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Prevalence and Risk Factors for Falls in an Older Community-Dwelling Population

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Background. Falls are responsible for considerable morbidity, immobility, and mortality among elderly people. The aim of this study was to determine the prevalence of falls and related intrinsic and extrinsic risk factors in a community-dwelling older population.

Methods. An observational study was performed on all patients ($N = 5570$) admitted from 1997 to 2001 to home care programs in 19 home health agencies that participated in the National Silver Network project in Italy. Patient evaluation was performed through the Minimum Data Set–Home Care (MDS-HC) instrument.

Results. A 35.9% falls prevalence was found within 90 days of the patient assessment through the MDS-HC instrument. After adjusting for all potential confounding factors, the logistic regression showed a high increase in risk of falling for those patients who wandered (odds ratio [OR] 2.38; 95% confidence interval [CI] 1.81–3.12) or suffered with gait problems (OR 2.13; 95% CI 1.81–2.51). Patients affected by depression were more likely to fall (OR 1.53; 95% CI 1.36–1.73). Those who lived in an unsafe place with environmental hazards had an increase in the risk of falling (OR 1.51; 95% CI 1.34–1.69). The associations of main risk factors for falls were also evaluated.

Conclusions. Rate of falls among frail elderly people living in the community is very high and frequently correlates with potentially reversible factors. To identify those with higher falling risk, home care staff and general practitioners could use the MDS-HC assessment tool.

FALLS are responsible for considerable morbidity, immobility, and mortality among elderly people. Every year, approximately 35% to 40% of the community-dwelling population older than 65 years falls. For those older than 75 years, the rates are higher (1). According to recent studies, about 6% of all medical expenditures for people older than 65 in the United States are due to fall-related injuries (2). Hospitalization is needed in 5% of elderly people who fall (3). The fall-related mortality rate in persons older than 85 in the United States is orders of magnitude greater than the rate in the younger population (4).

Falls have many different causes. Several risk factors that predispose patients to falls have been identified; they can be classified as either intrinsic or extrinsic (1). The first are usually identified as functional and health status (e.g., functional impairment, balance disorders); the second ones are represented by adverse drug reactions, prostheses, use of restraints, and environmental factors (e.g., poor lighting or lack of bathroom safety equipment).

Appreciating the interaction and probable synergism between multiple risk factors is just as important as identifying risk factors themselves. In fact, several studies have shown that the risk of falling increases dramatically as the number of risk factors increases (5,6).

In addition to injuries, falls can have serious consequences for physical functioning and life quality. Prevention has a primary importance to reduce falls in the general population by decreasing or eliminating commonly present risk factors.

The aim of this study was to determine, through the Minimum Data Set–Home Care (MDS-HC) (7) instrument, the prevalence of falls and related intrinsic and extrinsic risk factors in an older population in home care.

Methods

Study Population

Data were collected as part of the national home care program named the Silver Network Home Care project, under the sponsorship of the Italian Geriatrics Society and Pfizer Italy. The database has been described in detail elsewhere (8) and is briefly summarized here. This is a population-based, longitudinal, multilinked database that comprises (i) data collected with the MDS-HC instrument and (ii) data on all the medications used by each patient at the time of the MDS-HC assessment. Drugs were coded using the Anatomical Therapeutic and Chemical codes. The project was approved and monitored by the steering committee of the Catholic University of the Sacred Heart and the local state authorities.

The study population consisted of all patients admitted to home care programs from 1997 to 2001 in 19 home health agencies who participated in the National Silver Network project ($n = 5749$). One hundred seventy-nine patients

(1.14%) were excluded from our analysis due to paraplegia ($n = 12$), a comatose state ($n = 3$), or a terminal illness ($n = 164$). The sample study population was, for this reason, reduced to 5570 patients.

MDS-HC Assessment Data

The MDS-HC (7) contains more than 350 data elements, including sociodemographic variables, numerous clinical items about both physical and cognitive status, as well as all clinical diagnoses. The MDS-HC also includes information about an extensive array of signs, symptoms, syndromes, and treatments being provided (9). Among others, a scale based on MDS-HC items is designed to describe the performance in personal activities of daily living (ADLs) (10).

