

The Mediating Effect of Frailty on the Relationship Between Apathy and Fall Risk in Community-Dwelling Older Adults: Postprint

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Abstract

Background Apathetic older adults have a high risk of falls and are prone to recurrent falls. Although improving apathy can help reduce fall risk in older adults, intervention effects for apathy are limited. Frailty may provide a new approach to reducing fall risk in apathetic older adults.

Objective To investigate the mediating effect of frailty between apathy and fall risk, and to provide new insights for fall intervention in apathetic older adults.

Methods Using convenience sampling, 212 community-dwelling older adults were surveyed with a general information questionnaire, the Frailty Assessment Scale (Fried Frailty Phenotype, FFP), the Apathy Scale (Geriatric Depression Scale, GDS-3), and the Fall Risk Assessment Scale (Stopping Elderly Accidents, Deaths & Injuries Tool Kit, STEADI).

Results Apathy had a significant positive effect on fall risk ($B = 0.328$, $t = 5.095$, $P < 0.050$). Apathy had a significant positive effect on frailty ($B = 0.236$, $t = 3.860$, $P < 0.050$). Frailty had a significant positive effect on fall risk ($B = 0.308$, $t = 4.125$, $P < 0.050$). The mediating effect of frailty between apathy and fall risk was 0.22, accounting for 22.45% of the total effect.

Conclusion Frailty is a mediating variable between apathy and fall risk in community-dwelling older adults. Improving frailty is an important approach to reducing fall risk in apathetic older adults.

Full Text

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Abstract

Background: Older adults with apathy exhibit high fall risk and are prone to recurrent falls. Although improving apathy may help reduce fall risk in the elderly, effective interventions for apathy remain elusive. Frailty may offer a novel approach to reducing fall risk in apathetic older adults.

Objective: To investigate the mediating effect of frailty between apathy and fall risk, providing new insights for intervening in falls among apathetic older adults.

Methods: Using convenience sampling, we administered questionnaires to 212 community-dwelling older adults, including a general information survey, the Fried Frailty Phenotype (FFP), the apathy subscale of the Geriatric Depression Scale (GDS-3), and the Stopping Elderly Accidents, Deaths & Injuries Tool Kit (STEADI).

Results: Apathy demonstrated a significant positive effect on fall risk ($B = 0.328$, $t = 5.095$, $P < 0.050$), a significant positive effect on frailty ($B = 0.236$, $t = 3.860$, $P < 0.050$), and frailty showed a significant positive effect on fall risk ($B = 0.308$, $t = 4.125$, $P < 0.050$). The mediating effect of frailty on the

relationship between apathy and fall risk was 0.22, accounting for 22.45% of the total effect.

Conclusion: Frailty serves as a mediating variable between apathy and fall risk in community-dwelling older adults. Improving frailty represents an important pathway for reducing fall risk in apathetic elderly individuals.

Keywords: Apathy; Frailty; Fall risk

Introduction

Falls are a leading cause of injury and mortality among older adults [1], making the identification of novel fall risk factors critical for prevention. Recent research has established a strong association between apathy and falls [2]. Apathy involves motivational deficits affecting behavioral (initiative), cognitive (interest), and emotional domains, manifesting as reduced activity, diminished interests, and blunted emotional responses [3]. Over time, apathy can impair balance function and precipitate falls [4]. While addressing apathy is important for fall prevention, apathetic symptoms are often atypical and resistant to intervention [5], necessitating the identification of appropriate mediating variables to help reduce fall risk in apathetic older adults. Frailty increases fall risk in older adults [6] and may represent a significant adverse outcome for apathetic individuals [7], suggesting that frailty could mediate the relationship between apathy and fall risk, thereby serving as an intervention target. This cross-sectional study of community-dwelling older adults aimed to analyze the mediating role of frailty between apathy and fall risk, offering new approaches for reducing falls in apathetic older adults.

Methods

Study Design and Participants

Between November 2021 and March 2022, we conveniently sampled 212 community-dwelling older adults from Nanjing ($n = 128$) and Lianyungang ($n = 84$). Inclusion criteria were: (1) age ≥ 60 years; (2) informed consent and voluntary participation; and (3) ability to complete questionnaires independently or with researcher assistance. Exclusion criteria included: (1) coma or terminal illness; (2) obvious consciousness or mental disorders; and (3) severe language or hearing impairments preventing questionnaire completion. This study was approved by the Nanjing Medical University Ethics Committee (Approval No. [2022]761).

Sample Size Estimation

Based on previous research and multivariate analysis requirements, sample size should be 5-10 times the number of variables [8]. With 11 variables total (8 items in the general information survey, plus 1 item each for the apathy scale, frailty scale, and fall risk scale), the required sample size was 55-110. Considering a non-response rate of 10%-20%, the final required sample size was 61-121. We distributed 212 questionnaires, receiving 212 valid responses (100% valid response rate).

