*Article*

# Gender Differences in Risk Factors for Single and Recurrent Falls Among the Community-Dwelling Elderly

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**Abstract**

The purpose of this study was to identify gender differences in risk factors of fall accidents among older people, and whether these factors differ between single and recurrent fallers. A total of 4,426 individuals aged ≥65 years from two large-scale health surveys provided data. Logistic regression analyses were used to identify risk factors and to determine the risk model for falling and recurrent falling in men and women separately. Three major risk factors for falling regardless of gender or fall history are fear of falling, limitations in activities of daily living (ADL), and age ≥75 years. Fear of falling remains one of the common modifiable risk factors. Among those without a fall history, the use of sedatives or tranquilizers increases the risk of falling. Regarding gender differences, ADL limitations and fear of falling appear to be stronger fall risk factors for men than for women. Among women, alcohol use and educational level are significant risk factors for falling, while loneliness is associated with recurrent falling. Men with fear of falling or ADL limitations are at higher risk to have a recurrent fall accident than women with these conditions. Having a visual impairment or living with someone is associated with recurrent falling among men. Our findings emphasize the importance of multifactorial fall interventions, taking into account a variety of subgroup characteristics such as gender and fall history.

**Keywords**

older, fall accidents, gender differences, fear of falling, ADL, health survey, epidemiology

## Introduction

About one third of the independently living elderly aged 65 years and above fall at least once a year (Gill, Taylor, & Pengelly, 2005; Gillespie et al., 2012). Studies have identified multiple risk factors (Rubenstein, 2006). Physical limitations, such as visual impairments, hearing disabilities, and difficulties with performing activities of daily living (ADL), are possible risk factors for falling accidents (Sai, Gallagher, Smith, & Logsdon, 2010; Stalenhoef, Diederiks, Knottnerus, Kester, & Crebolder, 2002; Tromp et al., 2001; Yokoya, Demura, & Sato, 2007). There are multiple fall risk factors related to mental health, including fear of falling. This is an important predictor for falls: Older people who are afraid of falling are more likely to fall, while those who fell in the past have a significantly higher level of fear (Pluijm et al., 2006). Furthermore, common mental conditions among the elderly (such as depression) may cause an increase in instability (Turcu et al., 2004) and a higher risk of falling (Sai et al., 2010; Stalenhoef et al., 2002). Although studies on lifestyle-related risk factors present different results, there is clear evidence that insufficient physical activity and the use of sedatives and tranquilizers increase the risk of falling accidents (Askari et al., 2013; Evans, 2003). With regard to alcohol use, the magnitude of the associated risk of fall accidents among older adults is uncertain. Many studies found no association between increased alcohol use and falls, whereas others reported a higher risk when consuming more than the "acceptable" alcohol standard (Reid, Boutros, O'Connor, Cadariu, & Concato, 2002). The relationship between smoking and falling accidents has hardly been studied.

Besides the above-mentioned risk factors, another aspect associated with an increased risk of fall accidents to be taken into account is fall history. Recurrent fallers are often older and frailer because of comorbidity and/or other risk factors. This group is considered a high-risk group that needs more stringent follow-up than those without fall history and may benefit most from targeted treatment. In addition, specific

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characteristics of the subgroup such as gender may be relevant risk factors of falling. Fear of falling is more common in women than in men (Lach, 2005; Yamashita, Noe, & Bailer, 2012). With aging, hearing sensitivity declines more than twice as fast in men compared with women. Also, a low body mass index (BMI) is associated with hip fractures only among older women (Bernstein, Grisso, & Kaplan, 1999). Despite considerable research in this field, there is no consensus regarding the main independent risk factors. Intervention programs should focus on these factors to prevent (recurrent) falls among the elderly. Although not all fall accidents can be prevented, it may be possible to mitigate the risk factors.

