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Authors	Briggs, Robert;Ward, Mark;van der Velde, Nathalie;Scarlett, Siobhan;Hernandez, Belinda;Romero-Ortuno, Roman;Tysinger, Bryan;May, Peter;Ahern, Emer;Kenny, Rose Anne
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Original Study

The "Domino Effect": Functional Decline and Increased Social Care Requirements Following a Fall

Robert Briggs PhD [a,b,*], Mark Ward PhD [a], Nathalie van der Velde PhD [c], Siobhan Scarlett PhD [a], Belinda Hernandez PhD [a], Roman Romero-Ortuno PhD [b], Bryan Tysinger PhD [d], Peter May PhD [a,e], Emer Ahern MD [f], Rose Anne Kenny MD [a,b]

[a] The Irish Longitudinal Study on Ageing, Trinity College Dublin, Dublin, Ireland
[b] Mercer's Institute for Successful Ageing, St James's Hospital, Dublin, Ireland
[c] Section of Geriatric Medicine, Internal Medicine, Amsterdam UMC Location University of Amsterdam, Amsterdam, The Netherlands
[d] Leonard D. Schaeffer Center for Health Policy and Economics, University of Southern California, Los Angeles, California, USA
[e] Cicely Saunders Institute of Palliative Care, Policy and Rehabilitation, Florence Nightingale Faculty of Nursing, Midwifery & Palliative Care, King's College London, London, United Kingdom
[f] Department of Geriatric Medicine, Cork University Hospital, Cork, Ireland

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A B S T R A C T

Objectives: Falls represent an important inflection point in later life, increasing the risk of future adverse outcomes. This study aims to examine the association between an index fall, that is, a fall in a participant with no recent history of falls, and subsequent change in functional status, requirements for social care, and falls-related health care utilization.
Design: Longitudinal analysis of population-representative data.
Setting and Participants: Participants (n = 2454) aged ≥65 years from waves 1 to 3 of The Irish Longitudinal Study on Aging.
Methods: Index falls were those reported at wave 2 in participants with no falls reported at wave 1. Falls/fractures, functional status (activities of daily living), and social care (home care, home help, and meals on wheels) were assessed by self-report. Regression models assessed the independent relationship between index falls and outcomes of interest.
Results: Twenty percent of participants (n = 493) reported an index fall. In participants who were functionally independent at baseline, an index fall was associated with functional impairment at 2-year follow-up (odds ratio [OR], 1.71; 95% CI, 1.19-2.47; P = .004). Almost 12% with index falls developed functional impairment. In those not requiring home care at baseline, an index fall was independently associated with an almost 3-fold higher likelihood of requiring home care (OR, 2.87; 95% CI, 1.38-5.97; P = .005) and a higher number of monthly home care hours (β = 0.76; 95% CI, 0.18-1.34; P = .010) at 2-year follow-up. Almost 12% with index falls required "new" social supports. An index fall was independently associated with future falls −related emergency department presentations (OR, 1.69; 95% CI, 1.14-2.49; P = .008), future fractures (OR, 1.52; 95% CI, 1.08-2.15; P = .018), but not more general practitioner visits during follow-up.
Conclusions and Implications: This study demonstrates that even a single fall can signal a significant shift in the health and functional trajectories of community-dwelling older people, reinforcing the need for proactive and coordinated prevention strategies.
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Falls are the leading cause of hospital admission[1] and injury-related death in older people.[2] Each year, approximately 1-in-8 older people experience a fall requiring medical attention, with nearly half of these cases resulting in unscheduled emergency department (ED) visits.[3] In the context of increasing longevity and population aging, the number of older people presenting with falls to

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* Address ccorrespondence to Robert Briggs, PhD, The Irish Longitudinal Study on Ageing, Trinity College Dublin, Trinity Central, 152-160 Pearse St, Dublin 2, Ireland D02 R590.
E-mail address: briggsr@tcd.ie (R. Briggs).