Cognitive performance was assessed using a six-item, seven-category scale (Cognitive Performance Scale [CPS]). The CPS was scored on a seven-point ordinal scale in which higher scores were associated with worse cognitive performance. The CPS considers two cognitive items (short-term memory and skills for daily decision making), one item describing communication ability (understood by others), one ADL measure (self performance in eating), and whether or not in a comatose status (10).

MDS-HC items have been found to have excellent interrater and test-retest reliability when completed by nurses performing usual assessment duties (10). Data elements contained in the Silver Network Home Care database used in this study have been previously validated (10), making it a reliable research tool for evaluation of quality of care.

The "fall event" was considered as a sudden loss of gait causing the hit of any part of the body to the floor that occurs within 90 days of assessment.

According to the MDS-HC manual (9), risk factors for falls can be classified as either intrinsic or extrinsic. The former were all clinical and functional conditions that were able to increase risk for falling, while the latter were environmental hazards.

Statistical Analysis

Data were analyzed first to obtain descriptive statistics. Continuous variables are presented as mean values ± standard error. Differences in sociodemographic, functional, and clinical characteristics between patients who fell and controls were analyzed in different ways.

Quantitative parameters with normal distribution were tested by one-way analysis of variance, after a pretest for homogeneity of variances. If abnormal distribution was present, a nonparametric test was used (the Kruskal-Wallis rank test). Categorical variables were analyzed by the chi-square test. The relationship between falling and main intrinsic and extrinsic risk factors was estimated by deriving odds ratios (ORs) from multiple logistic regression models considering the dependent variable of interest at least one fall in the last 90 days.

For all of the analyses, the reference group consisted of patients who did not fall. Age, gender, CPS score, and indices of functional ability (ADL score) were considered potential confounders. Conditions associated with a higher falling risk (foot problems, visual impairment, wandering, gait problems, and fear of falling) were considered in the analysis. Furthermore, all concurrent medical conditions possibly associated with the risk of falling were considered. Logistic regression was performed only for those factors that showed significant differences between the control and the group with "positive anamnesis" for falls.

Significance level was $p \leq .05$.

From the final model, ORs and corresponding 95% confidence intervals (CIs) were derived.

The four main risk factors for falls, found at the multivariate logistic regression, were selected and grouped to form six couples. Multivariate logistic regression was then performed adding in the four predictors and the six interactions. Those risk factor couples that showed a significant level were then "unpacked" in four-level variables and logistic regression models, adjusted for age and gender, and were run as described by Melin and colleagues (11).

Statistical analyses were performed using SPSS software (SPSS, Inc., Chicago, IL).

Results

The main characteristics of the study population are reported in Table 1.

A 35.9% falls prevalence was found within 90 days of the patient assessment through the MDS-HC instrument.

Mean age of the study sample population was 77.2 years old. Patients with a positive anamnesis for falls were older (78.7 years vs 76.4 years; $p < .001$) than patients included in the control group; they also presented a higher dependency in ADLs (ADL score 4.81 vs 4.54; $p < .001$). About 58% of the study population were women ($p = .19$). The CPS score did not show significant differences between the two groups (2.17 ± 0.04 vs 2.15 ± 0.03; $p = .72$).

There were no significant differences between the two groups in prevalence of heart failure (mean prevalence 17.8%), peripheral artery disease (mean prevalence 18.7%), Alzheimer's disease (mean prevalence 3.8%), and diabetes