Risk factors for falls can be divided into modifiable and unmodifiable ones, but only modifiable risk factors can be targeted by preventive interventions to reduce fall risk in the future. Taking into account the severity of the problem and the need to tailor intervention strategies, possible risk factors related to falls among older men and women should be examined separately and whether there are differences in risk factors for single and recurrent fallers need to be investigated.

Many studies on falling accidents among the elderly focus only on a few risk factors, have a small study population, and/or focus on elderly living in nursing care facilities and hospitals. Our study is unique in that we explore gender differences in falling accidents in relation to multiple different risk factors within one large population.

The aim of this study is to provide more insight into the relation between the most common risk factors and falling among a representative sample of community-dwelling elderly who participated in the Health Monitor in 2008 and 2010 (two large-scale health surveys among adult inhabitants of Amsterdam and its surroundings).The acquired data can be used to better tailor interventions in specific groups. The following research questions are addressed:

**Research Question 1:** Which individual factors are related to fall accidents among older men and women?
**Research Question 2:** Are there differences in fall risk factors between single fallers and recurrent fallers?

## Design and Method

### *Sample Selection*

The Public Health Service of Amsterdam conducts periodic large-scale health surveys to gain insight into the determinants of the health of citizens of Amsterdam and its surroundings. There were two large-scale surveys of interest: the Amsterdam Health Monitor 2008 of the city of Amsterdam, and the Health Monitor 2010 of the surroundings Amstelland and Diemen consisting of the five small municipalities Aalsmeer, Amstelveen, Ouder-Amstel, Uithoorn, and Diemen (for more information, see Dijkshoorn, El Fakiri, Janssen, Ujcic-Voortman, & Verhagen, 2009 and http://www.ggd.amsterdam.nl/beleid-onderzoek/gezondheidsmonitors/gezondheidsmonitor).

The design was according to the stratified design and weighting in Dutch regional health surveys (Uitenbroek, 2009; for English translation, see http://www.quantitativeskills.com/sisa/papers/paper7.htm). Independently living participants were drawn from the population registry, divided in groups according to gender, age, and neighborhood. Each stratum consisted of 200 participants in the city of Amsterdam (GMA, 2008) and 250 in the surroundings, respectively. More participants were drawn in strata with expected low response. The resulting total numbers of correctly completed questionnaires were weighted with respect to the response and total population in these groups.

The resulting total data were as follows: AGM 2008 ($n$ = 6,644; response rate = 50.4%) and GM 2010 ($n$ = 3,817; response rate = 55.5%). For the present analysis, data of 4,579 respondents aged ≥65 years were used. The response rates among these groups were 59% and 74%, respectively. In both surveys, there were no significant differences with regard to age group and gender between the non-respondents and respondents.

### *Questionnaire*

Self-completion questionnaires were sent to the selected participants. For specific groups, the questionnaires were provided in their own language. Questionnaires could also be filled-out online, and if required, assistance by an interviewer was provided. Non-respondents were encouraged by a reminder, and if needed a second reminder or even by phone or visit.

The questionnaire was based on the national standard for the Netherlands "Local and National Public Health Monitor" (in Dutch: Lokale en Nationale Monitor Volksgezondheid [LNMV]; GGD Nederland, ActiZ, & Rijksinstituut voor Volksgezondheid en Milieu, 2005). It included a wide range of health issues including physical and psychological health, health care use, and lifestyle. Specific attention was paid to the health of older people, including additional questions on falling accidents.

### *Measures: Outcome Variables*

Participants were asked whether they had experienced a fall in the previous 12 months, how many times they had fallen, the location of the last fall accident, if they had an injury due to the last fall, and whether and from whom they had received medical attention after their last fall accident. Elderly persons who experienced one or more falls in the past 12 months are defined as "fallers" (individuals with no fall history) and those who experienced more than one fall in the past 12 months as "recurrent fallers" (individuals with a fall history).

### *Measures: Independent Variables*

- Demographics and socioeconomic characteristics included age groups of 65 to 74 and ≥75 years, living situation (alone or with someone), and level of

education. Level of education is based on the highest acquired education level and divided into three categories: low (elementary school or less), moderate (lower vocational, general intermediate, intermediate vocational or general secondary school), and high (higher vocational education, college or university).

