J Nutr Health Aging.2023;27(8):673-679
Published online July 31, 2023, https://doi.org/10.1007/s12603-023-1952-7

Original Research

Longitudinal Relationship between Mobility Device Use, Falls and Fear of Falling (FOF) Differed by Frailty Status among Community-Dwelling Older Adults

M. Liu, C. Mo, Y. Luo, W. Peng, S. Tang

Central South University Xiangya School of Nursing, China

Corresponding Author: Minhui Liu, Central South University Xiangya School of Nursing, China, mliu62@jhu.edu

Abstract

OBJECTIVES: This study examined the longitudinal relationship between mobility device use, falls and fear of falling (FOF) among community-dwelling older adults by frailty status over a one-year follow-up.

DESIGN: A longitudinal cohort study.

SETTING: Communities in the United States.

PARTICIPANTS: Community-dwelling older adults from the National Health and Aging Trends Study, a nationally representative survey of Medicare Beneficiaries in the United States (N=5,896).

MEASUREMENTS: Based on yes or no response to the corresponding items for the variables, fall-related outcomes were determined separately including falls and FOF. Falls were assessed by asking participants whether they had a fall and if they had fallen down more than one time. FOF was measured by asking participants whether they worried about falling and if this worry ever limited activities. Mobility device use was determined by asking whether participants used any type of mobility devices and the number of devices used, including cane, walker, wheelchair and scooter. Frailty was assessed using the frailty phenotype. Multinomial logistic regression models were conducted to examine the association between mobility device use and fall-related outcomes among older adults by frailty status.

RESULTS: At Year 1, 28.6% of participants reported using mobility devices. Among robust participants, using one mobility device had 3.58 times higher risks of FOF with fear-related activity restriction (FAR) than non-device users (95% CI: 1.10-11.65). Cane-only robust users had 5.94 and 2.18 times higher risks of FOF with and without FAR (95% CI: 1.80-19.57; 95% CI: 1.12-4.22) than non-device users. Among pre-frail participants, using one mobility device was associated with recurrent falls and FOF with FAR (RRR=2.02, 95% CI: 1.30-3.14; RRR=2.13, 95% CI: 1.25-3.63). Using ≥2 devices was associated with one fall (RRR=2.08, 95% CI: 1.30-3.33), recurrent falls (RRR=2.92, 95% CI: 1.62-5.25) and FOF with FAR (RRR=2.84, 95% CI: 1.34-6.02). Pre-frail cane-only users were more likely to have one fall (RRR=1.57, 95% CI: 1.06-2.32), recurrent falls (RRR=2.36, 95% CI: 1.48-3.77) and FOF with FAR (RRR=2.08, 95% CI: 1.12-3.87) than non-device users. The number of mobility device used and the use of canes failed to be significantly associated with fall-related outcomes among frail participants.

CONCLUSION: The number of mobility devices used and the only use of canes were associated with fall-related outcomes among robust and pre-frail individuals. Further research is needed to develop targeted strategies for preventing falls and FOF among older adults with mobility device use, particularly for those in the early stages of frailty.

Key words: Fall, fear-related activity restriction, fear of falling, frailty; mobility device.

Introduction

Globally, falls have become an increasing challenge for the aging population, resulting in a greater risk of hospitalization, loss of independence and mortality (1, 2). With advancing age, the incidence of falls and their negative outcomes are expected to increase. Fear of falling (FOF) is also common among older adults, which may cause fear-related activity restriction (FAR) and result in deficient activity engagement and declined physical function (3). Falls and FOF are closely related and are usually associated with similar factors, which negatively affect the health of older adults (4, 5). Fall-related outcomes imposed a significant burden on older adults. The average cost of a medically treated fall was estimated to be $9780, and fatal and nonfatal fall costs were estimated to be $50 billion in 2015 in the United States (6, 7). Therefore, it is of great importance to identify risk factors for fall-related outcomes among older adults.

Mobility devices, such as canes and walkers can help older adults to improve physical stabilization, reduce the load on the lower limbs and maintain independence (8). Older adults with falls and FOF often use mobility devices to compensate for mobility limitations and prevent fall-related injuries. Although mobility devices are beneficial for fall prevention in older adults, research suggested that mobility device use was associated with a greater risk of falls and FOF (9-12). The use of a walker was found to be associated with recurrent falls (13). Additionally, a longitudinal study of 7,609 participants concluded that the incidence of falls and recurrent falls were not related to the use of mobility devices, but FAR was significantly higher among cane-only users compared with non-users (14). Evidence was still insufficient regarding the causal impacts of mobility device use on fall-related outcomes. To effectively apply mobility devices among older adults, it is imperative to further investigate the association between mobility device use and fall-related outcomes.

