JAMDA 26 (2025) 105542

JAMDA

journal homepage: www.jamda.com

Original Study

Sex-Specific Fall Trajectories and Associated Self-Reported Risk Factors: A Prospective Analysis of the 3-Year 5-Country DO-HEALTH Trial

Maud Wieczorek PhD [a,b,*], Gregor Freystaetter MD [a,c], Robert Theiler MD [a], Uwe Siebert MD [d,e,f], Andreas Egli MD [a,b], Tahir Masud MD [g,h], John A. Kanis MD [i], Heike A. Bischoff-Ferrari MD, DrPH [a,b,j,*], for the DO-HEALTH Research Group

[a] *Research Centre on Aging and Mobility, University of Zurich, Zurich, Switzerland*
[b] *Department of Aging Medicine and Aging Research, University of Zurich, Zurich, Switzerland*
[c] *University Clinic for Aging Medicine, Zurich City Hospital, Zurich, Switzerland*
[d] *Department of Public Health, Health Services Research and Health Technology Assessment, UMIT TIROL - University for Health Sciences and Technology, Hall in Tirol, Austria*
[e] *Center for Health Decision Science, Departments of Epidemiology and Health Policy & Management, Harvard T.H. Chan School of Public Health, Boston, MA, USA*
[f] *Institute for Technology Assessment and Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA*
[g] *University of Nottingham, Nottingham, United Kingdom*
[h] *Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom*
[i] *Centre for Metabolic Diseases, University of Sheffield Medical School, Sheffield, United Kingdom*
[j] *Department of Aging Medicine, Felix Platter, University of Basel, Basel, Switzerland*

Keywords:
Falls
trajectories
older adults
DO-HEALTH

A B S T R A C T

Objective: Few studies have explored specific trajectories or patterns of falls over time in older adults, and the role of sex and self-reported risk factors for these trajectories were overlooked. This study aimed to identify sex-specific fall trajectories over 3 years and the self-reported risk factors associated with each trajectory in European older adults.
Design: Observational analysis of DO-HEALTH, a double-blind, randomized controlled trial.
Setting and Participants: Multicenter trial conducted in 7 European centers: Zurich, Basel, Geneva (Switzerland), Berlin (Germany), Innsbruck (Austria), Toulouse (France), and Coimbra (Portugal), including 2157 community-dwelling adults aged 70 years and older without major health events in the 5 years prior to enrollment, with sufficient mobility and good cognitive status.
Methods: Falls were recorded prospectively via phone calls and in-person assessments every 3 months over 3 years of follow-up. Group-based trajectory modeling was used to identify sex-specific trajectories based on the number of falls experienced over the follow-up, and penalized logistic regression models identified the self-reported risk factors most associated with each trajectory.
Results: A total of 1958 participants were included in this analysis (mean age: 74.9 years, 61.7% women). We identified a “lower fall trajectory” and a “higher fall trajectory” among women and a “lower fall trajectory” and an “increasing fall trajectory” among men. In women, living alone was the only self-reported risk factor associated with the higher fall trajectory. In men, living alone (marginal), as well as reporting fatigue, pain or discomfort, mobility issues, and higher self-rated health, were significantly associated with experiencing the increasing fall trajectory.
Conclusions and Implications: This study provides a comprehensive assessment of falls over 3 years, highlighting differences in fall patterns and associated self-reported risk factors between men and

Funding: We acknowledge support from the Swiss National Science Foundation for the conduct of the present study (grant number: 216289). The DO-HEALTH trial was funded by the Seventh Research Framework Program of the European Commission (grant agreement no. 278588), and within this framework, also by the University of Zurich (Chair for Geriatric Medicine and Aging Research), DNP, Roche, NESTEC, Pfizer, and Streuli. The funding/supporting organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

* Address correspondence to Heike A. Bischoff-Ferrari, MD, DrPH; or Maud Wieczorek, PhD, Research Centre on Aging and Mobility, c/o Stadtspital Zürich Waid, Tièchestrasse 99, Zurich, 8037, Switzerland.
E-mail addresses: maud.wieczorek@uzh.ch (M. Wieczorek), heikea.bischoff-ferrari@uzh.ch (H.A. Bischoff-Ferrari).

https://doi.org/10.1016/j.jamda.2025.105542

women. These findings may offer valuable insights for developing sex-specific fall risk prediction models and targeted fall prevention strategies.