- Lifestyle included use of sedatives or tranquilizers (use in the past 2 weeks), smoking (yes or no), alcohol consumption (meeting the standard acceptable alcohol consumption or not), and physical inactivity (respondent meets the Dutch Healthy Exercise Norm or not). The standard acceptable alcohol consumption in the Netherlands is defined as a maximum of two glasses/drinking day for men and a maximum 1 glass/drinking day for women (Nederlands Instituut voor Alcoholbeleid [Dutch Institute for Alcohol Policy], 2009). The norm for healthy exercise is defined as a minimum of 30 min of moderately intensive physical activity per day (Wendel-Vos, Schuit, Saris, & Kromhout, 2003).
- Physical health and limitations. For BMI (defined as an individual's self-reported body weight divided by the square of the person's height—typically given in units of $kg/m^2$), four categories were distinguished following the World Health Organization BMI classification (World Health Organization, 2014): underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 25), overweight (25 ≤ BMI < 30), and obesity (BMI ≥ 30). Visual impairment was measured with two questions on the ability to read small letters and to recognize the face of a person at a distance of 4 m. Hearing disability was also measured by two questions about following and having a conversation with a person or group (Dijkshoorn et al., 2009). When one of these questions is answered with "yes, very difficult" or "no, I can't," a respondent is considered as having a visual impairment or a hearing disability, respectively. Ten questions assessed whether respondents had problems with personal care, such as bathing, dressing, eating, and mobility (e.g., getting out of bed and walking across a room with limitations; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). When a question is answered with "very difficult" or "only with help of others," this is reported as an ADL limitation (Dijkshoorn et al., 2009).
- Psychological health. The following three variables were examined: loneliness, depression, and fear of falling. The scale of de Jong-Gierveld was used to measure loneliness (de Jong-Gierveld & Kamphuls, 1985), categorized into three conditions: (a) based on the total score (0-11), the respondents are divided into two groups: "not/moderate (0-8)" and "severe/very severe (9-11)" burden of loneliness; (b) emotional loneliness: low emotional loneliness (0-3) and high emotional loneliness (4-6); and (c) social loneliness: low social loneliness (0-3) and high social loneliness (4-6). The Kessler Psychological Distress Scale (K10) was used to measure the level of distress and severity associated with psychological symptoms (Kessler et al., 2002). Low scores indicate low levels of psychological distress and high scores indicate high levels of psychological distress. Two groups were distinguished: respondents with a score ≤15 were considered as having no or a low risk of depression, and respondents with a score of ≥16 were considered as having a moderate to high risk of depression. With regard to fear of falling, one question asked about the extent to which respondents experience fear of falling (answered on a 5-point Likert-type scale; Dijkshoorn et al., 2009).

### Analysis

Participants aged ≤65 years and participants with missing data on falling accidents were excluded from the analysis. Descriptive statistics were used to describe the frequency and proportion of outcomes of non-fallers, fallers, and recurrent fallers. Univariate logistic regression analyses were conducted to determine the relationship between the variables of interest and falling accidents in the last 12 months. Fallers were compared with non-fallers, and recurrent fallers were compared with participants who experienced no falls or only one fall. Crude odds ratios (OR) were calculated for women and men separately and for fallers and recurrent fallers. In addition, variables with a significant relation were used to conduct multivariate logistic regression analyses to create risk models for women and men separately, and for falling and recurrent falling.

The data were weighted on the basis of age and sex according to the distribution of the population in Amsterdam and surroundings at the time of data collection (2008 and 2010, respectively).

Statistical analyses were conducted with the SPSS version 19.0. For all analyses, a $p$ value ≤.05 was considered statistically significant.

## Results

Of the 4,579 participants, 4,426 (97%) provided data on falls: 2,552 females (58%) and 1,874 males (42%). The mean age of women is 76.9 ($SD$ = ±7.1) years and of men 75.7 ($SD$ ±6.8) years. In the 12 months prior to the study, 34% of the respondents had experienced at least one fall and 14% had fallen multiple times (≥2 times).