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acute care is rising and will continue to do so unless preventative strategies are improved.[4]

Beyond immediate physical harm, falls can have important broader social and psychological consequences. Falls are frequently cited as a key reason for admission to residential care in later life,[5] negatively impact well-being and quality of life,[6,7] and are an important driver of health care costs.[8]

Given the movement toward community-based models, the emphasis has shifted to supporting older adults to age in place.[9] While this preserves autonomy, it also places a greater premium on primary prevention.[10] Preventing the first fall is paramount in this context, as even a single event can lead to a "fear of falling" or functional decline that necessitates an unwanted transition to residential care.[5–7]

Nationally representative data from The Irish Longitudinal Study on Aging (TILDA) have shown that almost 6% of people ≥50 years in Ireland have at least 1 impairment in personal activities of daily living,[11] whereas 8% of those ≥65 years receive publicly financed community-based social or home care.[12] While models of care differ across health systems, demand for community-based support and residential care is increasing internationally.[13] Community support may involve help with personal care, meal preparation, domestic tasks, or shopping, and is essential for supporting older people with functional impairment to continue living in the community, rather than in residential care.

While falls may increase the risk of functional impairment[14] and increase the demand for informal caregiving from family or community networks,[15] the relationship of an index fall, that is, a fall in an older person with no recent history of falls, with future functional status and impact on the requirement for formal social support is less clear.

Falls may also increase the risk of future health care use.[16] Studies examining the link with future falls–related health care use to date have focused on all-cause hospitalization,[17] transfers from nursing homes,[17,18] or the risk of falls associated with fear of falling,[19] with little work to date examining the pattern of health care use after an index fall in community-dwelling older people.

Given these important consequences of falls in later life, this study uses population-based longitudinal data to examine the downstream effects of an index fall on key outcomes, including functional status, social care requirements, and future falls–related health care utilization. We hypothesize that an index fall represents an important inflection point in later life and can initiate a cascade of effects characterized by worsening functional ability, increased reliance on social support, and heightened health care needs.

Methods

This study utilizes data from TILDA to examine the relationship between an index fall and future functional status, social care needs, and health care utilization among a cohort of community-dwelling older adults with no recent history of falls.

Study Design

The TILDA study design has been described fully elsewhere.[20] In brief, data were collected through 3 main components: computer-assisted personal interviews conducted by social interviewers in participants' homes; self-completion questionnaires filled out by participants and returned by post; and comprehensive health assessments performed at research centers or, when necessary, modified home-based assessments conducted by trained research nurses.

Data collection occurs in waves every 2 years. This analysis includes data from waves 1 to 3, which were conducted from 2009 to 2015.

Participants included in the study were those aged ≥65 years at wave 2, who denied any falls in the preceding 12 months at wave 1, and who completed the 2-year follow-up through wave 3.

Falls and Fractures

At each wave (waves 1-3), participants were asked, "Have you had any falls in the last year/since the last interview?" to assess fall incidence. Participants who reported a fall at wave 1 were excluded from the analysis to create a study sample with no recent history of falls. An index fall was defined as a fall reported by participants at wave 2 who had no prior fall history at wave 1. Participants were also asked about any fractures (hip, wrist, vertebral, or other) sustained in the past year. This information was used to create the "fractures" variable.

Functional Status

Functional status was assessed at wave 1 and at follow-up in wave 3. It was measured through self-reports on activities of daily living (ADLs), which include bathing, dressing, eating, toileting, transferring, and continence. Self-reported functional measures have been shown to correlate closely with objective measures of impairment in older people.[21]

Functional impairment was defined as requiring assistance with any of the 6 ADL domains. Functional decline was defined as a decrease in the number of ADLs the participant could perform independently between waves 1 and 3.

Social Care

At waves 1 and 3, participants were asked if they accessed any of the following social care services: home care: assistance with personal care or ADLs, typically provided by a home care assistant or personal support worker (eg, help with bathing, dressing, grooming, toileting, and mobility); home help: domestic assistance, such as light housekeeping or shopping; meals on wheels: meal delivery services for those unable to shop or cook for themselves.

Health Care Use

Participants reported the number of ED visits because of falls and the number of general practitioner (GP) visits between waves 2 and 3, and this was used to inform health care use variables.