Measurement Tools

General Information Survey Based on literature review [9] and participant circumstances, we designed a demographic survey including 8 items: gender, age, education level, marital status, monthly income, living environment, number of children, and pain.

Frailty Assessment The Fried Frailty Phenotype (FFP) [6], developed by Fried in 2001, is a commonly used frailty assessment tool comprising five items: unintentional weight loss, decreased grip strength, self-reported exhaustion, slow walking speed, and low physical activity. Each item scores 1 point; scores ≥ 3 indicate frailty, 1-2 indicate pre-frailty, and 0 indicates robust health. The 2017 Chinese Frailty Guidelines published Chinese versions of FFP items and scoring criteria [10], making it suitable for frailty screening in Chinese older adults.

Fall Risk Assessment We used the Chinese version of the STEADI Fall Risk Self-Assessment Scale to evaluate fall risk. STEADI (Stopping Elderly Accidents, Deaths & Injuries) was developed by the U.S. Centers for Disease Control and Prevention in 2015 and includes resources and assessment tools [11]. Li Yaling [12] translated the self-assessment component. The scale contains 12 dichotomous items covering fall history, assistive device use, unsteady gait, furniture-supported walking at home, fear of falling, chair rising, continence, foot problems, medication use, medication side effects, and mood. Total scores range from 0-14, with scores ≥ 4 indicating fall risk; higher scores indicate greater risk. In Chinese community-dwelling older adults, the scale demonstrates a Cronbach's α of 0.608, test-retest reliability $r = 0.998$, and good validity [12].

Apathy Assessment We used the GDS-3 (Geriatric Depression Scale-3) apathy subscale, which includes three items: giving up hobbies, doing unfamiliar things, and feeling energetic. All items are dichotomous (yes/no), scoring 1 point each; scores ≥ 2 indicate apathy [13]. The GDS-3 is widely used to measure apathy in community-dwelling older adults internationally [14] and has been validated in Chinese older adults by Zhou Ying [15], demonstrating high sensitivity and specificity as a screening tool for apathy in large-scale epidemiological studies or community settings.

Data Collection Process

Investigators explained the study purpose and obtained informed consent before distributing questionnaires. Investigators remained present throughout questionnaire completion to answer questions, and all questionnaires were collected on-site. Any questionable responses were confirmed with participants to ensure data quality. We distributed 212 questionnaires, achieving a 100% valid response rate ($n = 212$).

Statistical Analysis

Data were analyzed using SPSS 26.0 and Process 3.5. Normally distributed continuous variables were described using means and standard deviations; categorical data were described using frequencies and percentages. Chi-square tests compared differences in fall risk across demographic groups. Pearson correlation analysis examined relationships among frailty, apathy, and fall risk. Hayes' SPSS macro Process Model 4 (simple mediation model) tested the mediating effect of frailty between apathy and fall risk, controlling for gender, age, education, marital status, monthly income, living environment, number of children, and pain. Due to missing data (3 for apathy, 6 for fall risk, 4 for frailty), the mediation model included 192 participants. A two-tailed α level of 0.05 was used; $P < 0.05$ indicated statistical significance.

Results

General Characteristics

The study included 212 older adults with a mean age of 71.14 ± 6.85 years. Among participants without fall risk, 65 (44.5%) were male and 81 (55.5%) were female; among those with fall risk, 16 (26.7%) were male and 44 (73.3%) were female. Additional demographic characteristics are presented in .

Descriptive Statistics

Mean scores were 2.49 ± 2.57 for fall risk, 1.51 ± 0.90 for GDS-3 apathy, and 0.90 ± 1.18 for frailty. Statistical analysis revealed significant associations between fall risk and gender, age, education level, marital status, monthly income, living environment, number of children, pain, apathy, and frailty ($P < 0.050$). Details are provided in .

Correlation Analysis

Apathy was positively correlated with fall risk ($P < 0.050$) and frailty, and frailty was positively correlated with fall risk. Correlation coefficients are detailed in .

Mediating Effect Analysis

Using Hayes' (2012) SPSS macro Model 4 and controlling for gender, age, education, marital status, monthly income, living environment, number of children, and pain, we tested the mediating effect of frailty between apathy and fall risk. Results showed that apathy significantly predicted fall risk ($B = 0.328$, $t = 5.095$, $P < 0.050$), apathy significantly predicted frailty ($B = 0.236$, $t = 3.860$, $P < 0.050$), and frailty significantly predicted fall risk ($B = 0.308$, $t = 4.125$, $P < 0.050$). The mediation model is illustrated in [Figure 1: see original paper].