### Risk Factors for Female and Male Fallers and Recurrent Fallers

For both women and men, significant relationships between falling and risk factors are found, except for smoking and BMI (Table 1). The risk of falling is higher for men than for women on all the significant factors, except for social loneliness (women:

**Table 1.** Relation Between Each of the Variables of Interest and Falling (≥1 Fall in the Last 12 Months), Presented for Women and Men Separately.

| Falls | Women | | Men | |
|---|---|---|---|---|
| Variable | OR [95% CI] | *p* | OR [95% CI] | *p* |
| Age, years | | | | |
| 65-74 | 1.00 | | 1.00 | |
| 75+ | 1.80 [1.52, 2.15] | .00* | 2.05 [1.65, 2.53] | .00* |
| Educational level | | | | |
| Low | 1.00 | | 1.00 | |
| Moderate | 0.96 [0.81, 1.15] | .67 | 0.75 [0.60, 0.94] | .01* |
| High | 1.20 [0.90, 1.60] | .21 | 0.90 [0.68, 1.19] | .45 |
| Living situation | | | | |
| Alone | 1.00 | | 1.00 | |
| With someone | 0.66 [0.56, 0.78] | .00* | 0.66 [0.53, 0.82] | .00* |
| Lifestyle factors | | | | |
| Use of sedatives or tranquilizers | 1.61 [1.34, 1.95] | .00* | 2.14 [1.60, 2.88] | .00* |
| Alcohol | 1.29 [1.04, 1.59] | .02* | 0.96 [0.75, 1.23] | .76 |
| Smoking | 0.81 [0.64, 1.04] | .81 | 1.10 [0.84, 1.45] | .48 |
| Physical activity | 0.64 [0.54, 0.75] | .00* | 0.66 [0.53, 0.81] | .00* |
| Physical factors | | | | |
| Visual impairment | 1.59 [1.27, 1.99] | .00* | 3.18 [2.30, 4.40] | .00* |
| Hearing disability | 1.93 [1.49, 2.50] | .00* | 2.67 [1.97, 3.61] | .00* |
| ADL limitations | 2.41 [1.99, 2.92] | .00* | 4.54 [3.48, 5.94] | .00* |
| BMI | | | | |
| BMI < 18.5 | 1.00 | | 1.00 | |
| 18.5 ≤ BMI < 25 | 0.98 [0.56, 1.73] | .95 | 0.54 [0.21, 1.38] | .20 |
| 25 ≤ BMI < 30 | 1.15 [0.66, 2.03] | .62 | 0.45 [0.18, 1.17] | .10 |
| BMI ≥ 30 | 0.96 [0.54, 1.73] | .90 | 0.48 [0.18, 1.28] | .14 |
| Psychosocial health factors | | | | |
| Loneliness | 1.88 [1.46, 2.41] | .00* | 2.04 [1.46, 2.87] | .00* |
| Emotional loneliness | 1.67 [1.37, 2.05] | .00* | 1.88 [1.43, 2.48] | .00* |
| Social loneliness | 1.46 [1.22, 1.74] | .00* | 1.25 [1.01, 1.56] | .05* |
| Depression | 1.99 [1.74, 2.28] | .00* | 2.25 [1.89, 2.68] | .00* |
| Fear of falling | 2.54 [2.15, 3.01] | .00* | 3.90 [3.13, 4.87] | .00* |

*Note*. Values are crude ORs and 95% CI. OR = odds ratio; CI = confidence interval; ADL = activities of daily living; BMI = body mass index.
*$p < .05$.

OR = 1.64; men: OR = 1.25). Education level is related with fall accidents in men with a moderate education level (OR = 0.75), while consuming more than the acceptable alcohol standard is a risk factor for women (OR = 1.29).

