]. Studies also have shown that previous falls have adverse effects on function and loss of confidence, which may lead to limited activities [13]. There is a vicious cycle between fear of falling and previous falls in that they predict future falls, are outcomes of falls, and make future falls more likely. It is possible that fear of falling can put more risks on limited activities than previous falls because more studies have shown fear of falling to be associated with loss of function, social isolation, more falls, frailty, decreased mobility, and increased mortality [14–16].

Although there has been extensive research on fear of falling and previous falls as major risk factors resulting in limited daily activities, it is not clear whether fear of falling independently predicts limited activities controlling for previous falls, and vice versa from longitudinal studies. One longitudinal study found that the effects of fear of falling on declines of activities of daily living (ADLs) in non-fallers were as strong as those in fallers. However, it did not evaluate the effects of falls on declines in ADLs, and a clinical sample from a trial was used [17]. It is important to identify their independent effects on activity limitations because fear of falling is a psychological construct, and falls are physical [7]. Both are modifiable but may require different types of preventive strategies [18].

The purpose of this study is to examine the independent effects of previous falls on limited daily activities adjusting for covariates and fear of falling in older adults, and the independent effects of fear of falling on limited daily activities adjusting for covariates and previous falls in older adults. We hypothesized that fear of falling has a greater independent impact on developing activity limitations than previous falls.

Methods

The study was longitudinal, and aimed to examine whether previous falls and fear of falling independently predict limited daily activities among older adults. We used data from Round 1 to Round 5 of the National Health and Aging Trend Study (NHATS), which is a nationally representative survey of United States Medicare Beneficiaries aged 65 or older. The study was designed to investigate differences in the trajectory of various at-risk subgroups and sub-healthy older adults and deepen understanding of the gradual aging of older adults towards the end of life [19]. The data were collected in 2011 (N = 8,245) and then tracked annually [20]. Information on participants' physical and cognitive abilities, daily activities, and physical environment were collected via in-person interviews. The Johns Hopkins University Institutional Review Board approved the research protocol. We included a total of 866

community-dwelling participants who provided data on previous falls, fear of falling and limited activities from Round 1 to Round 5 and had no limited daily activities at Round 1 in this study.

Measures

Dependent Variables

Daily activity limitations included any difficulties or needing help with mobility (going outside, getting around inside, and getting in and out of bed), self-care activities (eating, bathing, toileting, and dressing), household activities (laundrying, shopping, preparing meals, managing bills, and taking medications). For mobility and self-care activities, participants were asked the extent to which activities were accomplished independently in the last month, the frequency of using assistive devices to accomplish tasks last month, how often they got help from others, how much difficulty it was to independently accomplish the task, and compared to a year ago whether they accomplished the task more often, less often, or about the same. For household activities, participants were asked if anyone else had accomplished the activities with them in the last month for some reasons such as health, how difficult to accomplish the activities by themselves, and whether they accomplished activities by themselves more or less often than a year ago [21].

We classified limitations in mobility, self-care, and household activities into four levels: 1) No limitations on daily activities, which mean no use of equipment, no difficulties in activities, no need for help, or no reduction in

frequency. 2) Need to use the equipment without encountering difficulties or receiving help from others. 3) Have difficulty working alone, but does not accept help from others. 4) Need help from others due to health, function, or living in nursing home [21]. Numbers of activity limitations in mobility, self-care, and household activities Participants were further classified into two groups based on these four levels: 1) No limitation in daily activities (level 1). 2) Have limitations in daily activities (level 2, 3, and 4). With these criteria, we also created variables to indicate the mean numbers of activity limitations in mobility, self-care, and household activities, respectively.

Independent Variables

Previous falls were measured with the question: “In the past 12 months, have you (or sample person, in the case of the surrogate interview) fallen down?” The answer was yes or no. A fall was defined as having a fall, trip, or slip on the floor, or lower level because of losing balance.

Fear of falling was measured by asking participants to the question: “In the last month, did you (or sample person, in the case of the surrogate interview) worry about falling down?” The responses were yes or no and we classified it as a binary variable.

