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Falls in Mexican older adults aged 60 years and older

Luis M Valderrama-Hinds, MD^{1,2,3}, Soham Al Snih, MD, PhD^{1,4,5}, Chen Nai-wei, PhD⁶, Martin A Rodriguez, MD, PhD^{2,3}, and Rebeca Wong^{1,6}

¹Sealy Center on Aging, University of Texas Medical Branch, Galveston, TX

²Division of Rheumatology, Department of Internal Medicine, Hospital Universitario de Caracas, Universidad Central de Venezuela, Caracas, Venezuela

³Centro Nacional de Enfermedades Reumáticas, Hospital Universitario de Caracas, Universidad Central de Venezuela, Caracas, Venezuela

⁴Division of Rehabilitation Sciences, School of Health Professions, University of Texas Medical Branch, Galveston, TX, USA

⁵Division of Geriatrics, Department of Internal Medicine, University of Texas Medical Branch, Galveston, TX, USA

⁶Department of Preventive Medicine and Community Health, University of Texas Medical Branch, Galveston, TX, USA

Abstract

Background—Falls are a major cause of disability, morbidity, institutionalization, and mortality in older adults.

Objectives—To examine the risk factors for falls among Mexican older adults aged 60 years and older.

Methods—This study included 6,247 participants and their spouse or partner aged 60 years and older from the Mexican Health and Aging Study, an ongoing longitudinal study (2001-2012) conducted in Mexico. Measures included socio-demographics, falls, physical activity, comorbid conditions, pain, vertigo, vision and hearing impairments, urinary incontinence, lower extremity functional limitation, Activities of Daily Living (ADLs), cognitive function, and depressive symptoms.

Corresponding author: Soham Al Snih, MD, PhD. Division of Rehabilitation Sciences, School of Health Professions, University of Texas Medical Branch. 301 University Blvd., Galveston, TX 77555-0177. Tel: 409-266-9691. Fax: 409-772-8931. soalsnih@utmb.edu.

Ethical approval: The MHAS study was approved by the Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch (in the United States) and the Instituto Nacional de Estadística y Geografía (INEGI) and the Instituto Nacional de Salud Pública (INSP) (in Mexico); and have been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki.

Conflict of Interest: The authors declare that they have no conflicts of interest.

Informed consent: “Oral informed consent was obtained from all individual participants included in the study.”

Data availability: The datasets generated during and/or analyzed during the current study are available in <http://www.mhasweb.org/>.

Results—Mean age was 69.6 years (Standard Error=0.18) and 51.8% were female. Forty percent reported one or more falls at baseline. Older age, being female, obesity, arthritis, fractures, stroke, suffering pain, vertigo, lower extremity functional limitations, physical activity, depressive symptoms, urinary incontinence, and ADL disability were significant factors associated with one or more falls over time.

Discussion—Early detection and treatment of the risk factors for falls in this population will help improve the quality of life and reduce medical complications and health care costs.

Keywords

Falls; Mexico; Older adults; Epidemiology; MHAS

INTRODUCTION

Falls are a major health problem in older adults and are the second leading cause of accidental or unintentional injury deaths worldwide [1]. According to the World Health Organization (WHO), each year an estimated 646,000 individuals die from falls globally, over 80% live in low- and middle-income countries [1]. According to the Centers for Disease Control and Prevention, one out of five falls causes serious injury such as head injury or broken bones [2]. Data from the 2014 Behavioral Risk Factor Surveillance System (BRFSS) survey found that 28.7% of older adults reported falling in the preceding 12 months and an estimated of 29.0 million falls resulted in seven million injuries requiring medical treatment [3]. In 2015, a total of 34,488 persons in the US died as a result of falls, 16.5% of all injury deaths [4]. Individuals who fall and suffer a consequent disability are at major risk for subsequent long-term care and institutionalization [5].