Table 1. Main Characteristics of Study Population

Characteristic	No Falls ($n = 3573$) n (%) or $M \pm SE$	Falls ($n = 1997$) n (%) or $M \pm SE$	p Value
Age (years)	76.4 ± 0.21	78.7 ± 0.24	<.001
Gender (female)	2088 (58.4)	1192 (58.9)	.19
Cognitive Performance scale score	2.15 ± 0.03	2.17 ± 0.04	.72
Activities of daily living impairment	4.54 ± 0.05	4.81 ± 0.05	<.001
Foot problems	717 (20.1)	480 (24.0)	<.001
Gait problems	1893 (53.0)	1454 (72.8)	<.001
Fear of falling	1525 (42.7)	1152 (57.7)	<.001
Visual impairment	1595 (44.6)	964 (48.3)	.005
Wandering	98 (2.7)	148 (7.4)	<.001
Alzheimer's disease	136 (3.8)	78 (3.9)	.45
Congestive heart failure	562 (17.3)	342 (18.7)	.12
Depression	1960 (54.9)	1370 (68.6)	<.001
Diabetes mellitus	623 (19.2)	379 (20.7)	.09
Parkinsonism	228 (6.4)	158 (7.9)	.04
Peripheral artery disease	597 (18.4)	352 (19.3)	.24
Urinary incontinence	1087 (30.4)	657 (32.9)	.03
Environmental hazards	1486 (41.6)	1097 (54.9)	<.001

Table 2. Adjusted Model for Risk of Falling in the Study Population

Characteristic	Adjusted Model	
	OR	95% CI
Age (years)	1.01	1.00–1.02
Gender (female)	1.01	0.90–1.14
Activities of daily living impairment	1.06	1.04–1.09
Foot problems	1.19	1.04–1.37
Gait problems	2.13	1.81–2.51
Fear of falling	0.97	0.83–1.13
Visual impairment	0.98	0.87–1.11
Wandering	2.38	1.81–3.12
Depression	1.53	1.36–1.73
Urinary incontinence	1.06	0.93–1.20
Parkinsonism	0.93	0.74–1.17
Environmental hazards	1.51	1.34–1.69

Note: OR = odds ratio; CI = confidence interval.

(mean prevalence 19.7%). We identified a significantly higher prevalence of depression (68.6% vs 54.9%; $p < .001$), of Parkinsonism (7.9% vs 6.4%; $p = .04$), and of urinary incontinence (32.9% vs 30.4%; $p = .03$) in the group who fell compared to the control group.

Patients who fell had a higher prevalence for wandering (7.4% vs 2.7%; $p < .001$), foot (24.0% vs 20.1%; $p < .001$), or gait (72.8% vs 53.0%; $p < .001$) problems, and fear of falling (57.7% vs 42.7%; $p < .001$). Domestic environment looked dangerous more often for those patients with a falling history (54.9% vs 41.6%; $p < .001$), too.

Multivariate logistic regression adjusted for age, gender, and any factor found significantly different in the two groups at the chi-square test is shown in Table 2.

The multivariate logistic regression, after adjusting for all potential confounding factors, showed a high increase in risk of falling for those patients who wander (OR 2.38; 95% CI 1.81–3.12) or present gait problems (OR 2.13; 95% CI 1.81–2.51). Patients affected by depression were more likely to fall (OR 1.53; 95% CI 1.36–1.73). Those who lived in an unsafe place with environmental dangers had a 51% increase in the risk of falling (OR 1.51; 95% CI 1.34–1.69).

After coupling the four main risk factors (wandering, gait problems, environmental hazards, and depression) isolated by the multivariate logistic regression, six couples of risk factors were found (wandering and gait problems, environmental hazards and gait problems, environmental hazards and depression, depression and gait problems, wandering and environmental hazards, depression and wandering). The logistic regression, adjusted for age and gender, was then rerun adding in the four first-order predictors and interactions between them. Three of these couples showed a level of significance lower than .05 (wandering and gait problems, $p = .017$; environmental hazards and depression, $p = .046$; depression and gait problems, $p < .001$).

Each of these significant interactions was "unpacked" in four-level variables; then, logistic regression, adjusted for age and gender, was performed for each. Results (Figure 1, panels A, B, and C) are shown in Figure 1. Falling risk determined by the patient's wandering habit has been found to be about five times higher when associated with gait problems or environmental hazards (OR 6.16, 95% CI 4.50–8.43 and OR 5.01, 95% CI 3.41–7.35, respectively). The same synergistic action, even if at a lower level, has been confirmed when depression and environmental hazards are present simultaneously (OR 2.92, 95% CI 2.49–3.43).