Covariates

Sociodemographics

Information on age group, sex, race/ethnicity, education and living arrangements were collected.

Health-related Factors

The BMI was calculated by dividing the current body weight in kilograms by the square of the height in meters, and obesity is defined as a BMI greater than or equal to 30 kg/m². Chronic diseases were assessed by asking participants whether doctors had diagnosed any of the following: heart attack, heart disease, high blood pressure, arthritis, osteoporosis, diabetes, lung disease, stroke, cancer and dementia/Alzheimer's disease. Hospitalizations were evaluated by asking participants if they had been hospitalized in the past year [22].

Behavioral Factors

Smoking status was determined by the response to ever smoked or currently smoke cigarettes regularly, at least 1 cigarette a day. Vigorous activities were assessed by asking participants whether they ever spend time on vigorous activities in the last month.

Data Analysis

We first used frequencies and proportions to describe the demographic and health-related characteristics of all participants and then use Chi-square tests to compare these characteristics between those with and without previous falls, and between those with and without fear of falling reported in Round 1. We then calculated the

percentages of participants who developed limitations in mobility, self-care, and household activities at follow-ups by previous falls and fear of falling status. We also used Chi-square tests to examine the associations between previous falls and fear of falling in Round 1 and development of activity limitations in mobility, self-care, and household activities at follow-ups.

To investigate the independent effects of previous falls and fear of falling on development of activity limitations, we used generalized estimating equations (GEEs) with a Poisson distribution to model the prior-wave (period $t-1$) falls or fear of falling on the probability of having activity limitations at each current wave (period t) assessment using the log link function. GEE models are an extension of generalized linear models for analyzing longitudinal data accounting for the correlation of repeated measures. Using the lagged independent variables allow us to determine the temporal effects of falls and fear of falling on development of activity limitations in this study. Independent effects of previous falls and fear of falling were examined in three steps. First, we included previous falls as the main predictor of each activity limitation in the models, only adjusting for covariates (Model 1). Second, we examined fear of falling as the main predictor of each activity limitation in the model, only adjusting for covariates (Model 2). Finally, we included both previous falls and fear of falling as predictors of each activity limitation adjusting for covariates to examine their independent effects on activity limitations (Model 3). All analyses were performed using Stata version 14.0 (Stata Corp, College Station, Texas, USA); $p < .05$ (two-

tailed) was used to indicate statistical significance. Incidence rate ratios (IRRs) and 95% confidence intervals (CIs) were reported from GEE models.

Results

Sample Characteristics

The participants without activity limitations in Round 1 were mostly aged between 65 and 79 years old. About 57% were male, 60% received some college education or higher, the majority were non-Hispanic White (79%), and about 26% lived alone. They were generally healthy, with only about 24% being obese, 8% ever smoked, 18% having none chronic condition, 88% not hospitalized in last year, and about half performing vigorous activities in the last year. About 18% and 9% of participants had previous falls and fear of falling in Round 1, respectively. Participants who fell last year were more likely to be female and have a smoking history. Those who had fear of falling tended to be older females and with 3 or more chronic conditions (Table 1).

Table 1
Sample Characteristics by Previous Falls and Fear of Falling Status in Round 1 (n, %)