Several risk factors have been associated with falling, including: a) individual factors as age, gender, ethnicity, poor education, and low income; b) health characteristics as chronic conditions, high body mass index (BMI), medication use, alcohol intake, lack of sleep, and low physical activity; c) intrinsic capacity factors, such as declines in physical, emotional, and cognitive capacity and impairments in vision, balance, and mobility; and d) environmental factors as poor housing, inadequate stairway design, poor lighting, slippery floors, uneven surfaces, footwear, and clothing, lack of access to health and social services, and inadequate use of assistive devices [6,7].

A systematic review and meta-analysis conducted by Deandrea et al. [8] examining the risk factors for falls in community-dwelling older adults found that age, being female, living alone, a history of falls, physical disability, disability in instrumental activities of daily living (IADLs), use of a walking aid, vertigo, Parkinson disease, fear of falling, gait problems, and vision and hearing impairment were all predictors of both all fallers and recurrent fallers. In another systematic review and meta-analysis, Lusardi et al. used posttest probability (PrTP) to determine the risk of falls in community-dwelling older adults [9] and found that previous falls, use of psychoactive medications, requiring assistance with any activities of daily living (ADLs), fear of falling, two-self-reported measures (Geriatric Depression Scale-15 and Falls Efficacy Scale International), and scores on five performance-based functional measures (Berge Balance Scale, Timed Up and Go Test, Single-limb stance eyes open, Five Times Sit-

To-Stand Test, and self-selected walking speed) were clinically useful indicators of a PrTP of 30% of one or more future falls.

The prevalence of falls varies among countries. For example, data from a study conducted across seven large cities in Latin America and the Caribbean found that the proportion of adults aged 60 years and older who fell in the previous year ranged from 21.6% to 34% [10]. The 2012 National Survey of Health and Nutrition in Mexico reported that a third of community-dwelling older adults aged 60 years and older fall once a year, and half of them fall again; additionally, women were more frequently affected when compared to men, and 40% of those who fell received medical attention [11,12]. Findings from the Health, Ageing, and Retirement in Europe (SHARE) reported a significant variation across countries in the rate of falling in the previous 6-months, from 7.9% in Switzerland to 16.2% in the Czech Republic [13]. The prevalence of falls reported in the English Longitudinal Study of Ageing was 28.4% [14]. Findings from the National Interview Survey indicated that 16.4% of those aged 65 years and older had a fall [15].

In the last decades, Mexico has experienced important epidemiologic and demographic changes, including declining fertility rate, decreasing mortality rate, increasing life expectancy, and increasing chronic disease burden, and all these factors contribute to rapid aging [16]. However, little is known from longitudinal studies about the factors associated with falls in this population. Thus, we used data from the Mexican Health and Aging Study (MHAS) to examine the risk factors for falls among Mexican older adults aged 60 years and older over time.

MATERIALS AND METHODS

Study population

The sample for this study was drawn from the MHAS, an ongoing nationally representative longitudinal study of adults in Mexico aged 50 years or older (N= 15,186) interviewed in 2001, 2003, 2012, and 2015. The details of the study methodology are reported elsewhere [17,18]. The present study included participants and their spouse or partner aged 60 years and older (N= 7,039) interviewed in-person in 2001 and who were followed up in 2003 and 2012. Of these, we excluded 792 participants with missing information on falls and covariates associated with risk of falls [10,13,14,19,20]. The final cohort for analysis included 6,247 participants. Of these, at the end of the follow up in 2012, 3,477 participants were re-interviewed in-person, while 1,038 were lost to follow up and 1,732 were reported dead (Figure 1). Excluded participants were significantly more likely than included participants to be older; have fewer years of education; live in low-density areas; report more stroke and lower extremity functional limitations; and report fewer fractures and fewer falls.

Outcome variable

Falls—Falls were assessed by the question, “Have you fallen down in the last two years?” [14,19,21]. A positive response was followed by, “Approximately how many times has this happened?” and “Have you hurt yourself in these falls badly enough to need medical treatment?” Fall status was dichotomized as having one or more falls versus no falls.

Predictor variables

Sociodemographic variables—Sociodemographic variables including age (as continuous variable), gender, marital status (married vs. unmarried), locality size (population of 100,000 or more, 15,000 – 99,999, 2,500 – 14,999, and under 2,500 inhabitants), and years of formal education (0 years, 1 – 5 years, 6 years, and 7 years or more).