Received February 28, 2023
Accepted for publication June 16, 2023

Frailty, a reversible geriatric syndrome commonly seen in older adults, is considered a predictor of future falls and FOF (15, 16). Older adults with frailty reported a high prevalence of mobility difficulties and often use mobility devices to deal with difficulties with mobility or daily activities (17). Given the dynamic reversible nature of frailty, it is reasonable to speculate that the relationship between mobility device use and fall-related outcomes may differ during the transition processes of frailty (i.e. improve or worsen). A previous study has shown that frail older adults who used ambulatory assistive devices reported more falls than non-users (18). In addition, assistive device use at the time of a fall was significantly associated with worry about re-injury and limiting one's activities due to this worry, but this association became insignificant after controlling for frailty variables, indicating that frailty should be considered when determining the relationship between mobility device use and falls (19). However, to our knowledge, little is known about the association between mobility device use and fall-related outcomes according to different frailty statuses (robust, prefrail and frail). Given the challenges of fall-related outcomes and frailty in older adults, investigating the associations between mobility device use and fall-related outcomes by frailty status is necessary to provide appropriate prescriptions for mobility devices and establish effective strategies for fall-related management for the older population.

Therefore, this study aimed to evaluate the longitudinal relationships of mobility device use, falls and FOF according to frailty status by examining 1) whether the number of mobility devices used at Year 1 predicted falls and FOF at Year 2 among robust, pre-frail and frail older adults; and 2) whether the use of canes at Year 1 predicted falls and FOF at Year 2 among robust, pre-frail and frail older adults. We hypothesized that 1) the number of mobility devices used at Year 1 independently predicted falls and FOF at Year 2 after adjusting for falls/FOF, demographics and health-related covariates at Year 1 among robust, pre-frail and frail older adults; and 2) the use of canes at Year 1 independently predicted falls and FOF at Year 2 after adjusting for falls/FOF and other covariates at Year 1 among robust, pre-frail and frail older adults.

Methods

Study sample

We used data from Year 1 (2011) and Year 2 (2012) of the National Health Aging Trends Study (NHATS), a nationally representative longitudinal cohort study of U.S. Medicare beneficiaries aged 65 or older. The data collection has been conducted through in-person interviews since 2011 and then tracked annually to examine the disability trends of older adults in late life (20). In this study, we included a total of 5,896 community-dwelling participants who provided complete data on falls, FOF and FAR, frailty and mobility device use. The blinded for peer review approved the protocol. All participants or their proxy respondents provided written informed consent.

Measures

Assessment of fall-related outcomes

Falls were defined as any fall, slip, or trip in which one loses balance and lands on the floor or ground or at a lower level. Participants were asked whether they had a fall and if they fell more than once in the last 12 months (yes or no). Falls were categorized into 3 groups (no fall, one fall, and recurrent falls).

FOF was assessed by asking participants if they worried about falling in the last month (yes or no). Participants were then asked whether this worry ever limited their activities based on the "yes" response to the previous question. FOF was classified into 3 groups (no FOF, FOF without FAR, and FOF with FAR).

Assessment of mobility device use

Mobility device use was measured by asking participants whether they used any mobility device use in the last month, including the use of a cane, walker, wheelchair (manual, power, electric, or motorized), and/or scooter (yes or no). Categories of mobility device use were created based on the number of devices used in the last month into 3 groups (no device, 1 device, and ≥2 devices). Considering that canes are easy to carry and inexpensive to afford for older adults with mobility and balance problems, participants were additionally classified into 2 groups (cane-only users and non-device users).

Assessment of frailty status

Frailty was assessed by NHATS interview and performance assessments using the physical frailty phenotype paradigm based on 5 criteria: unintentional weight loss, exhaustion, weakness, slow gait and low physical activity (21). Unintentional weight loss was defined as unintentionally losing 10 pounds or more in the last year. Exhaustion was identified as self-reported low energy or being easily exhausted to limit activities. Weakness was assessed by maximum grip strength measured by the dominant hand over 2 trials as being at or below the 20th percentile. Slow gait was determined as gait speed from the best of two timed 3-meter walk tests being at or below the 20th percentile. Low physical activity was defined as self-reported not having taken part in vigorous activities or never walking for exercise in the last month. Participants were grouped into 3 types: those meeting 3 or more criteria were classified as "frail", 1-2 as "pre-frail", and none as "robust.