Variables	All	Previous Falls in Round 1			Fear of Falling in Round 1		
		No	Yes	P value	No (n = 786)	Yes (n = 80)	P value
Age (y)				.18			.041
65–79	720 (83.1)	588 (81.7)	132 (18.3)		660 (91.7)	60 (8.3)	
80–90+	146 (16.9)	126 (86.3)	20 (13.7)		126 (86.3)	20 (13.7)	
Sex				.049			.011
Female	371 (42.8)	295 (79.5)	76 (20.5)		326 (87.9)	45 (12.1)	
Male	495 (57.2)	419 (84.7)	76 (15.4)		460 (92.9)	35 (7.1)	
Education				.28			.17
Less than high school	134 (15.6)	106 (79.1)	28 (20.9)		126 (94.0)	8 (6.0)	
High school graduates	209 (24.3)	173 (82.8)	36 (17.2)		184 (88.0)	25 (12.0)	
Some college or vocational school	195 (22.7)	169 (86.7)	26 (13.3)		174 (89.2)	21 (10.8)	
Bachelor or higher	323 (37.5)	262 (81.1)	61 (18.9)		298 (92.3)	25 (7.7)	
Race				.35			.08
White, non-Hispanic	684 (79.0)	562 (82.2)	122 (17.8)		619 (90.5)	65 (9.5)	
Black, non-Hispanic	128 (14.8)	111 (86.7)	17 (13.3)		122 (95.3)	6 (4.7)	
Hispanic	30 (3.5)	23 (76.7)	7 (23.3)		25 (83.3)	5 (16.7)	
Indian/Asian/Native/Hawaii/Other	24 (2.8)	18 (75.0)	6 (25.0)		20 (83.3)	4 (16.7)	
Living				.25			.32

Variables	All	Previous Falls in Round 1			Fear of Falling in Round 1		
		No	Yes	P value	No (n = 786)	Yes (n = 80)	P value
Alone	221 (25.6)	182 (82.4)	39 (17.7)		198 (89.6)	23 (10.4)	
With spouse/partner only	483 (56.0)	394 (81.6)	89 (18.4)		443 (91.7)	40 (8.3)	
With others only	77 (8.9)	61 (79.2)	16 (20.8)		66 (85.7)	11 (14.3)	
With spouse/partner and with others	81 (9.4)	73 (90.1)	8 (9.9)		75 (92.6)	6 (7.4)	
BMI				.33			.12
Normal	662 (77.5)	542 (81.9)	120 (18.1)		607 (91.7)	55 (8.3)	
Obesity	192 (22.5)	163 (84.9)	29 (15.1)		169 (88.0)	23 (12.0)	
Smoking				.044			.58
No	798 (92.2)	664 (83.2)	134 (16.8)		723 (90.6)	75 (9.4)	
Yes	68 (7.9)	50 (73.5)	18 (26.5)		63 (92.7)	5 (7.4)	
Vigorous activities				.59			.18
No	393 (45.4)	321 (81.7)	72 (18.3)		351 (89.3)	42 (10.7)	
Yes	473 (54.6)	393 (83.1)	80 (16.9)		435 (92.0)	38 (8.0)	
Number of chronic illnesses				.43			.043
No disease	157 (18.1)	135 (86.0)	22 (14.0)		149 (94.9)	8 (5.1)	
1 ~ 3	603 (69.6)	493 (81.8)	110 (18.2)		546 (90.6)	57 (9.5)	
≥ 4	106 (12.2)	86 (81.1)	20 (18.9)				
Hospitalization				.09			.88

Variables	All	Previous Falls in Round 1			Fear of Falling in Round 1		
		No	Yes	P value	No (n = 786)	Yes (n = 80)	P value
No hospitalization	764 (88.2)	636 (83.3)	128 (16.8)		693 (90.7)	71 (9.3)	
At least one hospitalization	102 (11.8)	78 (76.5)	24 (23.5)		93 (91.2)	9 (8.8)	

Association of Round 1 Previous falls, Round 1 Fear of falling (fear of falling), and Development of Activity Limitations from Round 2 to Round 5

Figure 1 shows the percentage of participants who developed activity limitations from Round 2 to Round 5 by previous falls and fear of falling status at Round 1. Overall, among participants with reported previous falls or fear of falling at Round 1, the percentages of developing limitations in mobility, self-care, and household activities steadily increased from Round 2 to Round 5. For example, among participants who reported a fall at Round 1, 13.2%-27.6% developed limitations in mobility, 29.0%-52.0% experienced limitations in self-care activities, and 18.4%-32.9% had household activity limitations during follow-ups Round 2 to Round 5. Round 1 previous falls were only significantly associated with a higher percentage of participants who had limitations in self-care activities in Round 4 and household activities in Round 5. However, Round 1 fear of falling significantly contributed to developing limitations in mobility, self-care, and household activities in the following years. For example, participants who had fear of falling in Round 1 were more likely to have limitations in mobility since Round 2 and limitations in self-care activities since Round 3 (Fig. 1).