BMI—BMI was computed as weight in kilograms divided by height in meters squared and grouped into underweight (<18.5 kg/m²), normal weight (18.5 to <25 kg/m²), overweight (25 to <30 kg/m²), and obesity (≥ 30 kg/m²) [22].

Self-reported comorbid conditions—Self-reported comorbid conditions included hypertension, diabetes, arthritis, fractures, heart attack, stroke, and cancer.

Pain—Pain was assessed with the question, “Do you often suffer from pain?” and dichotomized as suffering pain or not.

Vertigo—Vertigo was assessed by asking the participant, “During the last two years have you frequently had fainting spells or vertigo?” and dichotomized as having vertigo or not.

Urinary incontinence—Urinary incontinence was assessed with “During the last two years have you frequently had involuntary loss of urine?” and dichotomized as having urinary incontinence or not [23,24].

Vision problem—Vision problem was assessed by asking participants, “How is your vision (using glasses)?” and dichotomized into 1) respondents who answered “excellent, “very good”, “good”; and 2) those who answered “fair”, “poor”, or “legally blind” [24].

Lower extremity functional limitation and ADL disability—Participants were asked if they had difficulty performing the following activities: walking one/several blocks; walking across room; sitting for about two hours; getting up from a chair after sitting for long periods; climbing one/several flights of stairs without resting; stooping, kneeling, or crouching; and pushing or pulling large objects. ADLs included bathing, eating, going to bed, using the toilet, and dressing. Respondents were asked to indicate “yes”, “no”, “cannot do” or “does not do” to the activity. Each activity was dichotomized into 1) “yes” or “cannot do” the activity and 2) “no limitation” in the activity or “does not do” the activity. Any lower extremity functional limitation was dichotomized as having difficulty or not in performing one or more of the nine activities. Any ADL disability was dichotomized as having difficulty in or not performing one or more of the six ADLs. These questions have been used in previous studies [25,26].

Physical activity—Physical activity was assessed by asking the participants whether they had participated in vigorous physical activity or exercise three times a week or more on average over the last two years [27]. Responses were categorized as dichotomous (yes or no).

Depressive symptoms—Depressive symptoms were assessed using a modified Center for Epidemiological Studies Depression Scale (CES-D), with a score ranging from 0 to 9, where high scores indicated more depressive symptoms [28].

Statistical analysis

Baseline characteristics of the subjects were summarized by fall status (no falls versus one or more falls) using means and standard deviations (SD) for continuous variables, and frequencies and percentages for categorical variables. Comparisons were made using independent t-tests for continuous variables and chi-squared tests for categorical variables. A generalized linear mixed model (GLMM) was fitted using the GLIMMIX procedure in SAS to account for inter-subject heterogeneity and intra-subject dependence on repeated measures. Since repeated fall status represented different years along with unequal time intervals, the spatial power structure of a variance-covariance model that incorporates correlations for all observations from the same subject was further employed [29]. To address the partial effect of risk factors on fall status across study years, modeling analysis included study year (time), gender, education, and time variant covariates (marital status, BMI, comorbid conditions, pain, vision problems, depressive symptoms, vertigo, urinary incontinence, ADL disability, lower extremity functional limitations, and physical activity). Those participants who died, refused, and were lost to follow-up were included in the study until their last follow up (2003 or 2012). Sensitivity analysis was conducted by including those falls that occurred among those who died between 2001 and 2003 (N=155) and 2003 and 2012 (N=818). All analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