The results for recurrent fallers are similar to those for the fallers but show a stronger relationship for nearly all significant variables (Table 2). Both men and women with physical limitations, who use sedatives or tranquilizers, and/or suffer from depression, loneliness, or fear of falling, are more likely to have recurrent falls than those not having these problems. Elderly who are living with someone are less likely to fall than those living alone. Similarly, physically active individuals are less likely to fall than the physically inactive. In general, respondents with a moderate (or higher) educational level are less likely to have a recurrent fall than those with a low education level. However, this association is not significant among highly educated women.

## *Risk Model for Falling and Recurrent Falling*

Multiple logistic regression analysis shows that elderly aged ≥75 years who have an ADL limitation or experience fear of falling, or use sedatives or tranquilizers are more likely to fall than those aged 65 to 74 years without these factors (Table 3). ADL limitations and fear of falling appear to be stronger risk factors for men than for women (OR = 2.02 vs. 1.60 for ADL limitations, and OR = 2.66 vs. 1.65 for fear of falling). In addition, alcohol use and educational level are significant risk factors for women.

In general, the results of recurrent fallers are similar to those who experienced one or more falls (Table 4). Individuals who are afraid to fall or with ADL limitations are more likely to have a recurrent fall accident than those who are not afraid to fall or are not ADL limited, respectively. Especially men with these conditions are at higher risk than women

**Table 2.** Relationship Between Each of the Variables of Interest and Recurrent Falling (≥2 Falls in the Last 12 Months) Presented for Women and Men Separately.

| Recurrent falls | Women | | Men | |
|---|---|---|---|---|
| Variable | OR [95% CI] | *p* | OR [95% CI] | *p* |
| Age, years | | | | |
| 65-74 | 1.00 | | 1.00 | |
| 75+ | 2.06 [1.59, 2.66] | .00* | 2.21 [1.62, 3.01] | .00* |
| Educational level | | | | |
| Low | 1.00 | | 1.00 | |
| Moderate | 0.63 [0.49, 0.80] | .00* | 0.62 [0.45, 0.85] | .00* |
| High | 0.92 [0.62, 1.36] | .69 | 0.56 [0.37, 0.85] | .01* |
| Living situation | | | | |
| Alone | 1.00 | | 1.00 | |
| With someone | 0.68 [0.54, 0.86] | .00* | 0.74 [0.55, 1.00] | .05* |
| Lifestyle factors | | | | |
| Use of sedatives or tranquilizers | 1.66 [1.30, 2.11] | .00* | 2.52 [1.76, 3.61] | .00* |
| Alcohol | 0.94 [0.67, 1.27] | .67 | 0.97 [0.67, 1.41] | .88 |
| Smoking | 1.03 [0.75, 1.43] | .84 | 1.39 [0.97, 1.99] | .07 |
| Physical activity | 0.54 [0.43, 0.68] | .00* | 0.45 [0.34, 0.60] | .00* |
| Physical factors | | | | |
| Visual impairment | 2.23 [1.70, 2.92] | .00* | 4.05 [2.81, 5.82] | .00* |
| Hearing disability | 2.75 [2.04, 3.69] | .00* | 3.53 [2.48, 5.02] | .00* |
| ADL limitations | 3.88 [3.07, 4.91] | .00* | 8.89 [6.54, 12.10] | .00* |
| BMI | | | | |
| BMI < 18.5 | 1.00 | | 1.00 | |
| 18.5 ≤ BMI < 25 | 0.66 [0.33, 1.30] | .23 | 1.02 [0.23, 4.52] | .98 |
| 25 ≤ BMI < 30 | 0.61 [0.31, 1.22] | .16 | 1.08 [0.24, 4.76] | .92 |
| BMI ≥ 30 | 0.84 [0.41, 1.71] | .63 | 1.29 [0.28, 5.89] | .74 |
| Psychosocial health factors | | | | |
| Loneliness | 2.71 [2.02, 3.63] | .00* | 3.12 [2.10, 4.62] | .00* |
| Emotional loneliness | 2.17 [1.67, 2.82] | .00* | 3.24 [2.32, 4.54] | .00* |
| Social loneliness | 2.14 [1.68, 2.71] | .00* | 1.93 [1.44, 2.60] | .00* |
| Depression | 1.20 [1.12, 1.27] | .00* | 1.26 [1.15, 1.37] | .00* |
| Fear of falling | 5.07 [3.81, 6.73] | .00* | 6.42 [4.78, 8.63] | .00* |