Independent Effects of Previous Falls and Fear of Falling on Activity Limitations

Table 2 summarizes incidence rate ratio estimates of activity limitations adjusting for covariates from GEE models. Model 1 and Model 2 showed that both previous falls and fear of falling in the prior year independently predicted development of limitations in mobility, self-care, and household activities a year later after adjusting for covariates. For example, the incidence rate of mobility limitations was 1.52 times greater among those who fell last year compared to those without previous falls (IRR: 1.52, 95% CI: 1.26, 1.82). Participants who had fear of falling in the prior year also had a significant higher incidence of mobility limitations compared to those without fear of falling (IRR: 1.95, 95% CI: 1.57, 2.42). After including both previous falls and fear of falling in the adjusted models, previous falls (IRR: 1.30, 1.08, 1.56) and fear of falling (IRR: 1.86, 95% CI: 1.50, 2.31) still independently predicted subsequent mobility limitations; which was also true for limitations in household activities (IRR: 1.27, 95% CI: 1.05, 1.54) vs. (IRR: 1.34, 95% CI: 1.11, 1.62). However, only fear of falling significantly independently predicted

subsequent self-care activity limitations (IRR: 1.32, 95% CI: 1.11, 1.62) after including previous falls and fear of falling in the adjusted models.

Table 2
Independent Effects of Previous Falls and Fear of Falling on Developing Activity Limitations

Variables	Model 1	Model 2	Model 3
	IRR [95%CI]	IRR [95%CI]	IRR [95%CI]
Mobility			
Previous Falls	1.52 [1.26,1.82]***		1.30 [1.08,1.56]**
Fear of Falling		1.95 [1.57,2.42]***	1.86 [1.50,2.31]***
Self-care activities			
Previous Falls	1.17 [1.05,1.31]**		1.10 [0.98,1.23]
Fear of Falling		1.34 [1.16,1.55]***	1.32 [1.14,1.52]***
Household activities			
Previous Falls	1.45 [1.20,1.75]***		1.27 [1.05,1.54]*
Fear of Falling		1.53 [1.20,1.95]***	1.34 [1.11,1.62]**
* IRR=incidence rate ratio; * $p < .05$, ** $p < .01$, *** $p < .001$.			
† All models adjusted for demographic covariates (age, sex, education, race/ethnicity, living arrangement), health-related covariates (BMI, number of chronic illnesses, hospitalizations), and behavioral covariates (smoking and vigorous activities).			

Discussion

Using a nationally representative sample of community-dwelling older adults, this study examined the independent effects of fear of falling on development of activity limitations adjusting for covariates and previous falls, and vice versa. The prevalence rates of previous falls and fear of falling in Round 1 of this study were 18% and 9%, respectively. These rates were lower than those of previous studies in which fall rates ranged from 29–45% and fear of falling rates ranged from 20–60% [23–28]. This is expected as we excluded participants with limited activities in Round 1 for the study purpose.

As we hypothesized, fear of falling may have a greater impact on daily activity limitations than previous falls. This hypothesis was confirmed by results from the adjusted GEE models. Delbaere et al. showed that previous falls do not directly lead to changes in daily behaviors, but effective-cognitive variables associated with falls, such as a concern about falling during activity, can mediate this process [29]. Further their modelling supported that catastrophic fear of falling, such as fear of hip fracture or institutionalization, can lead to activity and mobility restriction without having had a fall. Thus, fear of

falling as an affective-cognitive variable, whether a worry about falls or a fear of falling, is an important influencing factor leading to changes in daily activities. Another study has shown that even without previous falls, there was still a strong relationship between fear of falling and limited daily activities [28]. Excessive fear of falling can have a major impact on physical performance and lead to poor balance [30, 31]. In some older adults with impaired mobility, fear of falling may result in ADLs impairments, depression, and disability [14, 15, 32, 33]. On this basis, our research adds to previous research findings, recognizing that fear of falling may be more important than previous falls in limiting the daily activities of older adults. Studies have shown that fear of falling can be alleviated by improving cognitive behavior and daily activities in older adults [34, 35]. For older adults who have fear of falling, lifestyle changes are recommended to achieve effective intervention and reduce the incidence of falls [36].