RESULTS

Table 1 shows the descriptive characteristics of the total sample by falls at baseline. The baseline average age was 69.6 years (Standard Error [SE] = 0.18). Fifty-two percent of participants were female, 62.5% were married, 45.5% lived in high-density areas of >100,000 inhabitants, and around 28.8% had six or more years of education. The most frequent comorbid conditions were hypertension (40.9%), arthritis (24.6%), and diabetes (16.9%). The BMI average was 26.7 Kg/m². Sixty four percent reported lower extremity functional limitations, 49.1% vision impairment, 44% pain, 27.6% vertigo, 11.1% ADL disability, and 10.9% urinary incontinency. Compared to participants who did not fall, those who fell were older, more likely to be female, unmarried, have fewer years of education, report more comorbid conditions, have pain, vertigo, urinary incontinence, vision impairment, depressive symptoms, any lower extremity functional limitation, and any ADL disability. The prevalence of one or more falls was 40.4% in 2001, 40.7% in 2003, and 46.5% in 2012. The percent of frequent falls (2 or more falls) was 25.5% in 2001, 26.5% in 2003, and 31.9 in 2012. Around 40% of the falls required medical treatment in 2001, 42.4% in 2003, and 39.1% in 2012.

Table 2 presents the results of the GLMM testing the relationship between predictor variables and falls (one or more falls) over the 11-year period. The odds ratio (OR) of having one or more falls over time was 1.03 (95% CI=1.02-1.04). Several predictor variables were associated with one or more falls over time. Among socio-demographics, older age

(OR=1.01, 95% CI=1.01-1.02), female gender (OR=1.71, 95% CI=1.54-1.90), living in a density area between 15,000 and 99,999 (OR=1.29, 95% CI=1.12-1.49), and living in a density area of < 2,500 (OR=1.17, 95% CI=1.01-1.04) were associated with falls. Obesity (OR=1.14, 95% CI=1.01-1.30), arthritis (OR=1.14, 95% CI=1.02-1.27), fracture (OR=2.03, 95% CI=1.78-2.31), and stroke (OR=1.39, 95% CI=1.04-1.85) were the medical conditions associated with falls. Vertigo (OR=1.41, 95% CI=1.27-1.57), pain (OR=1.26, 95% CI=1.14-1.38), urinary incontinence (OR=1.16, 95% CI=1.01-1.33), any lower extremity functional limitation (OR=1.33, 95% CI=1.20-1.47), ADL disability (OR=1.16, 95% CI=1.02-1.32), physical activity (OR=1.13, 95% CI=1.03-1.24), and depressive symptoms (OR=1.06, 95% CI=1.05-1.08) were also associated with one or more falls over time. No significant interaction term was found between gender and time, and education and time in predicting one or more falls. Sensitivity analysis was conducted by adding the falls reported by next-of-kin among those who died between 2001 and 2003 to falls reported in 2003 (total falls = 2,303 + 155) and between 2003 and 2012 to falls reported in 2012 (total falls = 1,715 + 818). The findings were similar to those reported (data not shown).

DISCUSSION

This study examined the risk factors for one or more falls over an 11-year follow-up period among Mexican older adults aged 60 years and older. Older age, being female, population density, obesity, arthritis, fractures, stroke, suffering pain, vertigo, lower extremity functional limitations, ADL disability, physical activity, and depressive symptoms were significant predictors over time of one or more falls in this population. Forty-percent reported one or more falls and approximately half of them reported frequent falls.

Our findings are consistent with previous studies. For example, Gale et al., using the English Longitudinal Study of Ageing, found age, female gender, pain, and depression associated with falls [14]. Himes et al. [30], using data from the US Health and Retirement Study (HRS - 1998-2006), found older age, female gender, lower body limitation, obesity, pain, stroke, arthritis, diabetes, dizziness, and vision problems associated with a greater risk of falls. Nicklett et al., using more recent data from the HRS (2000 – 2010), showed that older age, female gender, limitations in ADLs and in instrumental activities of daily living (IADLs) were associated with falls [19]. In a Swedish population of 1,763 subjects, Stenhausen et al. found that reduced mobility, heart dysfunction, and functional impairment (e.g., nocturia) predicted falls [31].