*Note*. Values are crude ORs and 95% CI. OR = odds ratio; CI = confidence interval; ADL = activities of daily living; BMI = body mass index.
*$p < .05$.

(OR = 3.49 vs. 2.56 for fear of falling, and OR = 3.17 vs. 1.86 for ADL limitations). Also, loneliness is associated with recurrent falling among women (OR = 2.91). Older men with visual impairment are more likely to have recurrent falls than those without this limitation (OR = 2.75).

## Discussion

This study has identified three important risk factors that increase the risk of falls in older people, regardless of their fall history or gender; that is, age ≥75 years, having an ADL limitation, or fear of falling. Elderly with a fall history and one of the above-mentioned risk factors have a higher risk of falls than those with no fall history. The use of sedatives or tranquilizers increases the risk of falling for both men and women, but appears to have no effect on recurrent falling. Other risk factors of significance in this study are gender related, such as alcohol use in women and visual limitation in men.

These results support earlier studies reporting that about one third of the people aged ≥65 years will fall during a 12-month period, and that fall accidents are associated with multiple risk factors. Similar to other reports, in the present study, age is a significant risk factor: As people get older, balance reactions, increasing physical impairment, and other age-induced changes (such as vision) may increase the risk of falling (Gill et al., 2005; Rubenstein, 2006). Our finding that functional limitations (as defined by ADL limitations) are significantly associated with the risk of falling is also consistent with previous research (Yokoya et al., 2007).

Fear of falling is a prominent symptom experienced by many older people. In line with other research (Lach, 2005), our findings show that fear of falling is consistently associated with a higher risk of falling, and in case of a fall history,

**Table 3.** Risk Model for the Prediction of Falls (≥1 Fall) Versus Non-Falls Presented for Women and Men Separately, Obtained by Multiple Logistic Regression.

| Falls | Women | | | Men | | |
|---|---|---|---|---|---|---|
| Predictors | OR | 95% CI | *p* | OR | 95% CI | *p* |
| Age ≥75 years | 1.03 | [1.01, 1.05] | .01* | 1.04 | [1.01, 1.06] | .00* |
| Educational level | 1.24 | [1.03, 1.50] | .03* | 1.14 | [0.95, 1.38] | .17 |
| Living situation | 0.87 | [0.66, 1.14] | .31 | 0.82 | [0.59, 1.14] | .24 |
| Use of sedatives/tranquilizers | 1.37 | [1.02, 1.84] | .04* | 1.58 | [1.04, 2.41] | .03* |
| Alcohol | 1.68 | [1.29, 2.18] | .00* | 1.13 | [0.84, 1.52] | .41 |
| Physical activity | 0.91 | [0.69, 1.20] | .52 | 1.21 | [0.88, 1.66] | .24 |
| Visual impairment | 0.98 | [0.63, 1.50] | .91 | 1.63 | [0.91, 2.92] | .10 |
| Hearing impairment | 0.85 | [0.53, 1.38] | .52 | 1.16 | [0.71, 1.92] | .55 |
| ADL limitation | 1.60 | [1.10, 2.34] | .02* | 2.02 | [1.24, 3.30] | .01* |
| Loneliness | 1.55 | [0.85, 2.82] | .15 | 1.34 | [0.60, 2.98] | .47 |
| Emotional loneliness | 0.79 | [0.50, 1.26] | .33 | 0.75 | [0.39, 1.44] | .39 |
| Social loneliness | 1.35 | [0.99, 1.83] | .06 | 0.86 | [0.61, 1.22] | .40 |
| Depression | 1.04 | [0.86, 1.26] | .67 | 1.06 | [0.81, 1.41] | .66 |
| Fear of falling | 1.65 | [1.25, 2.16] | .00* | 2.66 | [1.90, 3.74] | .00* |

*Note*. OR = odds ratio; CI = confidence interval; ADL = activities of daily living.
*$p < .05$.