Covariates

Demographic variables included chronological age, gender (female, and male), education (less than high school, high school graduates, some college or vocational school, and bachelor or higher), race/ethnicity (non-Hispanic White, non-Hispanic Black, Indian/Asian/Native/Hawaii, Hispanic, and other) and living arrangement (alone, with spouse/partner only,

Table 1. Baseline characteristics of participants stratified by frailty status (N=5,896)

Characteristics	Total	Robust (n=2,118)	Pre-frail (n=2,869)	Frail (n=909)	P value
Age, years, mean (SD)	77.4 (7.8)	75.1 (6.9)	78.1 (7.8)	80.7 (8.1)	< 0.001
Gender (Female), n (%)	3,432 (58.2)	1,108 (52.3)	1,724 (60.1)	600 (66.0)	< 0.001
Race/ethnicity, n (%)					< 0.001
Non-Hispanic White	4,101 (69.6)	1,590 (75.1)	1,988 (69.3)	523 (57.5)	
Non-Hispanic Black	1,289 (21.9)	372 (17.6)	648 (22.6)	269 (29.6)	
Indian/Asian/Native/Hawaii	156 (2.7)	63 (3.0)	68 (2.4)	25 (2.8)	
Hispanic	339 (5.8)	92 (4.3)	157 (5.4)	91 (10.0)	
Other	11 (0.2)	1 (0.1)	9 (0.3)	1 (0.1)	
Education, n (%)					< 0.001
Less than high school	1,526 (25.9)	355 (16.8)	780 (27.2)	391 (43.2)	
High school graduates	1,603 (27.2)	540 (25.5)	820 (28.6)	243 (26.9)	
College or vocational school	1,424 (24.2)	538 (25.4)	729 (25.4)	157 (17.4)	
Bachelor or higher	1,335 (22.7)	684 (32.3)	537 (18.7)	114 (12.6)	
Living arrangement, n (%)					< 0.001
Living alone	1,935 (33.0)	629 (30.0)	1,008 (35.3)	298 (32.9)	
With spouse/partner only	2,411 (41.1)	1,076 (51.0)	1,091 (38.2)	244 (27.0)	
With others only	1,002 (17.1)	243 (11.5)	486 (17.0)	273 (30.2)	
With spouse/partner and with others	523 (8.9)	160 (7.6)	273 (9.6)	90 (9.9)	
Number of ADL impairments, mean (SD)	1.3 (0.8)	1.0 (0.3)	1.2 (0.7)	2.0 (1.2)	< 0.001
Number of chronic diseases, n (%)					< 0.001
No disease	516 (8.8)	288 (13.7)	207 (7.3)	21 (2.4)	
1~3	3,881 (66.4)	1,558 (74.0)	1,876 (65.9)	447 (49.9)	
≥4	1,450 (24.8)	260 (12.4)	763 (26.8)	427 (47.7)	
Dementia, n (%)	281 (4.8)	26 (1.2)	130 (4.5)	125 (13.8)	< 0.001
BMI ≥ 30 kg/m^2, n (%)	1,605 (27.5)	477 (22.7)	863 (30.4)	265 (29.5)	< 0.001
Depression, n (%)	879 (14.9)	120 (5.7)	430 (15.0)	329 (36.2)	< 0.001
Pain, n (%)	3,179 (53.9)	808 (38.2)	1,658 (57.8)	713 (78.4)	< 0.001
Hospitalization, n (%)	1,335 (22.7)	264 (12.5)	689 (24.0)	382 (42.2)	< 0.001
Vigorous activities, n (%)	2,102 (35.7)	1,308 (61.8)	743 (25.9)	51 (5.6)	< 0.001
Number of mobility devices used					< 0.001
no device	4,221 (71.4)	1,941 (91.6)	1,993 (69.5)	277 (30.5)	
1 device	1,025 (17.4)	144 (6.8)	568 (19.8)	313 (34.4)	
≥2 devices	660 (11.2)	33 (1.6)	308 (10.7)	319 (35.1)	
Cane	1,202 (20.4)	149 (7.0)	647 (22.6)	406 (44.7)	< 0.001
Walker	806 (13.7)	50 (2.4)	382 (13.3)	374 (41.1)	< 0.001
Wheelchair	402 (6.8)	12 (0.6)	169 (5.9)	221 (24.3)	< 0.001
Scooter use	145 (2.5)	4 (0.2)	63 (2.2)	78 (8.6)	< 0.001

Abbreviations: SD, standard deviations; ADL, activities of daily living; BMI, body mass index.

with others only, with spouse/partner, and with others).

Health-related variables included the following: (1) the number of activities of daily living (ADL) impairments regarding eating, dressing, bathing and toileting; (2) the number of chronic diseases (heart attack, heart disease, high blood pressure, arthritis, osteoporosis, diabetes, lung disease, stroke, cancer) diagnosed by a doctor; (3) dementia or Alzheimer's disease diagnosed by a doctor; (4) BMI classified into 2 groups (normal with BMI <30 kg/m2, and obesity with a BMI ≥30 kg/m^2); (5) depression assessed by the Patient Health Questionnaire (PHQ-2) scale; (6) bothersome pain in the last month; (7) reported hospitalization in the past year; (8) vigorous activities that increased heart rate and made breathing harder in the last month.