Covariates

Demographic and health-related covariates were assessed as follows: educational attainment (primary, secondary, or tertiary) and marital status (married, never married, and divorced/separated) were self-reported; alcohol intake was assessed using the CAGE (Cut Down, Angry, Guilty, Eye Opener) scale[22]; chronic disease burden was assessed based on self-reports of the following conditions: cancer, liver disease, Parkinson's disease, osteoporosis, diabetes, eye diseases (eg, glaucoma, cataracts, age-related macular degeneration), thyroid disease, arthritis, and lung disease; polypharmacy was defined as being prescribed ≥5 medications; heart disease was self-reported and included conditions, such as heart attack, angina, congestive heart failure, and arrhythmia; cognitive impairment was either a diagnosis of dementia or mild cognitive impairment by a health care professional or self-reported memory problems.

Statistical Analysis

Data were analyzed using Stata, version 14.1 (StataCorp). Baseline characteristics were summarized for the study sample, stratified by fall status at wave 2, presenting proportions with 95% CIs. We used regression models to assess the independent relationship between falls and outcomes, including functional impairment and decline; requirement for social care; future falls; fractures; GP visits; and ED visits because of falls.

For the analysis of functional impairment, participants who were functionally impaired at baseline (wave 1) were excluded. Similarly, for the analysis of social care requirements, participants who required social care at baseline were excluded. Figure 1 shows the flow diagram of study participants.

All regression models were adjusted for age, sex, educational attainment, marital status, alcohol intake, chronic disease burden (none, 1, or ≥2 conditions), heart disease, polypharmacy, and memory impairment. These covariates were selected a priori based on their potential to modify the relationship between falls and the outcomes of interest.

Ethics

The TILDA study was approved by the relevant research ethics committee at the site where the research was conducted, and all participants gave informed written consent. All experimental procedures adhered to the Declaration of Helsinki. All assessments were carried out by trained research nurses.

Results

Baseline Characteristics

Of the 2454 participants included in the study, 20% (n = 493) reported an index fall.

Participants with an index fall were marginally older, more likely to be female, with higher rates of educational attainment, chronic disease burden, and polypharmacy. Baseline characteristics are shown in Table 1.

Functional Status

As shown in Figure 2, participants with an index fall at wave 2 had significantly higher rates of functional impairment at 2-year follow-up.

Almost 12% (53/459) of participants with an index fall who were previously functionally independent at wave 1 had at least a single ADL impairment during follow-up, compared with 6% (120/1879) of participants who did not have a fall ($P < .001$; $X^2 = 14.337$).

Fully adjusted regression models demonstrated that in participants who were functionally independent at wave 1, an index fall was associated with functional impairment at 2-year follow-up (odds ratio [OR], 1.71; 95% CI, 1.19-2.47; $P = .004$).

An index fall was also associated with a greater than 50% higher chance of functional decline (an increase of ≥1 ADL impairment(s)) between waves 1 and 3 in fully adjusted regression models (OR, 1.51; 95% CI, 1.05-2.17; $P = .025$). Index falls associated with a fracture were not associated with a higher likelihood of functional decline at follow-up than those not associated with a fracture (OR, 1.23; 95% CI, 0.56-2.71 versus OR, 1.83; 95% CI, 1.25-2.69).

Social Care

As shown in Figure 1, participants with an index fall at wave 2 were significantly more likely to be receiving either home care or home help at follow-up (10% vs 5%, $X^2 = 17.37$; $P < .001$).

In participants who did not require home care at wave 1, an index fall was independently associated with an almost 3-fold higher likelihood of requiring home care during follow-up (OR, 2.87; 95% CI, 1.38-5.97; $P = .005$).

Participants with an index fall required a higher mean number of home care hours per month (OR, 1.04; 95% CI, 0.17-1.91) than those with no falls (OR, 0.33; 95% CI, 0.06-0.59) during follow-up ($t = -2.037$; $P = .042$).

In fully adjusted regression models, an index fall was associated with a higher number of home care hours per month ($\beta = 0.76$; 95% CI, 0.18-1.34; $P = .010$).