Female gender, older age, diabetes, arthritis, urinary incontinence, high depressive symptoms, and having any functional limitations were significant independent risk factors for falls in 9,765 subjects from the Health, Well-Being and Aging in Latin America and the Caribbean [20]. Reyes-Ortiz et al. examined data from the Hispanic Established Population for the Epidemiological Study of the Elderly of older Mexican Americans from the southwestern US, and found that age ≥ 80 years, female sex, diabetes, arthritis, high depressive symptoms, and limitations in IADLs were risk factors associated with falls; and that the risk of falling increased from 14% for those with no risk factors to 41% for those with three or more risk factors of falling [20]. Data from the SHARE study, showed that older age, less than good self-rated health, mobility limitations, ADL limitations, dizziness,

depression, and previous history of falls was associated with falls, although there were differences between countries [13]. Our findings are different from those found in the National Health and Aging Trends Study (NHATS) [21], where underweight, heart disease, osteoporosis, dementia, and low performance in the Short Physical Performance Battery were factors associated with falls.

Our study has some limitations. First, we used self-reported data on falls and comorbidities. However, self-reports of falls and medical conditions have been used in many studies, and have been found to be accurate and reliable [32–34]. Second, the time interval to recall a fall was two years instead of one year, the interval most surveys use to document falls. However, surveys similar to the MHAS such as the Health Retirement Study and the English Longitudinal Study of Aging used the two-year window for self-report of falls. Third, we do not have information about injuries related to falls. Fourth, we had no access to medical records to obtain information on medication use. Fifth, no information was available about falls that might have occurred between 2003 and 2010. Six, we lacked information on environmental factors such as inadequate stairway design, irregular streets and footpaths, or sidewalks. However, the strengths of this study included its large, well-defined representative sample of Mexican older adults, the prospective design, and the 11-year period of follow up. The prospective design allows for establishing relationships between the predictor variables and falls over time.

CONCLUSIONS

Falls among Mexican older adults is high (40.4%) and several factors predicted falls in a two-year period. There is a need to build awareness of the importance of falls in this population by implementing multifactorial interventions [35,36] targeting the risk factors identified during the fall risk assessment, through: 1) provide medical assessment and management of modifiable risk factors such as pain, vertigo, arthritis, depression, urinary incontinency, and obesity, all predictors of falls in this population; 2) provide balance-gait and muscle strength exercise training to improve mobility; and 3) enact environmental modifications at the municipal level, as we found participants living in localities with < 100,000 inhabitants at risk for falls. The design and implementation of interventions to prevent falls in this population should be culturally-appropriate evidence-based interventions that will significantly improve quality of life and reduce health care costs and medical complications resulting from falls.

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Figure 1.
Flow chart of the selection of the study population.

Table 1

Descriptive characteristics of the sample by falls at baseline among Mexican older adults (N= 6,247).Predictor Variables