Table 2. The number of mobility device used at Year 1 predicting fall-related outcomes at Year 2 by frailty status

Variables	Robust		Pre-frail		Frail	
	Model 1[a] RRR (95% CI)	Model 2[b] RRR (95% CI)	Model 1[a] RRR (95% CI)	Model 2[b] RRR (95% CI)	Model 1[a] RRR (95% CI)	Model 2[b] RRR (95% CI)
One fall vs No fall (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
1 device	1.14 (0.66-1.99)	0.97 (0.55-1.79)	1.37 (1.00-1.87)*	1.32 (0.92-1.89)	1.14 (0.61-2.11)	1.54 (0.76-3.13)
≥2 devices	0.59 (0.14-2.57)	0.28 (0.07-2.11)	1.93 (1.28-2.90)**	2.08 (1.30-3.33)**	1.57 (0.85-2.90)	1.80 (0.85-3.83)
Recurrent falls vs No fall (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
1 device	0.99 (0.55-1.79)	1.26 (0.44-3.60)	2.00 (1.35-2.95)**	2.02 (1.30-3.14)**	0.97 (0.52-1.80)	1.09 (0.52-2.26)
≥2 devices	0.40 (0.07-2.11)	2.10 (0.57-7.72)	3.05 (1.88-4.97)***	2.92 (1.62-5.25)***	0.81 (0.41-1.62)	0.82 (0.33-2.01)
FOF without FAR vs No FOF (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
1 device	2.74 (1.61-4.65)***	1.87 (1.00-3.50)	1.25 (0.88-1.77)	1.09 (0.73-1.63)	1.34 (0.69-2.61)	1.35 (0.65-2.82)
≥2 devices	3.07 (1.13-8.35)*	1.37 (0.48-3.94)	1.69 (1.07-2.67)*	1.33 (0.77-2.32)	1.67 (0.85-3.27)	1.39 (0.59-3.32)
FOF with FAR vs No FOF (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
1 device	4.79 (1.75-13.08)**	3.58 (1.10-11.65)*	2.18 (1.38-3.44)**	2.13 (1.25-3.63)**	2.01 (1.07-3.77)*	1.84 (0.87-3.93)
≥2 devices	4.08 (0.52-32.00)	0.84 (0.05-14.47)	3.13 (1.77-5.52)***	2.84 (1.34-6.02)**	1.33 (0.65-2.75)	1.18 (0.46-3.06)

Abbreviations: RRR, relative risk ratios; CI, confidence intervals; FOF, fear of falling; FAR, fear-related activity restriction; Ref = Reference Comparison Category. a. Model 1: Independent variables of interest; b. Model 2: Model 1+ demographic covariates (age, sex, education, race/ethnicity, living arrangement) + health-related covariates (ADL impairments, chronic diseases, dementia, BMI, depression, pain, hospitalization, vigorous activity); d. *P <0.05, **P <0.01, ***P<0.001

Data analysis

Descriptive statistics for demographics, health-related factors and mobility device use are presented with frequencies, percentages, means and standard deviations (SDs). Chi-square test and one-way analysis of variance (ANOVA) were used to assess the differences among groups of participants by frailty status. Multinomial logistic regressions were conducted to evaluate the associations of mobility device use, falls and FOF according to frailty status, with independent variables of interest examined in Model 1 and further adjustments for covariates including demographic and health-related variables in Model 2. The association between mobility device use and falls was examined among participants with no falls at Year 1. The association between mobility device use and FOF was investigated among participants with no FOF at Year 1. To improve the robustness of our results, we excluded the data from proxy respondents to perform sensitivity analyses. Since the missing values on covariate variables were less than 1.0 %, we did not use any techniques to handle the missing data. P value of less than 0.05 was considered to be statistically significant. All statistical analyses were conducted using STATA 15.

Results

In this study, a total of 5,896 community-dwelling older adults were included. The average age of participants was 77.4 years old. Of all the participants, about 58.2% participants were female and 69.6% were non-Hispanic whites. The proportion of robust, pre-frail and frail respondents was 35.9%, 48.7% and 15.4%, respectively. The use of mobility devices varied according to frailty status. The percentage of using at least 1 mobility device was largest among frail participants (69.5%), followed by pre-frail (30.5%) and robust (8.4%) participants. The most used mobility device was a cane and the least used was a scooter, regardless of the frailty status (Table 1).