An index fall was also independently associated with the requirement for any social support (home care, home help, or meals

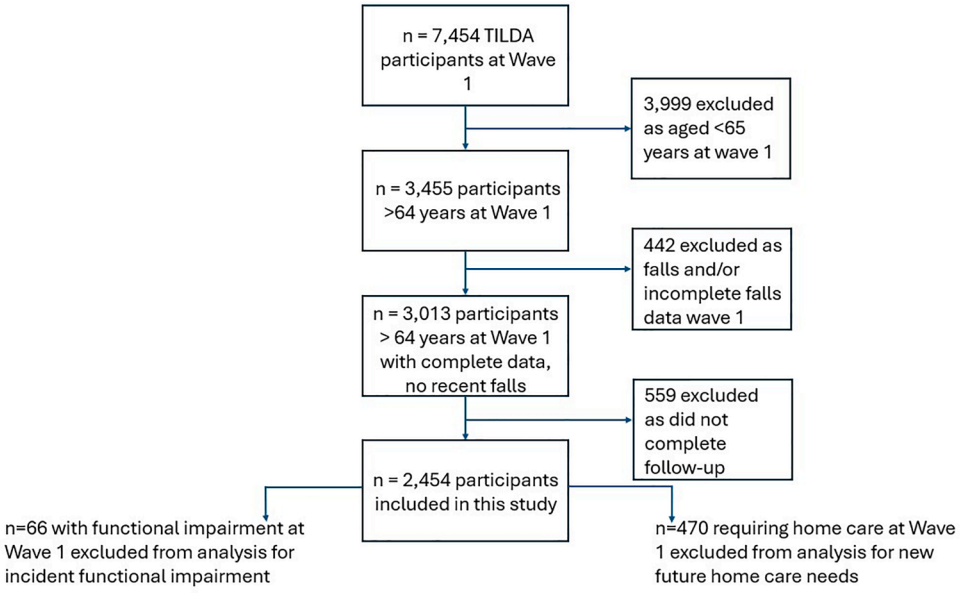


Fig. 1. Flow diagram of study participants. Functional impairment is defined as requiring support with at least 1 of the following by self-report: bathing, dressing, eating, toileting, transferring, and continence.

Table 1
Baseline Characteristics by Falls Status

Variables	No Falls (n = 1961)	Falls (n = 493)	Statistical Test
Age (mean, 95% CI), y	72.1 (71.8-72.4)	72.7 (72.1-74.2)	$t = -2.03$; $P = .0421$
Age breakdown, y (%, 95% CI)			
65-69	43% (41%-45%)	41% (37%-45%)	$X^2 = 4.34$; $P = .114$
70-79	42% (40%-44%)	41% (37%-45%)	
≥80	14% (13%-16%)	18% (15%-22%)	
Female (%, 95% CI)	50% (48%-53%)	61% (57%-65%)	$X^2 = 17.66$; $P < .001$
Educational attainment (%, 95% CI)			$X^2 = 7.79$; $P = .020$
Primary	39% (37%-41%)	32% (28%-36%)	
Secondary	35% (33%-37%)	38% (34%-43%)	
Tertiary	26% (24%-28%)	30% (26%-34%)	
Marital status (%, 95% CI)			$X^2 = 13.55$; $P = .004$
Married	67% (64%-69%)	60% (56%-64%)	
Never married	8% (7%-9%)	12% (9%-15%)	
Separated/divorced	4% (3%-5%)	3% (2%-5%)	
Widowed	22% (20%-23%)	25% (21%-29%)	
CAGE* (%, 95% CI)			$X^2 = 2.70$; $P = .259$
<2	75% (74%-77%)	73% (69%-77%)	
≥2	7% (6%-9%)	7% (5%-10%)	
Did not answer	17% (16%-19%)	21% (17%-24%)	
Chronic disease number† (%, 95% CI)			$X^2 = 11.85$; $P = .003$
None	36% (34%-39%)	30% (26%-34%)	
One	36% (34%-39%)	36% (32%-40%)	
Two or more	27% (25%-29%)	34% (30%-39%)	
Polypharmacy‡ (%, 95% CI)	36% (34%-38%)	44% (40%-49%)	$X^2 = 11.30$; $P = .001$
Heart disease§ (%, 95% CI)	12% (10%-13%)	13% (10%-16%)	$X^2 = 0.41$; $P = .520$
Memory impairment‖ (%, 95% CI)	3% (3%-4%)	5% (3%-7%)	$X^2 = 2.78$; $P = .096$

Analysis with *t* tests for continuous variables and X^2 for binary variables.

*Cut Down, Angry, Guilty, Eye Opener Scale with score ≥2 indicating alcohol dependence.

†The count of the following self-reported chronic conditions: cancer, liver disease, Parkinson's disease, osteoporosis, diabetes, eye disease, thyroid disease, arthritis, and lung disease.