Falls are a significant health burden among older adults, with serious implications for health systems and society, particularly as populations age rapidly worldwide.[1] In older adults, falls are a leading cause of injury-related morbidity and mortality,[2] contributing to long-term functional decline,[3] loss of independence,[4] and increased health care costs.[5] With the projected increase in the global older population, fall prevention has become a public health priority, underscoring the need to deepen our understanding of fall risk factors to inform targeted interventions.[6,7]

Given the complex and changing nature of fall risks, understanding fall trajectories—patterns of fall risk over time (eg, stable patterns vs increasing fall incidence)—has the potential to provide valuable insights by accounting for dynamic changes in fall risk rather than relying solely on a single incidence rate of falls, thereby enabling the development of more tailored risk profiling and prevention strategies. Recent studies using trajectory analysis have enhanced our understanding by examining longitudinal patterns in fall occurrence.[8,9] However, these studies are limited by sample sizes,[8] have been conducted primarily among US populations,[8,9] and did not explore sex-specific variations in fall trajectories or associated risk factors.[8,9]

Sex differences play a critical role in various health outcomes,[10] and an increasing body of evidence suggests that these differences also extend to the epidemiology of falls. Sex has been suggested as a major risk factor for falls, with most studies reporting an increased risk of falls among women.[11] Additionally, men and women may have different risk profiles for falls, likely because of biological, behavioral, and social variations between sexes.[12-14] However, comprehensive, sex-specific analyses of fall trajectories and the identification of risk factors for different fall trajectories in older adults remain limited.[12,14]

Research has identified a variety of factors contributing to falls among older adults, including biological, environmental, and behavioral elements.[7,11,15-17] Although understanding these factors is essential for effective fall prevention, there is a particular need to examine self-reported risk factors, which may provide accessible and practical tools for use in clinical and public health settings. Self-reported measures are easy to obtain in routine clinical practice, allowing for rapid, practical, and cost-effective assessments.[18] Furthermore, self-reported risk factors may help empower individuals to self-assess and recognize their risk of falling, fostering greater awareness and engagement in preventive actions.[7] Despite these advantages, self-reported risk factors are less studied than clinical and performance-based variables,[11,19] which often require specialized equipment or expertise.

The present study addresses these gaps by identifying sex-specific fall trajectories over 3 years among generally healthy older adults and associated self-reported risk factors using data from the DO-HEALTH trial conducted across 5 European countries.

Given the higher incidence rates of falls among women reported in previous studies, we hypothesize that women will exhibit distinct fall trajectory patterns, characterized by a greater frequency of falls over time compared with men. Furthermore, we hypothesize that the associated risk factors for fall trajectories will differ by sex, reflecting underlying biological, behavioral, and social variations between women and men.

Methods

Participants and Study Design

This study is a post hoc observational analysis of the DO-HEALTH (VitaminD3-Omega3-Home Exercise-Healthy Ageing and Longevity Trial) clinical trial, a 3-year, multicenter, double-blinded, randomized controlled clinical trial (NCT01745263).[20] A total of 2157 community-dwelling generally healthy adults aged 70 years and older were recruited from 7 centers in 5 European countries: Zurich, Basel, Geneva (Switzerland), Berlin (Germany), Innsbruck (Austria), Toulouse (France), and Coimbra (Portugal). Inclusion criteria were an absence of major health events (ie, history of cancer, myocardial infarction, stroke, transient ischemic attack, angina pectoris, or coronary artery intervention) in the 5 years prior to enrollment, sufficient mobility to come to the study centers, and good cognitive function with a Mini-Mental State Examination score of at least 24. In order to include participants with an increased risk of falling, recruitment was stratified to include approximately 40% of enrollees with falls in the 12 months prior to enrolment. Additional inclusion and exclusion criteria and the main trial results are published elsewhere.[21,22]

Outcome

The outcome was the 6-monthly counts of low- and high-trauma falls experienced over the 3-year follow-up. Fall data were collected prospectively through phone calls (months 3, 6, 9, 15, 18, 21, 27, 30, and 33) and in-person clinical visits (months 12, 24, and 36). Supported by a fall diary, all 2157 participants were asked whether they had sustained a fall in the last 3 months at each 3-monthly contact. Falling was defined as "unintentionally coming to rest on the ground, floor, or other lower level"; coming to rest against furniture or a wall was not considered a fall.[23]

Candidate Self-Reported Risk Factors

The candidate self-reported risk factors were measured at baseline and encompassed sociodemographic, physical and mental health, and lifestyle domains.