**Table 4.** Risk Model for the Prediction of Recurrent Falls (≥2 Falls) Versus Nonrecurring Falls (≤1 Fall) Presented for Women and Men Separately, Obtained by Multiple Logistic Regression.

| Recurrent falls | Women | | | Men | | |
|---|---|---|---|---|---|---|
| Predictors | OR | 95% CI | *p* | OR | 95% CI | *p* |
| Age ≥75 years | 1.05 | [1.01, 1.08] | .01* | 1.06 | [1.03, 1.10] | .00* |
| Educational level | 1.16 | [0.87, 1.55] | .32 | 1.13 | [0.84, 1.53] | .42 |
| Living situation | 1.18 | [0.78, 1.80] | .44 | 1.88 | [1.09, 3.27] | .03* |
| Use of sedatives/tranquilizers | 1.45 | [0.96, 2.17] | .08 | 0.95 | [0.51, 1.76] | .86 |
| Alcohol | 1.09 | [0.74, 1.61] | .67 | 1.31 | [0.82, 2.08] | .26 |
| Physical activity | 0.99 | [0.65, 1.50] | .96 | 1.58 | [0.94, 2.66] | .09 |
| Visual impairment | 1.32 | [0.76, 2.29] | .32 | 2.75 | [1.36, 5.54] | .01* |
| Hearing impairment | 0.86 | [0.46, 1.61] | .64 | 1.47 | [0.78, 2.77] | .24 |
| ADL limitation | 1.86 | [1.16, 2.99] | .01* | 3.17 | [1.72, 5.82] | .00* |
| Loneliness | 2.91 | [1.26, 6.73] | .01* | 1.43 | [0.51, 4.01] | .49 |
| Emotional loneliness | 0.70 | [0.34, 1.43] | .33 | 1.25 | [0.53, 2.98] | .61 |
| Social loneliness | 1.45 | [0.92, 2.30] | .11 | 1.35 | [0.79, 2.29] | .27 |
| Depression | 1.12 | [0.88, 1.43] | .35 | 1.29 | [0.89, 1.89] | .18 |
| Fear of falling | 2.56 | [1.63, 4.01] | .00* | 3.49 | [2.13, 5.71] | .00* |

*Note*. OR = odds ratio; CI = confidence interval; ADL = activities of daily living.
*$p < .05$.

this risk increases even more for both males and females. Many factors are associated with the development of fear of falling, including having previous falls (Lach, 2005). Consequently, elderly people who are afraid to fall tend to avoid physical activity (Wijlhuizen, de, & Hopman-Rock, 2007). This reduced mobility may in turn increase the risk of falling and social isolation and, in the long term, may lead to loss of quality of life (Austin, Devine, Dick, Prince, & Bruce, 2007; Bruce, Devine, & Prince, 2002). As fear of falling is a modifiable risk factor, preventive activities need to be introduced early on, and intervention strategies should take this risk factor into account, for example, by increasing knowledge on how to reduce falls (Austin et al., 2007).

It is reported that use of certain medication, such as benzodiazepines and sedatives, is a significant risk factor for falls (Askari et al., 2013; Evans, 2003). Surprisingly, in the present study, this risk factor only applies to individuals with no fall history. This is in accordance with Askari et al. (Askari et al., 2013), who found a relation between the use of several different drugs and recurrent falls, whereas no such relation

was found between sedatives and recurrent falls. Additional research is required to examine the effect of using these drugs, as this is a modifiable risk factor that can be targeted by interventions. Contrary to expectation, the association between education level and risk of falling remains unclear. Educational level appears to be a significant factor for falling only among women. Earlier studies also reported contradictory results: For example, whereas one study found that highly educated elderly are less likely to fall (Gill et al., 2005), another showed that a high education level is a risk factor for falling (Pluijm et al., 2006).