The number of mobility devices used predicting falls and FOF by frailty status

Table 2 shows the multinomial logistic regression results examining the relationship between the number of mobility devices used at Year 1 and fall-related outcomes at Year 2 according to frailty status. For falls, among robust respondents, the number of mobility devices used was not significantly associated with one fall or recurrent falls. Among pre-frail respondents, using ≥2 mobility devices was significantly related to one fall (RRR=2.08, 95% CI: 1.30-3.33) after adjusting for demographic and health-related covariates. In addition, pre-frailty individuals who used one mobility device and used ≥2 mobility devices were more likely to have recurrent falls (RRR=2.02, 95% CI: 1.30-3.14; RRR=2.92, 95% CI: 1.62-5.25) compared with those without using any mobility devices. The number of mobility devices used was not significantly associated with falls among frail participants.

For FOF, regardless of the frailty status, the associations were not significant between the number of mobility devices used and FOF without FAR in the adjusted models. For robust individuals, using 1 mobility device was associated with FOF

Table 3. Cane use at Year 1 predicting fall-related outcomes at Year 2 by frailty status

Variables	Robust		Pre-frail		Frail	
	Model 1[a] RRR (95% CI)	Model 2[b] RRR (95% CI)	Model 1[a] RRR (95% CI)	Model 2[b] RRR (95% CI)	Model 1[a] RRR (95% CI)	Model 2[b] RRR (95% CI)
One fall vs No fall (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
cane only	1.08 (0.59-1.98)	0.94 (0.49-1.80)	1.60 (1.13-2.26)**	1.57 (1.06-2.32)*	1.25 (0.62-2.53)	1.52 (0.70-3.28)
Recurrent falls vs No fall (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
cane only	1.41 (0.55-3.61)	1.46 (0.49-4.35)	2.29 (1.48-3.52)***	2.36 (1.48-3.77)***	0.65 (0.29-1.48)	0.78 (0.28-2.14)
FOF without FAR vs No FOF (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
cane only	3.23 (1.86-5.61)***	2.18 (1.12-4.22)*	1.46 (0.99-2.14)	1.34 (0.86-2.07)	1.18 (0.53-2.63)	1.18 (0.45-3.11)
FOF with FAR vs No FOF (ref)						
No device	1.00	1.00	1.00	1.00	1.00	1.00
cane only	5.97 (2.17-16.40)**	5.94 (1.80-19.57)**	2.17 (1.28-3.66)**	2.08 (1.12-3.87)*	1.58 (0.74-3.38)	2.25 (0.81-6.24)

Abbreviations: RRR, relative risk ratios; CI, confidence intervals; FOF, fear of falling; FAR, fear-related activity restriction; Ref = Reference Comparison Category.; a. Model 1: Independent variables of interest; b. Model 2: Model 1+ demographic covariates (age, sex, education, race/ethnicity, living arrangement) + health-related covariates (ADL impairments, chronic diseases, dementia, BMI, depression, pain, hospitalization, vigorous activity); d. *P <0.05, **P <0.01, ***P<0.001

with FAR after controlling for all covariates (RRR=3.58, 95% CI: 1.10-11.65), while using ≥2 mobility devices was not. For pre-frail individuals, those who used one mobility device (RRR=2.13, 95% CI: 1.25-3.63) and used ≥2 mobility devices (RRR=2.84, 95% CI: 1.34-6.02) had a higher risk of having FOF with FAR compared with non-device users. No significant association was observed between the number of devices used and FOF with FAR among frail participants.

Cane use predicting falls and FOF by frailty status

Table 3 shows the results of the association between the use of a cane at Year 1 and fall-related outcomes at Year 2 according to frailty status. For falls, there exists no significant results in the fully adjusted models concerning the association between the only use of a cane and falls among robust and frail participants compared with those who did not use any mobility devices. However, in pre-frail participants, cane-only users had a higher risk of having one fall (RRR=1.57, 95% CI: 1.06-2.32) and recurrent falls (RRR=2.36, 95% CI: 1.48-3.77) rather than non-device users.

For FOF, robust older adults who were cane-only users were 2.18 times and 5.94 times more likely to have FOF without FAR (95% CI: 1.12-4.22) and FOF with FAR (95% CI: 1.80-19.57) than non-device users. Among pre-frail participants, cane-only users were 2.08 times more likely to have FOF with FAR (95% CI: 1.12-3.87) compared with non-device users. No significant association was found between cane use and FOF among frail participants.

Sensitivity analyses excluding proxy respondents supported the robustness of the current findings assessing the association between mobility device use and fall-related outcomes among robust, pre-frail and frail participants (see supplementary material table 1 and table 2).