	Total N (%)	No falls N (%)	1 or more falls N (%)	p-value
Total	6,247 (100)	3,683 (59.6)	2,564 (40.4)	
Age (years), mean (SE)	69.6 (0.18)	69.1 (0.23)	70.4 (0.27)	0.0002
Gender (female)	3,364 (51.8)	1,715 (44.6)	1,649 (62.6)	<0.0001
Marital status (married)	3,878 (62.5)	2,460 (67.9)	1,418 (54.6)	<0.0001
Locality size (population)				
>100,000	3,629 (45.5)	2,220 (47.2)	1,409 (42.9)	0.1176
15,000 – 99,999	912 (13.2)	490 (13.8)	422 (12.4)	
2,500 – 14,999	590 (13.8)	343 (12.8)	247 (15.4)	
<2,500	1,116 (27.5)	630 (26.2)	486 (29.3)	
Education				
0 years	1,897 (34.9)	1,033 (31.0)	864 (40.6)	<0.0001
1 – 5 years	2,357 (36.3)	1,363 (36.2)	994 (36.3)	
6 years	973 (14.1)	623 (16.7)	350 (10.4)	
7 years or more	1,016 (14.7)	661 (16.1)	355 (12.8)	
BMI (kg/m²), mean (SE)	26.7 (0.17)	26.7 (0.21)	26.6 (0.30)	0.9802
BMI (kg/m²) category				
< 18.5	109 (3.5)	66 (3.20)	43 (3.94)	0.9044
18.5 - < 25	1,622 (37.0)	1,013 (36.65)	609 (37.53)	
25 - < 30	1,837 (38.1)	1,133 (38.69)	704 (37.27)	
30	937 (21.4)	556 (21.44)	381 (21.27)	
Comorbid conditions				
Hypertension	2,613 (40.9)	1,412 (38.41)	1,201 (44.79)	0.0070
Diabetes	1,091 (16.9)	585 (15.63)	506 (18.86)	0.0723
Arthritis	1,543 (24.6)	779 (19.85)	764 (31.71)	<0.0001
Fracture	1,035 (16.6)	407 (12.04)	628 (23.21)	<0.0001
Heart Attack	254 (3.2)	136 (3.03)	118 (3.38)	0.6398
Stroke	191 (2.6)	93 (2.34)	98 (2.96)	0.3284
Cancer	105 (1.6)	59 (1.39)	46 (1.84)	0.3806
Pain	2,687 (44.0)	1,329 (36.44)	1,358 (55.22)	<0.0001
Vertigo	1,562 (27.6)	697 (21.76)	865 (36.34)	<0.0001
Urinary incontinence	615 (10.9)	283 (7.9)	332 (15.48)	<0.0001
Vision impairment	3,007 (49.1)	1,647 (45.24)	1,360 (54.90)	<0.0001
Any lower extremity functional limitation	3,938 (63.6)	2,098 (58.2)	1,840 (71.62)	<0.0001
ADL disability	836 (11.1)	364 (8.09)	472 (15.51)	<0.0001
Physical Activity	1,809 (28.4)	1,094 (28.42)	715 (28.41)	0.9947
Depressive symptoms, mean (SE)	3.9 (0.07)	3.4 (0.08)	4.6 (0.10)	<0.0001

SE= Standard Error; BMI= Body Mass Index; ADL= activities of daily living.

Note: Means and percents were obtained after adjusting for sampling weights used in the Mexican Health and Aging (MHAS) study.

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Table 2

Generalized Linear Mixed Model for one or more falls during the follow-up period among Mexican older adults (N= 6,247).

Predictor variables	OR (95% CI)
Time	1.03 (1.02 - 1.04)
Age	1.01 (1.01 - 1.02)
Gender (female)	1.71 (1.54 - 1.90)
Marital status (married)	0.87 (0.77 - 0.96)
Locality size (population)	
>100,000	Reference
15,000 – 99,999	1.29 (1.12 - 1.49)
2,500 – 14,999	1.11 (0.92 - 1.30)
< 2,500	1.17 (1.01 - 1.04)
Education, years	
0 years	Reference
1 - 5 years	1.03 (0.91 - 1.17)
6 years	0.98 (0.84 - 1.15)
7 years or more	0.98 (0.84 - 1.15)
BMI category (Kg/m²)	
Underweight (<18.5)	0.77 (0.58 - 1.03)
Normal weight (18.5 - <25)	Reference
Overweight (25 to <30)	1.10 (0.99 - 1.22)
Obesity (≥ 30)	1.14 (1.01 - 1.30)
Comorbid conditions	
Hypertension	1.03 (0.94 - 1.13)
Diabetes	1.12 (0.99 - 1.26)
Arthritis	1.14 (1.02 - 1.27)
Fracture	2.03 (1.78 - 2.31)
Heart Attack	0.99 (0.80 - 1.24)
Stroke	1.39 (1.04 - 1.85)
Cancer	0.95 (0.69 - 1.31)
Pain	1.26 (1.14 - 1.38)
Vertigo	1.41 (1.27 - 1.57)
Urinary incontinence	1.16 (1.01 - 1.33)
Vision problem	1.08 (0.99 - 1.18)
Any lower extremity functional limitation	1.33 (1.20 - 1.47)
ADL disability	1.16 (1.02 - 1.32)
Physical activity	1.13 (1.03 - 1.24)
Depressive symptoms	1.06 (1.05 - 1.08)

OR= odds ratio; CI= confidence interval; BMI= Body Mass Index; ADL= activities of daily living.