Females consuming more than the acceptable alcohol standard have a higher risk of falling than women drinking no more than this standard, whereas this relation is not significant in males. This difference between men and women may be explained by the smaller gastric alcohol metabolism in females, which increases the vulnerability of women to the effects of ethanol (Baraona et al., 2001). Female recurrent fallers who are lonely are more likely to fall than those who do not feel lonely. This may be attributed to a reciprocal causation; a fall accident may increase the feeling of being lonely and vice versa. Elderly males with a visual impairment have a significantly higher risk of having ≥2 fall accidents in the past 12 months. Also, among elderly males, living with someone appears to be a risk factor for recurrent falling. We have no explanation for this unexpected result. Further research is required to examine this issue.

### *Strengths and Limitations*

This study is cross-sectional and therefore susceptible to reverse causality. Another limitation is the reliance on self-reports for all measurements. However, we believe that socially desirable answers are unlikely to play a role when reporting risk factors/fall accidents. Also, although participants' answers may be affected by recall bias (e.g., they may not remember the exact number of fall accidents in the previous 12 months), our data on fall accidents are in line with data from cohort studies on falling among elderly (Stalenhoef et al., 2002).

It is known that neurological disorders are related to falls (Allan, Ballard, Rowan, & Kenny, 2009; Marshall, 2012). The present study provides no information on the relationship between chronic disorders, for example, neurodegenerative conditions and fall accidents. Chronic diseases were part of the questionnaire, but three neurological diseases (Parkinson's disease, multiple sclerosis, and epilepsy) were grouped in one item. The risk factors in this study were selected based on modifiability (e.g., lifestyle, fear of falling) and/or targetability by preventive interventions. It is possible that some individuals in the study sample may have one of these disorders. Nevertheless, we are convinced that the influence of this small proportion is negligible.

Strengths of the present study are the large sample of elderly men and women, the high response rate, and the considerable amount of information obtained on different risk factors from the same sample. In addition, we investigated the risk factors for single and recurrent falls, taking into account differences between men and women; these items have rarely been addressed in previous studies.

### *Implications for Practice*

Based on these results, multifactorial interventions focusing on the risk factors for fear of falling and on ADL limitations may help in preventing falls. There is evidence that multicomponent cognitive behavioral interventions can be effective in reducing concerns about falling (Zijlstra et al., 2009; Zijlstra et al., 2011). Based on our findings with regard to gender differences in risks for falls, more attention should be paid to men with a visual impairment and to women who are lonely or who drink more than the acceptable alcohol standard. Although physical activity was not significant in the multiple logistic analyses, fall prevention exercise programs for older people not only reduce the rate of falls but also help to prevent injuries caused by falls, including the most severe ones (El-Khoury, Cassou, Charles, & Dargent-Molina, 2013; Karlsson, Vonschewelov, Karlsson, Coster, & Rosengen, 2013).

## Conclusion

The present study has identified several fall risk factors, including three major risk factors for falling and recurrent falling, regardless of gender, that is, fear of falling, ADL limitations, and age ≥75 years. In all subgroups, fear of falling remains one of the common modifiable risk factors for falls. The use of sedatives or tranquilizers increases the risk of falling, but only among elderly with no fall history.

Regarding gender differences in fall risk, ADL limitations and fear of falling appear to be stronger risk factors for men than for women. In addition, alcohol use and educational level are significant risk factors for women. Men with fear of falling or ADL limitations are at a higher risk to have a recurrent fall accident than women with these conditions. Loneliness is associated with recurrent falling among women. Having a visual impairment or living with someone is associated with recurrent falling among men.

Our findings emphasize the importance of multifactorial fall interventions for fallers and recurrent fallers and of taking into account gender differences in the aim to reduce falls among older people.

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