Sociodemographic factors included participants' living situation, specifically whether they lived alone as a binary variable (yes/no), and the total years of education they completed.

Health-related factors included polypharmacy, defined as the use of 5 or more medications and coded as a binary variable (yes/no).[24] Multimorbidity, or the presence of 3 or more chronic conditions,[25] was assessed using the Sangha questionnaire.[26] Current self-rated health was measured through the EuroQol-5D-3L (EQ5D-3L) visual analog scale, a vertical scale ranging from "The best health you can imagine" to "The worst health you can imagine," providing a quantitative health measure on a scale from 0 to 100.[27] Fatigue was evaluated using a question from the Survey of Health, Ageing and Retirement in Europe—Frailty Instrument (SHARE-FI).[28] Participants were asked, "In the last month, have you had too little energy to do things you wanted to?" with a positive response indicating fatigue. Health-related quality of life was assessed with the EQ5D-3L, comprising the following dimensions: mobility (problems with

walking about), usual activities (problems with performing usual activities such as housework, family or leisure activities), pain/discomfort, and anxiety/depression.[27] Each dimension has 3 response levels (no problems, some problems, and extreme problems, labeled 1-3), allowing participants to select the statement that most closely describes their health status in each dimension.[27] For the purposes of analysis, responses indicating "some problems" and "extreme problems" were grouped together to create binary variables, distinguishing between "no problems" and "any problems" for each dimension. Subjective cognitive status was assessed using an item from the Geriatric Depression Scale-15,[29,30] which asked respondents whether they feel they have more problems with memory than most people.

Lifestyle factors included current smoking status, recorded as yes or no, which covered the use of cigarettes, cigars, and pipe tobacco. Alcohol consumption was assessed by asking participants whether they consume alcohol and, if so, how many units per week. Responses were used to create a binary variable for excessive alcohol consumption, where "yes" indicates consumption of 21 or more units per week, a level associated with a higher risk of adverse physical and cognitive health outcomes,[31,32] and "no" includes those consuming fewer than 21 units or no alcohol at all. Physical activity was assessed with low activity level defined as a response of "less than once a week" to the question "How often do you engage in activities that require a low or moderate level of energy such as gardening, cleaning the car, or going on a walk?" from the SHARE-FI.[28]

Statistical Analysis

For this study, participants with at least 3 available 6-monthly counts of falls were included in the analyses to model trajectories effectively. Baseline demographic, health, and lifestyle characteristics of the analytical sample are presented both overall and stratified by sex and trajectory group. Differences between sexes and trajectory groups were tested using the Wilcoxon rank-sum test for non-normally distributed variables, the *t* test for normally distributed variables, and the χ^2 test for categorical variables.

We applied group-based trajectory modeling using the Traj procedure in SAS, version 9.4 (SAS Institute Inc, Cary, NC).[33,34] The follow-up times (6, 12, 18, 24, 30, and 36 months) served as the metric for defining trajectory groups, and the model was based on a Poisson distribution to account for the count nature of the fall data. For each trajectory, we tested several possible shapes (intercept-only, linear, or quadratic) and selected the optimal model by minimizing the Bayesian information criterion (BIC), while ensuring that all model terms remained statistically significant. To maintain sufficient sample sizes, each identified trajectory was required to include at least 5% of the total sample. The DO-HEALTH trial design variables, including age, study center, history of falls, and treatment allocation, were included in the "risk" statement of the SAS Traj procedure, as these factors may influence the probability of the membership in a specific trajectory group.

Model fit was assessed using posterior group-membership probabilities, which measure the likelihood of an individual's assignment to each trajectory. Following Nagin, an average posterior probability of at least 0.7 in each trajectory was considered indicative of good classification.[35] Additionally, relative entropy values, derived from posterior group-membership probabilities, assessed class separation, with values close to 1 indicating minimal classification uncertainty.[36]

To identify risk factors associated with each fall trajectory, we first applied a penalized regression model using the Least Absolute Shrinkage and Selection Operator (LASSO) to select the variables most associated with fall trajectory group membership.[37] The Akaike information criterion was used as the criterion for selecting the final model to balance model fit and parsimony. We then included all variables retained from the LASSO selection in a binary logistic regression model, including weights based on the posterior group membership probabilities to account for the likelihood of an individual's assignment to each trajectory. Results from the logistic regression models are expressed as odds ratios (ORs) with 95% CIs to quantify the association between each factor and fall trajectory membership.