Discussion

Using a nationally representative sample of community-dwelling older adults, the study examined the longitudinal relationship between mobility device use, falls and FOF by frailty status. We found that frail older adults accounted for the largest percentage of the use of mobility devices. Canes were the most used devices in each frailty group. The adjusted models showed that for robust older adults, using one mobility device was significantly associated with FOF with FAR. For pre-frail older adults, those using ≥2 mobility devices were more likely to have one fall, and those using at least one mobility device had higher risks of recurrent falls and FOF with FAR compared with non-device users. Additionally, robust cane-only users were more likely to have FOF with and without FAR. Pre-frail cane-only users had higher risks of having one fall, recurrent falls as well as FOF with FAR than non-device users.

In this study, the number of mobility devices used was not associated with falls in robust older adults. However, robust participants who used one mobility device had increased risks of developing FOF with FAR compared with non-device users. Besides, robust participants who used only canes had higher odds of having FOF with and without FAR. Possible reasons may explain these results. On one hand, older adults identified as robust were generally younger and had better physical functions than those with pre-frailty or frailty, which contributed to fewer mobility problems and lower falls rate (22, 23). Besides, the limited sample size of robust mobility users may account for insufficient statistical power to identify the longitudinal association between mobility device use and falls for robust older adults. On the other hand, mobility device use among robust participants may be associated with numbers of

potential factors. For example, as older adults age, they may gradually perceive a decline in physical function and become worried about falling down (24).

We found that the number of mobility devices used and the only use of canes were significantly associated with falls and FOF among pre-frail participants. Compared with robust older adults, pre-frail older adults may have worse health conditions at Year 1 and experienced fall-related injuries in the past years that contribute to their impaired physical function, falls and FOF at Year 2. However, pre-frail older adults may not have mobility disabilities that require the use of mobility devices to assist with physical activities. Given that the risk factors of falls are complicated and interacted with each other, potential reasons causing fall-related outcomes among pre-frail older adults may be other factors (e.g. chronic diseases) apart from the use of mobility devices, which cannot be determined in the present study (25). In addition, though pre-frail individuals possessed mobility devices for safety reasons to prevent fall-related outcomes, they may use mobility devices inappropriately which ultimately lead to fall-related outcomes. For example, mobility device users may not be using the devices when falling down even if they acknowledged the importance of using mobility devices to prevent falls. Others may incorrectly use the mobility devices (e.g. wrong hand, wrong size, never taught by a physical therapist) which possibly leads to fall-related outcomes (18, 25).

Contrary to the study hypothesis, frail mobility device users seemed not to have greater risks of falls or FOF than non-device users. It is acknowledged that mobility device is of great importance for fall prevention among older adults. Therefore, the insignificant relationship between mobility device use and fall-related outcomes among frail participants may confirm the effectiveness of mobility devices, indicating that mobility device use can be effective in preventing falls and FOF. However, from another perspective, frail older adults tend to have very little physical activity, and are often sedentary, which limits the risk of falls and FOF by itself (27). Furthermore, the insignificant association may also be explained by the relatively small sample size of frail participants in this study, resulting in inadequate statistical power. Though mobility device use was not significantly associated with falls or FOF among frail older adults in the present study, as one of the most vulnerable populations, great efforts are needed for the development of tailored fall prevention. Frailty is a dynamic process that involves transitions between frailty statuses over time. It is suggested that there were more transitions to greater frailty than to lesser frailty (28). Identification of mobility device use in older adults with frailty is of great significance to inform the development of fall prevention. Studying the relationship between changes in frailty status and the use of assistive devices will also be useful in providing insights for the design of fall prevention programs and ultimately enhance the quality of life for older adults.

Although the current study demonstrated the longitudinal relationship between mobility device use, falls and FOF among older adults by frailty status, the findings of this study need to be viewed with caution. Many factors, including the physical and psychological characteristics of the mobility device users, the assessments and prescriptions of the appropriate mobility devices, the environmental demands and other potential factors may directly or indirectly affect the effectiveness of the mobility device use in preventing falls and FOF. For example, beliefs and attitudes toward mobility device use are vital for fall prevention. It is suggested that most mobility device users fell when they were not using it, even if they believed in the effects of devices to prevent falls (18, 29). Social pressures and perceived stigma could also lead to reduced acceptance or even abandonment of mobility devices (30, 31). Further research may benefit from examining more detailed information on mobility device use to deepen understanding of its relationship with fall-related outcomes among older adults with and without frailty.

Strengths and limitations

To our knowledge, this is the first study to determine the longitudinal relationship between mobility device use, falls and FOF by frailty status based on a nationally representative sample. The longitudinal nature of the study allows us to examine if mobility device use contributes to falls and FOF among older adults according to frailty status. However, several limitations should be acknowledged. Firstly, the study was limited by retrospective self-reports of the main variables and therefore subject to recall bias and potential underreporting. Older adults tend to underreport falls and fall injuries (32). Monthly calendars are recommended to collect fall-related data. Additionally, mobility device use was classified according to the use of cane, walker, wheelchair and scooter. However, given the different applications and characteristics of the mobility devices in different contexts, these four types of devices cannot be generalized as the same, which should be investigated in future research. Lastly, additional information including the cause, frequency and duration of the mobility device use was not identified in the study, which should be addressed in future research to provide insights into fall prevention for high-risk older adults.