Our results showed that fear of falling had a significant impact on limited self-care activities, but previous falls did not. Self-care activities include eating, bathing, toileting, and dressing, which are considered to be ADLs [37]. Hoang al. pointed out that there is a strong negative correlation between the score of ADLs and fear of falling [38]. The lower the ability to perform daily activities, the less secure people felt about their physical abilities, and the more likely to experience fear of falling. Similarly, our study shows that fear of falling has a greater impact on self-care activities in older adults. One explanation is that fear of falling can lead to activity limitations for older people, which in turn leads to a decline in activity capacity, and eventually have the consequences of being afraid to go out. Staying at home for a long time in older adults can lead to a significant decrease in their daily activities, which leads to a decrease in physical ability and confidence in self-care activities [9]. The association between fear of falling and self-care activities may contribute to the development of prevention strategies to reduce the daily activity limitations of older adults, and improving their confidence in daily activities.

One strength of this study is that we used a nationally representative longitudinal dataset that allows us to examine the temporal effects of previous falls and fear of falling on the development of activity limitations. A comprehensive list of covariates were assessed and adjusted for in this study and this allows to provide relatively robust findings. However, there are also some limitations to this study. First, fear of falling was measured by a single item asking if they were worried about falling for which the reliability and validity are still unknown. However, this measure has been widely used in cohort studies and showed consistent findings on health outcomes. Second, recall bias might occur when asking participants about fall experience. We used previous falls as a binary variable instead of a continuous variable, which may lessen the threat to the robustness of our findings. Third, our sample is relatively small after excluding those who missed for follow-ups and had activity limitations in Round 1, therefore, our study results mainly apply to predominantly healthy and physically active older adults. Yet, fear of falling could have a less relevant influence on daily activities in subjects presenting with a higher number and severity of comorbidities, which may have a greater impact than fear of falling on individuals' autonomy.

Conclusions

In summary, while both previous falls and fear of falling are important predictors of limitations in performing daily activities, fear of falling may have a greater adverse impact on developing limitations in major daily activities than previous falls. Regardless of older adults' fall experience, useful strategies should be developed and applied to reduce fear of falling among older adults in order to improve their ability to perform daily activities and stay physically independent.

Abbreviations

ADLs
Activities of Daily Living; NHATS, National Health and Aging Trends Study; GEE:Generalized Estimating Equations; IRR:Incidence rate ratio; BMI:Body Mass Index; CI:Confidence Interval.

Declarations

Ethics approval and consent to participate

This is a secondary data analysis study using the National Health and Aging Trends Study database which is a publicly available to researchers and does not require access permission. The National Health and Aging Trends Study was approved by the Johns Hopkins University Institutional Review Board. The current analyses were deemed exempt by the Johns Hopkins School of Medicine.

Consent for publication

Not applicable.

Availability of data and materials

The NHATS data analyzed in the current study are available for research purposes at www.nhats.org.

Competing interests

The authors declare that they have no competing interests.

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None.

Authors' contributions

ML: study concept and design, acquisition of data, and analysis, interpretation of data, final approval of version to be published. TH: drafting of the manuscript, critical revision of the manuscript for important intellectual content. YL, XS, SLS, PMD, LC: critical revision of the manuscript for important intellectual content.