Table 1
Baseline Characteristics of the Analytical Sample, Overall and by Sex

	Women	Men	*P* Value*	Overall
	(n = 1205; 61.5)	(n = 753; 38.5)		(n = 1958)
Age, y, mean (SD)	74.7 (4.3)	75.1 (4.4)	.05	74.9 (4.4)
Age categories, n (%)			.50	
70-74	699 (58.0)	425 (56.4)		1124 (57.4)
≥75	506 (42.0)	328 (43.6)		834 (42.6)
Prior fall, n (%)	543 (45.1)	260 (34.5)	<.001	803 (41.0)
Study centers, n (%)			<.001	
Basel	127 (10.5)	88 (11.7)		215 (11.0)
Berlin	226 (18.8)	92 (12.2)		318 (16.2)
Coimbra	187 (15.5)	103 (13.7)		290 (14.8)
Geneva	120 (10.0)	71 (9.4)		191 (9.8)
Innsbruck	85 (7.0)	87 (11.6)		172 (8.8)
Toulouse	159 (13.2)	106 (14.1)		265 (13.5)
Zurich	301 (25.0)	206 (27.4)		507 (25.9)
Living alone, n (%)	654 (54.3)	151 (20.1)	<.001	805 (41.1)
Education years, mean (SD)	12.0 (4.1)	13.9 (4.5)	<.001	12.7 (4.3)
Polypharmacy, n (%)	325 (27.0)	206 (27.4)	.85	531 (27.1)
Multimorbidity, n (%)	349 (29.0)	158 (21.0)	<.001	507 (25.9)
Self-rated health (0-100), mean (SD)	80.5 (15.7)	83.7 (12.4)	<.001	81.7 (14.6)
Fatigue, n (%)	373 (31.1)	122 (16.22)	<.001	495 (25.4)
Problems with mobility, n (%)	220 (18.3)	88 (11.7)	<.001	308 (15.8)
Problems with usual activities, n (%)	106 (8.8)	25 (3.3)	<.001	131 (6.7)
Pain or discomfort, n (%)	626 (52.0)	294 (39.1)	<.001	920 (47.1)
Anxiety or depression, n (%)	284 (23.6)	97 (12.9)	<.001	381 (19.5)
Subjective memory problems, n (%)	198 (16.7)	128 (17.1)	.80	326 (16.8)
Excessive alcohol consumption, n (%)	18 (1.5)	67 (8.9)	<.001	85 (4.3)
Current smoking, n (%)	60 (5.0)	49 (6.5)	.15	126 (5.8)
Low physical activity level, n (%)	148 (12.4)	72 (38.6)	.06	220 (11.3)

*Differences between men and women were assessed by an independent *t* test for continuous variables and χ^2 test for categorical variables.

All statistical analyses were performed using SAS, version 9.4, and a 2-sided *P* value of <.05 was considered statistically significant.

Ethics

The Cantonal Ethical Committee of the Canton of Zurich approved this ancillary analysis (BASEC-Nr 2024-00858). Informed consent was obtained from all individual participants included in the study.

Results

Baseline Characteristics of the Analytical Sample

Of the 2157 participants in the DO-HEALTH study, 1958 individuals had at least 3 available 6-monthly counts of falls and were included in the analysis. A comparison of baseline characteristics between participants included and excluded from the analysis is provided in Supplementary Table 1. The baseline characteristics of the 1958 included participants, overall and by sex, are presented in Table 1. The sample consisted of 1205 women (61.5%) and 753 men (38.5%), with a mean age of 74.9 years (SD 4.4). As intended by the trial recruitment strategy, 41.0% reported a prior fall at baseline. Regarding other sociodemographic characteristics, participants had an average of 12.7 years of education (SD 4.3), and 41.1% lived alone.