‡Prescribed ≥5 medications.

§Self-reported angina, myocardial infarction, or cardiac failure.

‖Doctor's diagnosis of memory problems/dementia and/or self-rated memory as poor.

on wheels) during follow-up in this cohort (OR, 1.85; 95% CI, 1.18-2.88; $P = .007$). Index falls associated with a fracture were not associated with a higher likelihood of requiring social support at follow-up than those not associated with a fracture (OR, 0.90; 95% CI, 0.34-2.37 versus OR, 1.87; 95% CI, 1.17-2.99).

Health Care Use, Falls, and Fractures

An index fall was independently associated with a higher chance of future falls (OR, 2.56; 95% CI, 2.08-3.20; $P < .001$) as well as ED presentation because of falls (OR, 1.69; 95% CI, 1.14-2.49; $P = .008$) but not a GP visit (OR, 0.90; 95% CI, 0.73-1.10; $P = .297$) or the number of GP visits ($\beta = 0.19$; 95% CI, −0.42 to −0.81; $P = .545$) during follow-up (Figure 3).

An index fall was associated with a 50% higher chance of a future fracture during follow-up (OR, 1.52; 95% CI, 1.08-2.15; $P = .018$), and an almost 3-fold higher likelihood of future hip fracture (OR, 2.71; 95% CI, 1.23-5.98; $P = .014$) (Figure 3).

Discussion

This study delineates the changes in functional status, social care needs, future falls and fracture burden, and health care utilization following an index fall in a large cohort of community-dwelling older adults with no recent prior falls.

We found that an index fall is independently associated with a 70% increased likelihood of developing functional impairment among those previously independent (to an absolute proportion of 12% of those with index falls), a 50% higher likelihood of functional decline, a 3-fold increase in the chance of requiring home care (to an absolute proportion of 12% of those with index falls), and a 2-fold increase in the chance of needing any form of formal social care at 2-year follow-up. Findings also demonstrate the burden of future falls and fractures associated with an index fall, with a 50% higher chance of a fracture and almost 70% higher chance of ED attendance because of falls in the subsequent 2 years.

While the association between falls and functional impairment is well established,[14,23,24] and previous research has explored the impact of falls on informal caregiving burden,[15] this is the first study to explicitly examine the link between an index fall and increased need for formal social care services. This represents an important

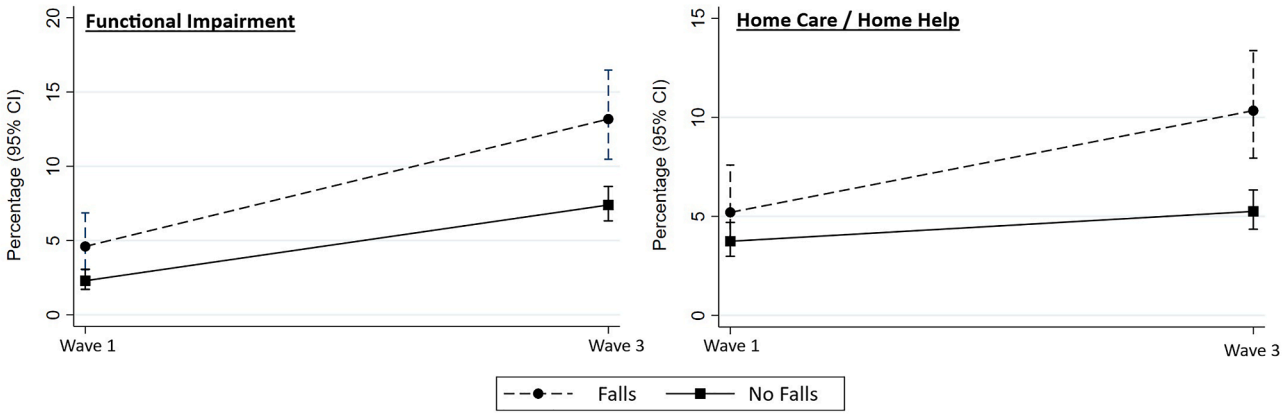


Fig. 2. Functional impairment and social supports at waves 1 and 3 by index falls. N = 2454; n = 211 with index fall; 2-year follow-up. Functional impairment is defined as requiring assistance with 1 or more of the following: bathing, dressing, eating, toileting, transferring, and continence.