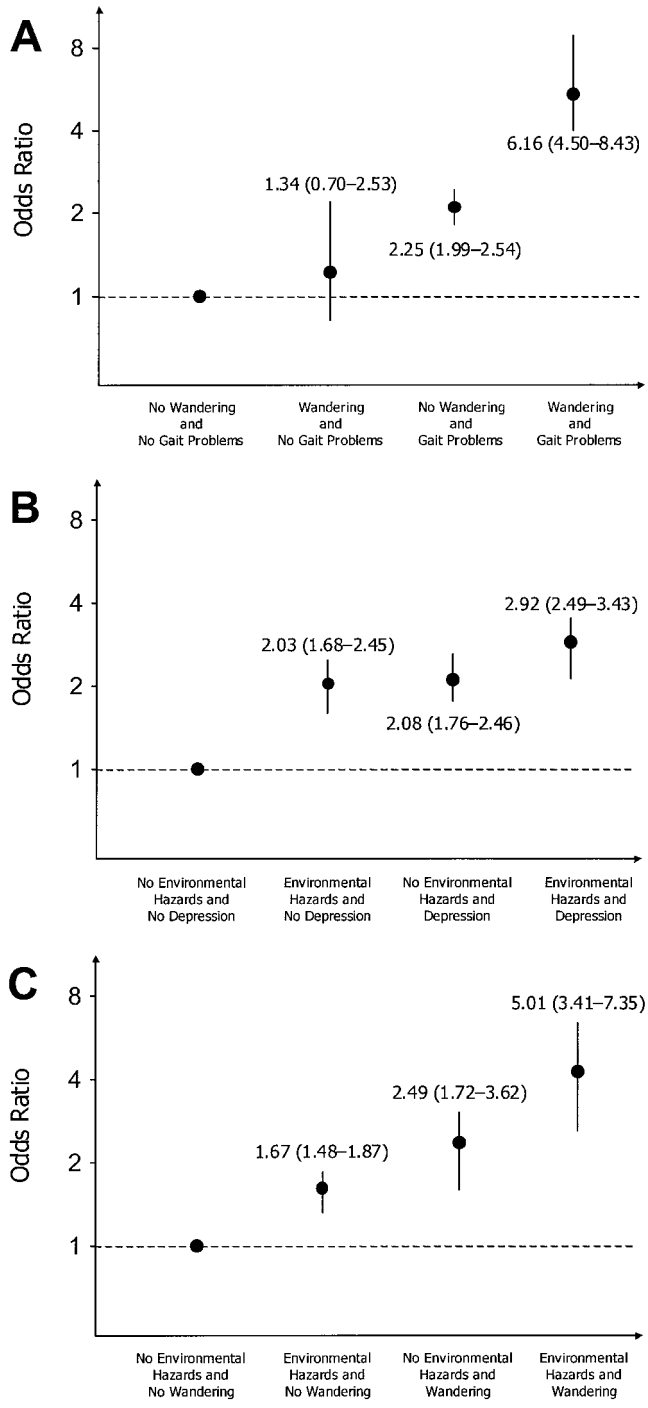

Figure 1. Odds ratios and 95% confidence intervals of significant risk factor interactions for falling. Each significant risk factor interaction is presented as a four-level variable. Models adjusted for age and gender. **A:** wandering and gait problems; **B:** environmental hazards and depression; **C:** environmental hazards and wandering.

Discussion

Falls are the leading cause of morbidity and mortality for persons aged 65 and older. When elders fall, they sustain such injuries as hip, spine, hand, and/or pelvic fractures. Even without injury, falls cause a loss of confidence that results in reduced physical activity, increased dependency, and social withdrawal. Many authors have documented that a fall is a multifactorial syndrome involving the patient and the environment.

The major finding of our study is that many of the identified risk factors for falling are potentially modifiable, particularly depression, wandering behavior, unsteady gait, or lack of safety in the domestic environment.

Depression, a clinical condition often unidentified or undertreated in the population (12–14), is strongly correlated with a higher tendency to fall. At the same time, several studies correlate a higher risk of falls with depression treatment, especially with drugs like selective serotonin reuptake inhibitors (15,16) or benzodiazepines (17,18). Physical exercise could help older patients suffering with depression (19,20).