Fall Trajectories Among Women

The final model, illustrated in Figure 1, identified 2 distinct fall trajectories among women, both following intercept-only shapes. Trajectory 1, referred to as the "lower fall trajectory," included 84.7% of the sample. Women in this group maintained a consistently low mean number of falls throughout the study period, of approximately 0.2 falls per measurement interval, with minor fluctuations over time. In contrast, trajectory 2, referred to as the "higher fall trajectory," comprised 15.4% of the sample. This group displayed a consistently higher mean number of falls, ranging from approximately 0.9 to 0.95 falls across the follow-up period, with a slightly increased frequency observed during the final measurement interval. The final model demonstrated strong classification reliability, as reflected in the mean posterior group-membership probabilities: 0.95 (SD 0.10) for trajectory 1 and 0.87 (SD 0.15) for trajectory 2. Additionally, the model achieved a relative entropy value of 0.86, suggesting a high degree of separation between the 2 trajectories and low classification uncertainty. Detailed information about the model selection process and model fit can be found in Supplementary Tables 2 and 3. Detailed baseline characteristics of participants within each fall trajectory are presented in Supplementary Table 4.

Self-Reported Risk Factors Among Women

The risk factors retained in the final penalized regression model using LASSO are presented in Table 2, along with weighted ORs and 95% CI. Among women, only living alone was significantly associated with a higher likelihood of belonging to the higher fall trajectory (trajectory 2) (OR 1.67, 95% CI 1.17-2.38, $P = .005$).

Fall Trajectories Among Men

The final model, shown in Figure 2, identified 2 distinct fall trajectories among men. Trajectory 1, referred to as the "lower fall

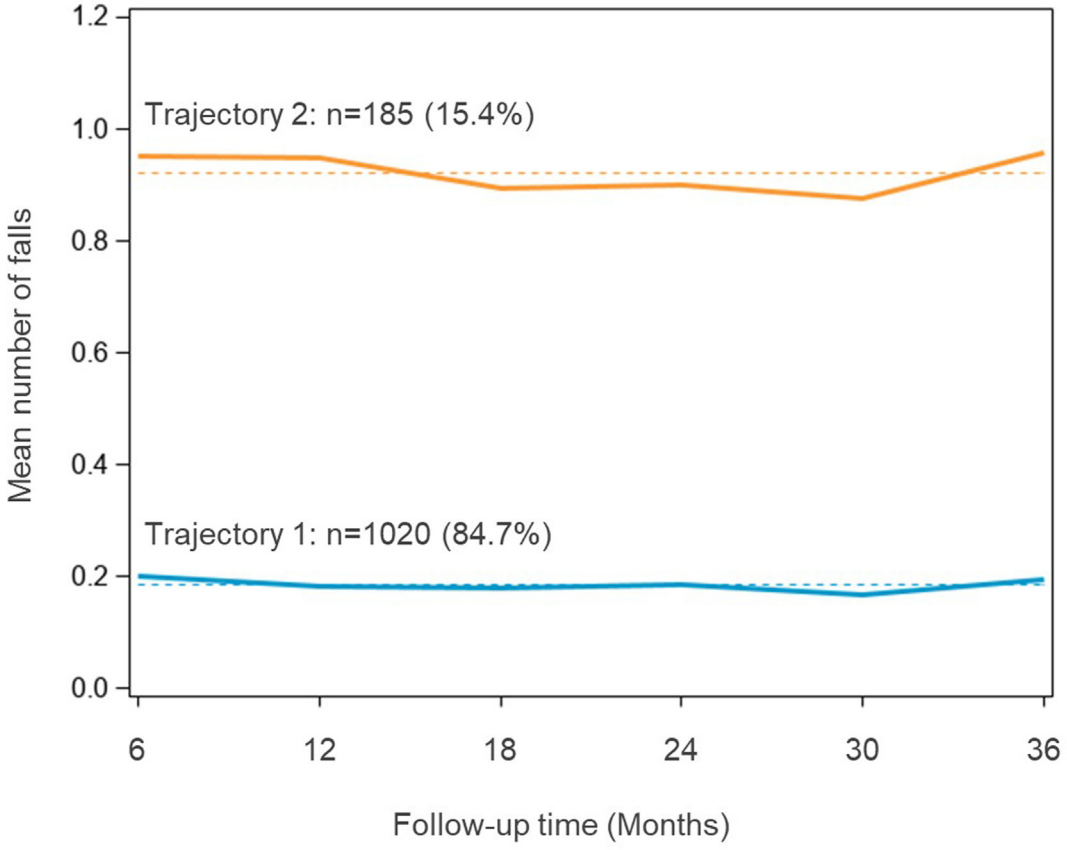

Fig. 1. Three-year fall trajectories among women in the DO-HEALTH study. Trajectory 1: lower fall trajectory, trajectory 2: higher fall trajectory.