Bootstrap analysis revealed that the indirect effect of “apathy \rightarrow frailty \rightarrow fall risk” was 0.22 [95% CI (0.08, 0.38)], with the confidence interval not containing zero, confirming the mediating effect. Apathy influenced fall risk both directly and indirectly through frailty. The total effect was 0.98, direct effect 0.76, and mediating effect 0.22, with the mediating effect accounting for 22.45% of the total effect. Detailed breakdowns are presented in .

Discussion

Severity of Falls in Community-Dwelling Older Adults

Falls are common adverse events among older adults, with studies reporting that 15–26% of community-dwelling older adults experience a fall within one year [16]. Our findings show that 29.13% of participants had fall risk, consistent with community fall incidence rates. Falls are a primary cause of injury in older adults, with 20–30% of fallers sustaining moderate to severe injuries such as lacerations, fractures, and traumatic brain injuries [17]. Hip fractures, in particular, can lead to serious complications including deep vein thrombosis and infections, prolonging hospitalization and increasing mortality [18]. The financial burden is substantial, with fall-related injury costs in China ranging from \$16 to \$3,812 per incident [19].

Consistent with previous literature, we found fall risk associated with multiple demographic factors including gender, age, education, marital status, monthly income, living environment, number of children, and pain [20,21]. Advanced age brings functional decline and increased disease susceptibility, elevating fall risk [22]. Postmenopausal women experience decreased estrogen, reducing disease resistance and increasing fall vulnerability [23]. Income, living arrangement, number of children, and marital status reflect social support, which is closely related to fall risk—higher social support correlates with lower fall risk [24]. Higher education is associated with better medication adherence and health maintenance, reducing fall risk [25]. Pain can impair mobility and increase fall risk [26].

Correlations Among Apathy, Frailty, and Fall Risk

Our results demonstrate a positive correlation between apathy and fall risk, consistent with Nagai et al. [27]. Apathy may increase fall risk by impairing motor executive function, reducing activity, and compromising balance and gait stability [4]. Addressing apathy and encouraging activity in apathetic individuals is therefore crucial for fall prevention. We also found a positive correlation between frailty and fall risk. Zhang et al. [28] conducted a four-year prospective study showing that frail older adults had 81% higher odds of falling than non-frail adults after controlling for covariates. This may be attributed to low physiological reserve, decreased muscle function, and gait instability in frail individuals [29].

These findings indicate that both apathy and frailty are important fall risk factors, suggesting that caregivers should promptly assess both conditions, enhance activity interest, promote physical activity, and improve muscle function to reduce fall risk and enhance quality of life.

Mediating Role of Frailty

Our results indicate that apathy directly predicts fall risk. The prefrontal cortex and striatum are key brain regions controlling apathy; damage to these areas can reduce motor interest, impair executive function [30], decrease muscle function, and cause gait instability leading to falls. Intervening on apathy is therefore essential. Importantly, we found that apathy also indirectly affects fall risk through frailty, validating frailty as a crucial mediating factor. Apathy in older adults manifests as lack of motivation, reduced interest in surroundings, and diminished emotional responses—symptoms that are nonspecific and easily overlooked [31]. Additionally, apathetic individuals have reduced dopamine secretion and low motivation to complete interventions, potentially leading to treatment failure [32].

Melina et al. [5] found no difference in apathy changes between experimental and control groups after nurse-led health education with 3–4 year follow-up. Dimitrios et al. [33] similarly found no significant apathy score differences between groups after implementing reminiscence therapy. These findings underscore that apathy is both difficult to detect and challenging to treat, while frailty offers a new avenue for reducing fall risk in apathetic older adults. Unlike apathy, frailty is more readily identifiable—for example, slow gait speed can prompt further assessment. Frailty interventions are also more diverse, including nutritional support and exercise programs [34]. Caregivers should therefore prioritize early frailty identification and encourage physical activity to prevent or mitigate frailty and reduce fall risk. However, frailty's partial mediating effect (0.22, 22.45% of total effect) suggests other factors may also mediate the apathy-fall risk relationship. Future research should incorporate additional variables to further elucidate mediating mechanisms and reduce fall risk in apathetic older adults.

Summary and Limitations

Preventing falls in older adults is essential for achieving healthy aging. Our study demonstrates high fall risk among community-dwelling older adults, with both apathy and frailty increasing fall risk and frailty partially mediating the apathy-fall risk relationship. These findings provide novel methods for reducing fall risk in apathetic individuals and new insights into the mechanisms linking apathy to fall risk. However, several limitations should be noted. First, our sample from only two communities limits representativeness; future studies should expand sample size and diversity. Second, this cross-sectional design cannot establish causality; longitudinal data are needed to confirm these relationships and inform effective interventions. Finally, we did not control for certain covariates such as number of chronic diseases, which may influence main variable relationships; future research should control for additional covariates.

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