An approach through physical activities aimed at preventing falling in the elderly population plays an important role in the improvement of the health status of the patient (21). For these reasons, simple physical exercises could make the patient able to gain a better balance, improving deambulation. Moreover, physical training could be useful to improve the patient's affective status (22).

Wandering behavior has been correlated in some studies with a higher falling risk, confirmed by our data. Preventing this habit and rendering the home environment safer could bring a drastic reduction in falling events. Cumming and colleagues showed that home visits by occupational therapists can prevent falls among older people with an increased risk of falling. These effects may not be caused by home modifications alone. Home visits by occupational therapists may also lead to changes in behavior that enable older people to live more safely in both the home and the external environment (23).

In our study, patient wandering was associated with a more than doubled prevalence of falls. Treatment of behavioral problems, previously faced in a superficial way by adding neuropsychiatric drugs, must primarily afford patient medical illness, psychiatric disorders, and drug reactions (24).

A similar tendency for falling was found in people who presented gait problems. Proper footwear can provide safety, especially in the older population suffering with foot wounds or lesions (25).

Moreover, according to our results, we are able to determine the importance of environmental modification. In fact, domestic hazards (such as poor lighting, uneven floor surfaces, no grab bars in the bathroom) may increase prevalence of falls more than 50%. Environmental assessment identifies and aids in the removal of potential hazards, favoring mobility and safety of the patient. Evaluation of the house seems to be of primary importance, especially in frail older people assisted in home care. Otherwise, modification of the home environment without other components of multifactorial intervention could be insufficient to improve outcome (23,26–28). Modification of domestic hazards must be combined with the control of the patient's intrinsic falling risk factors.

Wandering behavior and depression are clinical conditions that should be evaluated and treated for prevention of falls.

In this study, combinations of main risk factors for falls were evaluated. Each interaction found with a significant level was "unpacked" in a four-level variable; in this way, we have been able to identify conjoint effects of a risk factor upon the other. We found that three interactions showed a significant level (wandering and gait problems, environmental hazards and depression, environmental hazards and wandering). Wandering seems to have an exponential increasing power on risk for falling. In fact, when this patient's habit is present with other risk factors (environmental hazards, gait problems), risk for falling undergoes an increase of five to six times. The same trend, even if on a lower level, has been identified by our analysis when environmental hazards are linked to depression.

Although falls may not be easily prevented, these data show clearly that falls indicate the presence of many important treatable conditions. Recognition of risk factors could be useful in falls prevention by a thorough assessment that is able to recognize extrinsic possible causes of falling beyond clinical conditions. Several studies attempted the implementation of a multidimensional program that is able to identify and to treat risk factors for falling in elderly patients. The MDS-HC system is a comprehensive geriatric assessment instrument that is able to recognize clinical, psychological, socioeconomic, and environmental conditions in older patients assisted in home care. Furthermore, this evaluation instrument represents a useful tool for the extension of an individualized care plan.

An important limitation of our study needs to be recognized. The cross-sectional design of our study could not ascertain the cause–effect relationship between independent variables and fall. However, because of the use of MDS-HC, a multidimensional assessment instrument, the present study could comprehensively investigate the different domains of elderly status influencing the ability to walk, to balance, and to turn around. For this reason and to permit an analysis taking care of the largest number of potential confounders, we incorporated in our model a whole series of variables, including measures of cognitive performance, functional status, and comorbid conditions.

Despite this limitation, our data suggest that the rate of falls among frail elderly people living in the community is very high and frequently correlates with potentially reversible factors. To identify those with higher falling risk, home care staff and general practitioners could use the MDS-HC assessment tool. After a specific intervention is instituted, a repeat assessment should be carried out, thereby allowing observations to be made on the efficacy of the preventive and treatment plan. Furthermore, research is needed to explore the potential of using MDS-HC data to target diagnostic evaluation and to monitor the appropriateness of preventive strategies for falls in the community setting. A failure to make all reasonable efforts to successfully prevent falls among such population should be considered one of the most important indicators of poor quality care.

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