Table 2
Multivariate Logistic Regression Model of Baseline Characteristics Associated With Membership in the Higher Fall Trajectory (Trajectory 2) Among Women

Risk Factors	OR (95% CI)	*P* Value
Living alone	1.67 (1.17-2.39)	.005
Polypharmacy	1.38 (0.93-2.04)	.11
Self-rated health	0.89 (0.74-1.06)	.18
Fatigue	1.33 (0.90-1.96)	.16
Problems with mobility	1.41 (0.89-2-23)	.15
Problems with usual activities	1.24 (0.68-2.25)	.48
Anxiety or depression	1.31 (0.87-1.98)	.20
Subjective memory problems	1.23 (0.79-1.91)	.36
Current smoking	0.53 (0.20-1.45)	.22

trajectory," displayed an intercept-only shape, indicating a stable pattern of falls over the follow-up period. This trajectory included 86.5% of the sample. Men in this group maintained a consistently low mean number of falls, of approximately 0.15 falls per measurement interval, with minimal variation throughout the study period. In contrast, trajectory 2, referred to as the "increasing fall trajectory," exhibited a quadratic shape. This trajectory comprised 13.6% of the sample. Men in this group initially had a higher mean number of falls compared with trajectory 1, starting at approximately 0.95 with a notable dip to around 0.7 until 30 months, followed by a marked increase to >1.1 toward the end of the follow-up period. The classification reliability of the model was high, as indicated by the mean posterior group-membership probabilities: 0.97 (SD 0.08) for trajectory 1 and 0.90 (SD 0.13) for trajectory 2. Additionally, the model achieved a relative entropy value of 0.93, indicating a high degree of separation between the 2 trajectories and low classification uncertainty. Detailed information about the model selection process and model fit can be found in Supplementary Tables 2 and 3. Detailed baseline characteristics of participants within each fall trajectory are presented in Supplementary Table 5.

Self-Reported Risk Factors Among Men

The risk factors retained in the final penalized regression model using LASSO are presented in Table 3, along with weighted ORs and 95% CIs. Men in the increasing fall trajectory (trajectory 2) were more likely to report fatigue (OR 2.00, 95% CI 1.11-3.59, $P = .02$), pain or discomfort (OR 2.33, 95% CI 1.38-4.00, $P = .002$), problems with mobility (OR 2.45, 95% CI 1.25-4.81, $P = .009$), and higher self-rated health (OR 1.03, 95% CI 1.00-1.05, $P = .02$). Additionally, as in women, living alone was associated with an increased likelihood of belonging to trajectory 2, with borderline significance (OR 1.71, 95% CI 1.00-2.93, $P = .05$).

Discussion

In this observational, prospective analysis of the DO-HEALTH trial involving 1958 European generally healthy older adults followed over 3 years, we identified 2 distinct fall trajectories for women and 2 for men. For women, both trajectories were intercept-only, reflecting relatively stable fall patterns over time. In contrast, for men, we identified 1 intercept-only trajectory and 1 quadratic trajectory, with the latter indicating an increasing pattern of falls over time. These findings highlight the dynamic longitudinal nature of fall risk, particularly among men, and move beyond static single-incidence measures to account for temporal changes in fall risk. Additionally, self-reported risk factors associated with trajectory group membership varied by sex, underscoring the importance of sex-specific