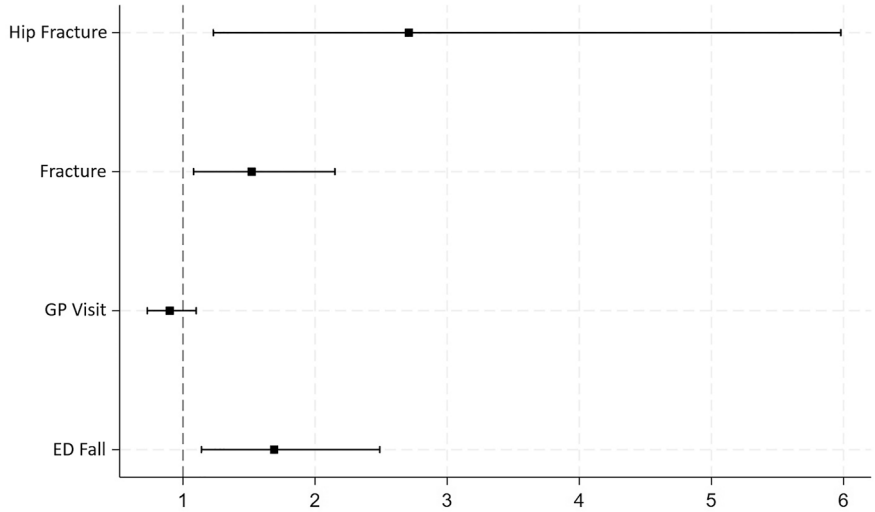


Fig. 3. Association of index fall with future falls–related health care utilization. N = 2454; n = 211 with index fall; 2-year follow-up. Output from the logistic regression model reporting ORs with 95% CIs for the association of the index fall with outcomes of interest. 1. Model adjusted for age, sex, educational attainment, marital status, alcohol intake, chronic disease burden (none, 1, or ≥2 conditions), heart disease, polypharmacy, and memory impairment.

under-recognized outcome, with implications for individuals, families, and the broader health and social care systems.

These findings are important for several reasons. They highlight falls as a sentinel event, a key trigger for increased dependency, social care needs, and loss of independence. Further, they add urgency to the case for investing in fall prevention as a public health strategy to reduce downstream health care costs and alleviate strain on an already overburdened social care system.

Disrupting this "domino effect," from initial fall to escalating social care and health care use, should be a public health priority. There is strong evidence that multifactorial interventions (including exercise, medication review, and home safety modifications) can reduce falls by over 20% in community-dwelling older people.[25] Interventions targeted to high-risk groups, including older people presenting to the ED with falls,[26] or nursing home residents[27] have also demonstrated efficacy in reducing falls and related outcomes. These interventions, when targeted appropriately, could therefore delay or prevent the downstream health and social care needs we identified in this study.

There are some limitations to this study that should be noted. Falls are by self-report, so could therefore be subject to recall bias. Important steps were taken to reduce recall bias in the TILDA study, however, including using experienced interviewers, cross-checking variables against prior waves, and including informants in interviews when indicated and with consent of the participant. In addition, while it is possible that the increased social care need in participants with falls may reflect underlying frailty or comorbid conditions that predisposed the individual to fall in the first place, we robustly adjusted for covariates, including chronic disease burden, polypharmacy, heart disease, and cognitive impairment, to minimize residual confounding as much as possible. While we lacked an objective measure of frailty status, these variables are surrogate markers of frailty within the data set. Further, environmental hazards within the home, an important factor in many falls, were not assessed. Finally, using a numerical definition of polypharmacy may not capture the disproportionate risk of specific high-risk or fall-inducing medications. Thus, our findings reflect overall care complexity rather than specific pharmacologic risk profiles.

Strengths include the large, well-described sample of older people with robust follow-up. Moreover, few studies to date have quantified the broader implications of a fall in terms of formal care provision.

Conclusions and Implications

This study demonstrates that even a single fall can signal a significant shift in health and functional trajectory, which may carry substantial personal, economic, and social implications. Overall, these findings reinforce the need to view falls not merely as isolated events but as critical inflection points in the aging trajectory that warrant proactive and coordinated prevention strategies.

Disclosure

The authors declare no conflicts of interest.

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