Conclusions

In summary, the number of mobility devices used and the only use of canes were significantly associated with falls and FOF among robust and pre-frail older adults. Healthcare professionals should pay special attention to multiple-device users and cane-only users among older adults in the early stage of frailty. Besides, targeted preventive interventions should be developed and implemented to prevent and reduce the risk of fall-related outcomes.

Acknowledgements: The publication of this manuscript was supported by the Youth Grant from the National Natural Science Foundation of China (Grant No. 72004237).

Conflict of interest statement: The authors declare no conflict of interest.

Funding sources: This work was supported by blinded for peer review.

Ethical standards: The study complies with the current laws of the country in which it was performed.

References

1. Lohman MC, Sonnega AJ, Nicklett EJ, Estenson L, Leggett AN, Newman A. Comparing Estimates of Fall-Related Mortality Incidence among Older Adults in the United States. Journals Gerontol - Ser A Biol Sci Med Sci. 2019;74(9):1468-1474. doi:10.1093/gerona/gly250
2. Gill TM, Murphy TE, Gahbauer EA, Allore HG. Association of injurious falls with disability outcomes and nursing home admissions in community-living older persons. Am J Epidemiol. 2013;178(3):418-425. doi:10.1093/aje/kws554
3. Rivasi G, Kenny RA, Ungar A, Romero-Ortuno R. Predictors of Incident Fear of Falling in Community-Dwelling Older Adults. J Am Med Dir Assoc. 2020;21(5):615-620. doi:10.1016/j.jamda.2019.08.020
4. Jamison M, Neuberger GB, Miller PA. Correlates of falls and fear of falling among adults with rheumatoid arthritis. Arthritis Rheum. 2003;49(5):673-680. doi:10.1002/art.11383
5. Delbaere K, Close JC, Brodaty H, Sachdev P, Lord SR. Determinants of disparities between perceived and physiological risk of falling among elderly people: cohort study. BMJ. 2010;341:c4165. Published 2010 Aug 18. doi:10.1136/bmj
6. Florence CS, Bergen G, Atherly A, Burns E, Stevens J, Drake C. Medical Costs of Fatal and Nonfatal Falls in Older Adults. J Am Geriatr Soc. 2018;66(4):693-698. doi:10.1111/jgs.15304
7. Burns ER, Stevens JA, Lee R. The direct costs of fatal and non-fatal falls among older adults — United States. J Safety Res. 2016;58:99-103. doi:10.1016/j.jsr.2016.05.001
8. Brown CJ, Flood KL. Mobility limitation in the older patient: A clinical review. JAMA - J Am Med Assoc. 2013;310(11):1168-1177. doi:10.1001/jama.2013.276566
9. Pellicer-García B, Antón-Solanas I, Ramón-Arbués E, García-Moyano L, Gea-Caballero V, Juárez-Vela R. Risk of Falling and Associated Factors in Older Adults with a Previous History of Falls. Int J Environ Res Public Health. 2020;17(11):4085. Published 2020 Jun 8. doi:10.3390/ijerph17114085
10. Roman De Mettelinge T, Cambier D. Understanding the relationship between walking AIDS and falls in older adults: A prospective cohort study. J Geriatr Phys Ther. 2015;38(3):127-132. doi:10.1519/JPT.0000000000000031
11. Choi NG, Sullivan JE, Marti CN. Low-income homebound older adults receiving home-delivered meals: Physical and mental health conditions, incidence of falls and hospitalisations. Heal Soc Care Community. 2019;27(4):e406-e416. doi:10.1111/hsc.12741
12. West BA, Bhat G, Stevens J, Bergen G. Assistive device use and mobility-related factors among adults aged ≥ 65 years. J Safety Res. 2015;55:147-150. doi:10.1016/j.jsr.2015.08.010
13. Anderson LK, Lane K. Characteristics of falls and recurrent falls in residents of an aging in place community: A case-control study. Appl Nurs Res. 2020;51. doi:10.1016/j.apnr.2019.151190
14. Gell NM, Wallace RB, Lacroix AZ, Mroz TM, Patel K V. Mobility device use in older adults and incidence of falls and worry about falling: Findings from the 2011-2012 national health and aging trends study. J Am Geriatr Soc. 2015;63(5):853-859. doi:10.1111/jgs.13393