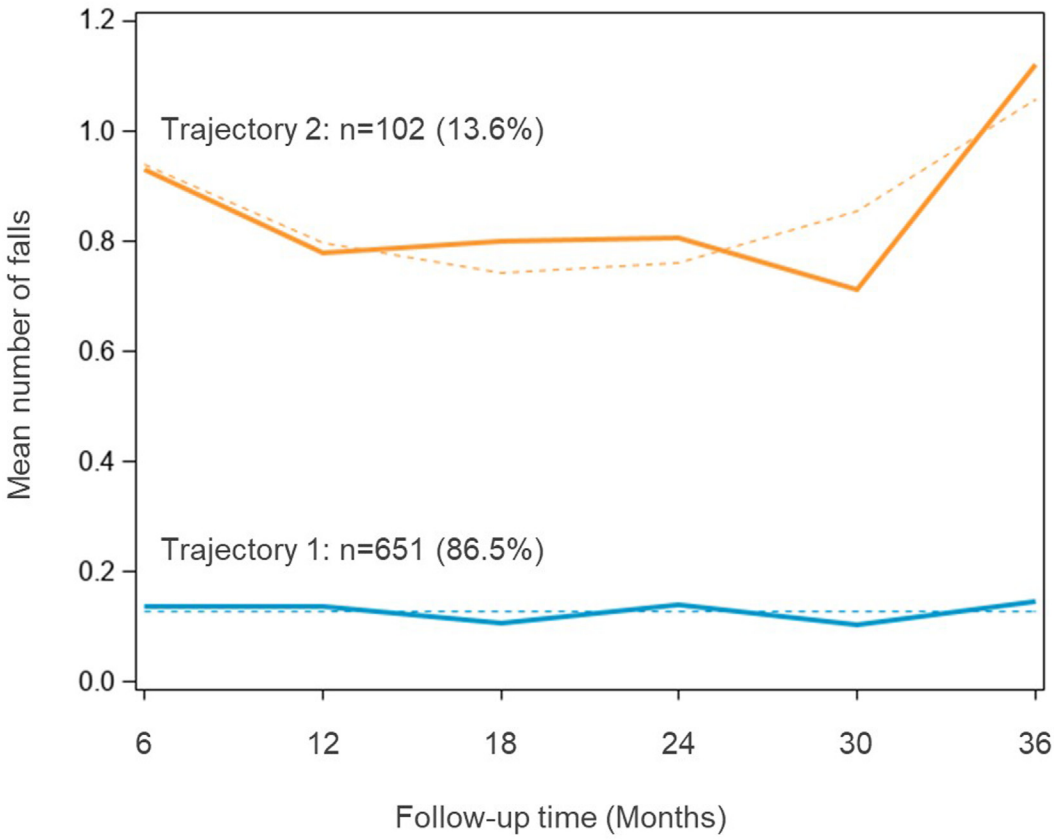

Fig. 2. Three-year fall trajectories among men in the DO-HEALTH study. Trajectory 1: lower fall trajectory, trajectory 2: increasing fall trajectory.

Table 3
Multivariate Logistic Regression Model of Baseline Characteristics Associated With Membership in the Increasing Fall Trajectory (Trajectory 2) Among Men

Risk Factors	OR (95% CI)	*P* Value
Living alone	1.71 (1.00-2.93)	.05
Education years	1.02 (0.97-1.07)	.51
Polypharmacy	0.81 (0.46-1.43)	.46
Multimorbidity	1.33 (0.73-2.43)	.35
Self-rated health	1.03 (1.00-1.05)	.020
Fatigue	2.00 (1.11-3.59)	.020
Problems with mobility	2.45 (1.25-4.81)	.009
Problems with usual activities	1.76 (0.59-5.30)	.31
Pain or discomfort	2.33 (1.38-4.00)	.002
Subjective memory problems	1.28 (0.70-2.34)	.42
Current smoking	0.53 (0.15-1.84)	.32
Low physical activity level	0.42 (0.15-1.12)	.08

analyses in understanding fall risk and informing targeted prevention strategies.

Our findings contribute to the growing body of research on fall trajectories and associated risk factors in older adults. To our knowledge, only 2 studies to date have used trajectory analysis specifically in the context of falls. In the MOBILIZE Boston study, Tchalla et al used monthly calendar postcards to prospectively assess falls, identifying 4 distinct 5-year fall trajectories among 765 community-dwelling men and women aged 70 years and older: no falls (30.1%), cluster falls (46.1%), increasing falls (5.8%), and chronic recurring falls (18.0%).[8] They concluded that individuals with multiple falls, multimorbidity, and depressive symptoms should be targeted for preventive measures. More recently, Guo et al analyzed data from the MrOS Study, which followed 5976 community-dwelling men aged 65 years and older over 15 years, with fall data collected triannually via mailed questionnaires.[9] They identified 5 trajectories: lowest fall risk (51.6%), persistently low fall risk (18.3%), gradually increasing risk (18.2%), steeply increasing risk (8.3%), and persistently high fall risk (3.6%). Men in the steeply increasing and persistently high fall-risk groups were more likely to have higher body mass index, greater use of central nervous system medications, diabetes, Parkinson disease, moderate back pain, weaker grip strength, and lower physical and mental health scores at baseline.