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Figures

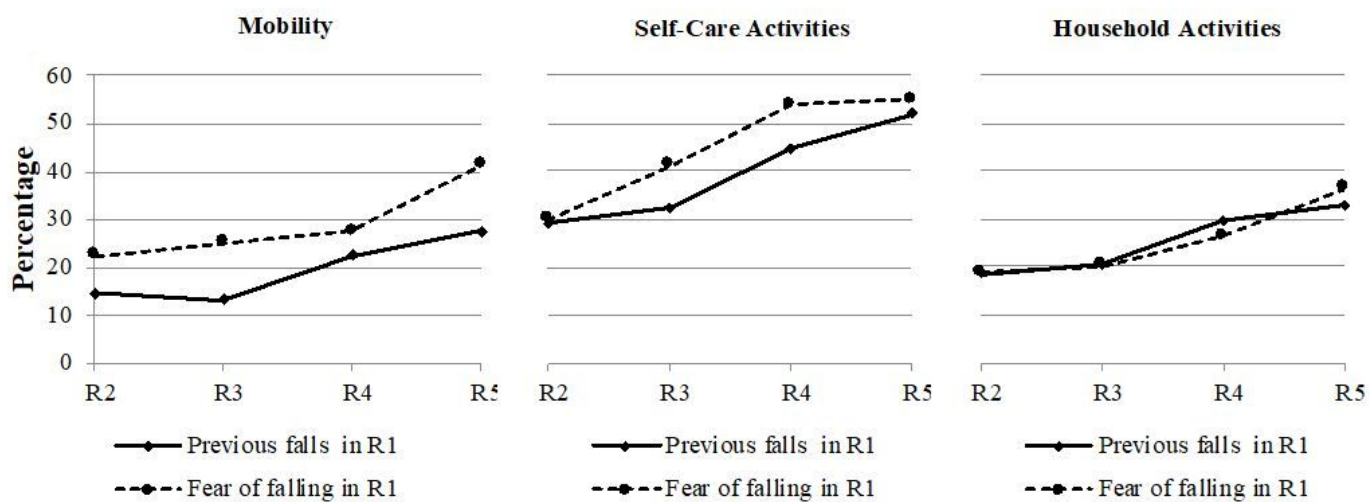


Figure 1

Percentages of participants who developed activity limitations from Round 2 to Round 5.

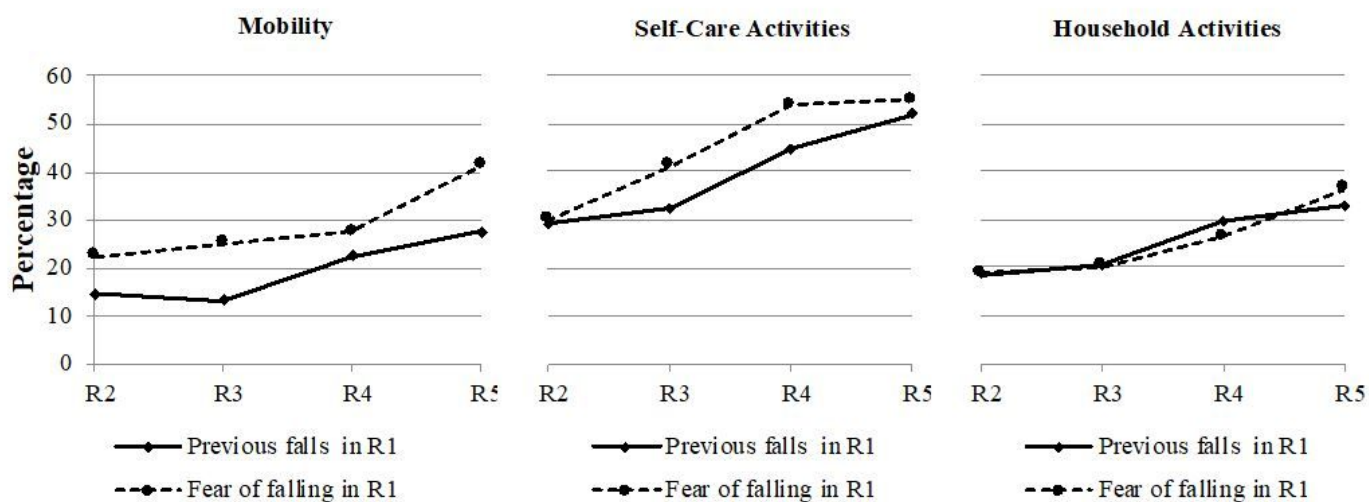


Figure 1

Percentages of participants who developed activity limitations from Round 2 to Round 5.