15. Kojima G. Frailty as a Predictor of Future Falls Among Community-Dwelling Older People: A Systematic Review and Meta-Analysis. J Am Med Dir Assoc. 2015;16(12):1027-1033. doi:10.1016/j.jamda.2015.06.018
16. Makino K, Lee S, Bae S, et al. Prospective Associations of Physical Frailty With Future Falls and Fear of Falling: A 48-Month Cohort Study. Phys Ther. 2021;101(6). doi:10.1093/ptj/pzab059
17. Gale CR, Cooper C, Sayer AA ihi. Prevalence of frailty and disability: findings from the English Longitudinal Study of Ageing. Age Ageing. 2015;44(1):162-165. doi:10.1093/ageing/afu148
18. Cruz A de O, Santana SMM, Costa CM, Gomes da Costa LV, Ferraz DD. Prevalence of falls in frail elderly users of ambulatory assistive devices: a comparative study. Disabil Rehabil Assist Technol. 2020;15(5):510-514. doi:10.1080/17483107.2019.1587016
19. Griffith L, Sohel N, Walker K, et al. Consumer products and fall-related injuries in seniors. Can J Public Health. 2012;103(5):e332-e337. Published 2012 Jul 18. doi:10.1007/BF03404436
20. Kasper JD, Freedman VA. Findings from the 1st round of the National Health and Aging Trends Study (NHATS): introduction to a special issue. J Gerontol B Psychol Sci Soc Sci. 2014;69 Suppl 1:S1-S7. doi:10.1093/geronb/gbu125
21. Bandeen-Roche K, Seplaki CL, Huang J, et al. Frailty in Older Adults: A Nationally Representative Profile in the United States. Journals Gerontol - Ser A Biol Sci Med Sci. 2015;70(11):1427-1434. doi:10.1093/gerona/glv133
22. Siriwardhana DD, Hardoon S, Rait G, et al. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. BMJ Open. 2018;8(3):e018195. doi:10.1136/bmjopen-2017-018195
23. Ellmers TJ, Delbaere K, Kal EC. Frailty, falls and poor functional mobility predict new onset of activity restriction due to concerns about falling in older adults: a prospective 12-month cohort study. Eur Geriatr Med. 2023;14(2):345-351. doi:10.1007/s41999-023-00749-2
24. Korenhof SSA, van Grieken AA, Franse CCB, et al. The association of fear of falling and physical and mental Health-Related Quality of Life (HRQoL) among community-dwelling older persons; a cross-sectional study of Urban Health Centres Europe (UHCE). BMC Geriatr. 2023;23(1):291. doi:10.1186/s12877-023-04004-y
25. Chong EY, Lim AH, Mah FCY, et al. Assessing the psychosocial dimensions of frailty among older adults in Singapore: a community-based cross-sectional study. BMJ Open. 2022;12(2):e047586. doi:10.1136/bmjopen-2020-047586
26. Dickson NC, Gohil AR, Unsworth CA. Powered mobility device use in residential aged care: a retrospective audit of incidents and injuries. BMC Geriatr. 2023;23(1):363. doi:10.1186/s12877-023-04073-z
27. Dent E, Morley JE, Cruz-Jentoft AJ, et al. Physical Frailty: ICFSR International Clinical Practice Guidelines for Identification and Management. J Nutr Health Aging. 2019;23(9):771-787. doi:10.1007/s12603-019-1273-z
28. Gill TM, Gahbauer EA, Allore HG, et al. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166(4):418-423. doi:10.1001/archinte.166.4.418
29. Luz C, Bush T, Shen X, et al. Do canes or walkers make any difference? nonuse and fall injuries. Gerontologist. 2017;57(2):211-218. doi:10.1093/geront/gnv096
30. Resnik L, Allen S, Isenstadt D, et al. Perspectives on use of mobility aids in a diverse population of seniors: Implications for intervention. Disabil Health J. 2009;2(2):77-85. doi:10.1016/j.dhjo.2008.12.002
31. Borade N, Ingle A, Nagarkar A. Lived experiences of people with mobility-related disability using assistive devices. Disabil Rehabil Assist Technol. 2021;16(7):730-734. doi:10.1080/17483107.2019.1701105
32. Hoffman GJ, Ha J, Alexander NB, et al. Underreporting of Fall Injuries of Older Adults: Implications for Wellness Visit Fall Risk Screening. J Am Geriatr Soc. 2018;66(6):1195-1200. doi:10.1111/jgs.15360

How to cite this article: M. Liu, C. Mo, Y. Luo, et al. Longitudinal Relationship between Mobility Device Use, Falls and Fear of Falling (FOF) Differed by Frailty Status among Community-Dwelling Older Adults. J Nutr Health Aging.2023;27(8):673-679; https://doi.org/10.1007/s12603-023-1952-7