Like Tchalla et al and Guo et al, we employed group-based trajectory modeling to identify distinct fall trajectories. However, our study differed in several key respects: we conducted sex-specific analyses, used 3-monthly fall assessments, had a shorter follow-up period, and, most important, focused on self-reported rather than clinical assessments. Among women, living alone was the only self-reported risk factor significantly associated with the higher fall trajectory, consistent with recent studies suggesting a positive association between living alone and an increased fall risk.[38-41] Interestingly, living alone was less significantly associated with the increasing fall trajectory in men. In this subgroup, factors related to physical health and frailty—rather than sociodemographic characteristics or lifestyle behaviors—showed the strongest associations with belonging to the increasing fall trajectory, including prevalent fatigue, problems with mobility, and pain or discomfort. Although these findings align with evidence from systematic reviews and meta-analyses linking fatigue, pain and mobility impairments or use of walking aids with higher incidence of falls, they contrast with the studies by Tchalla et al and Guo et al, which did not exclusively focus on self-reported factors.[8,9,11,42] In the MOBILIZE Boston study, a fast gait speed (>0.78 m/s) was associated with higher odds of belonging to increasing and chronic recurring fall trajectories, whereas the role of pain or fatigue was not assessed.[8] In the MrOS Study, walking speed was not significantly associated with being in the high-risk fall trajectory group, although mild back pain was.[9] Similar to Guo et al,[9] we also found that higher self-rated health was associated with belonging to the increasing fall trajectory. A recent study of 2222 older adults in Sweden reported that discrepancies between objective and subjective health measures may be associated with an increase in the risk of injurious falls over time, particularly in men.[43] As suggested by Guo and colleagues,[9] individuals with high self-rated health may overestimate their physical abilities or engage in riskier behaviors, increasing their likelihood of falling.

Beyond the sex-specific analysis, our focus on self-reported variables—captured with simple, single-item measures—offers practical insights for fall risk management in both clinical and community settings. These self-reported measures are easier to collect and interpret than performance-based assessments, making them feasible for routine use. In addition to helping health care providers identify individuals at higher risk in a more resource-efficient manner,[44] this approach could empower older adults to self-assess their fall risk. This point particularly echoes the emphasis placed by the World Falls Guidelines on older people's perspectives on falls, along with the strong recommendation that "clinicians should inquire about the perceptions the older adult holds about falls, their causes, future risk and how they can be prevented," as part of a multifactorial fall risk assessment.[7]

In summary, our findings, which identified distinct fall trajectories for women and men, underscore the importance of conducting sex-specific analyses in fall risk studies. The variation in self-reported risk factors associated with trajectory group membership highlights the complex interplay of biological, behavioral, and social factors influencing fall risk by sex. These findings may have important implications for future research and clinical practice. Future studies should investigate the mechanisms driving these sex-specific differences, including hormonal, physiological, and behavioral factors, to deepen our understanding of fall risk in older adults. Furthermore, the observed differences point to the need for more sex-specific approaches in fall prevention strategies. The development of sex-specific risk prediction models and tailored prevention programs that account for sex-specific risk profiles could enhance the effectiveness of fall reduction strategies. Further research is needed to evaluate the efficacy of such targeted approaches and their potential to mitigate sex-related disparities in fall risk.

Despite several strengths, the present study has some limitations. Because of the DO-HEALTH trial's inclusion criteria, participants were generally healthier than the broader population of older adults, potentially limiting the generalizability of our findings to more vulnerable or frail individuals. Future studies in the general population are needed to validate these findings and improve their generalizability. Additionally, other potential important risk factors, such as fear of falling,[45] self-reported sensory loss,[46,47] or perceived balance disorders,[48,49] were not assessed in the present study and their roles remain to be investigated in future studies. Finally, given the 3-year follow-up of the present study, longer-term studies are needed to determine whether the identified trajectories persist, particularly the "increasing fall trajectory" among men. Although this study focused on identifying and analyzing sex-specific fall trajectories, future research could explore the detailed circumstances and characteristics of falls within each trajectory group to enhance the understanding of trajectory-specific mechanisms and inform more targeted fall prevention strategies.[50,51]

Conclusions and Implications

In conclusion, this study identified 2 fall trajectories among women and 2 among men from a large sample of European generally healthy older adults followed over a 3-year follow-up period. It provides a comprehensive assessment of fall patterns and their associated risk factors, revealing how these differ by sex and offering valuable insights for more targeted, sex-specific fall prevention strategies.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used ChatGPT for English language editing. After using this service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Disclosure

The authors declare no conflicts of interest.

Acknowledgments

We thank all the members of the DO-HEALTH Research Group, and we are grateful to the highly engaged participants of the study in all 5 countries.

Supplementary Data

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.jamda.2025.105542.

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