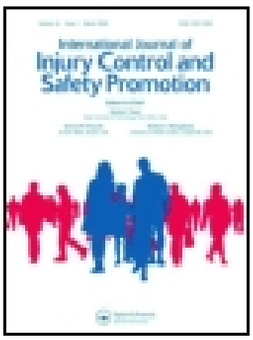

International Journal of Injury Control and Safety Promotion

ISSN: 1745-7300 (Print) 1745-7319 (Online) Journal homepage: https://www.tandfonline.com/loi/nics20

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To cite this article: Zahra Taheri-Kharameh, Jalal Poorolajal, Saeed Bashirian, Rashid Heydari Moghadam, Mahmoud Parham, Majid Barati & Éva Rásky (2019): Risk factors for falls in Iranian older adults: a case-control study, International Journal of Injury Control and Safety Promotion, DOI: 10.1080/17457300.2019.1615958

To link to this article: https://doi.org/10.1080/17457300.2019.1615958

INTERNATIONAL JOURNAL OF INJURY CONTROL AND SAFETY PROMOTION
https://doi.org/10.1080/17457300.2019.1615958

Risk factors for falls in Iranian older adults: a case-control study

Zahra Taheri-Kharameh[a], Jalal Poorolajal[b], Saeed Bashirian[c], Rashid Heydari Moghadam[d], Mahmoud Parham[e], Majid Barati[c] and Éva Rásky[f]

[a]Students Research committee, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran; [b]Department of Epidemiology, School of Public Health, Research Center for Health Sciences, Hamadan University of Medical Sciences, Hamadan, Iran; [c]Department of Public Health, School of Health, Social Determinants of Health Research Center, Hamadan University of Medical Sciences, Hamadan, Iran; [d]Department of Ergonomics, School of Health, Research Center for Health Sciences, Hamadan University of Medical Sciences, Hamadan, Iran; [e]Clinical Research Development Center, Department of Internal Medicine, Qom University of Medical Sciences, Qom, Iran; [f]Institute of Social Medicine and Epidemiology, Medical University of Graz, Graz, Austria

ABSTRACT

Falls are an important cause of morbidity and mortality in older adults. Identifying potential risk factors would provide a considerable public health benefit. The objective of this retrospective study was to determine the risk factors for falling among Iranian older adults. Two hundred eighty community-dwelling elders, with and without a history of falls, participated in the study. Elders aged 60 or over referred to retirement centres completed a multi-section questionnaire on demographic information, behavioural, environmental, and medical factors of fall from May to September 2018. Data analysis was performed with descriptive statistics and logistic regression using the Stata version 14 software. Sedentary activity level (OR: 2.14; 95% CI: 1.85, 3.23), hearing loss (OR: 2.17; 95% CI: 1.23, 3.83), vertigo or dizziness (OR: 2.24; 95% CI: 1.02, 4.91) and visual impairment (OR: 1.63; 95% CI: 1.01, 2.67) were important predictors of falls. No significant associations were observed between falls with demographic factors and medication. This study indicates several modifiable risk factors may be associated with falls that affect the health of older adults. Appropriate interventions are necessary to reduce modifiable risk factors of falls of high-risk elders.

ARTICLE HISTORY
Received 7 March 2019
Accepted 2 May 2019

KEYWORDS
Fall; risk factors; elderly; community-dwelling

Introduction

The number of older people is increasing worldwide (WHO, 2015). Older people have a higher risk of falling, meaning a person moves inadvertently on the ground or onto a lower level (Ku et al., 2013). About the health consequences, falls are, therefore, a major public health issue worldwide. According to the World Health Organization (WHO), 28–35% of the elderly falls every year, and the number of incidences increases with age (WHO, 2014). Falling is known to be the main cause of injury, physical inability and death in the elderly (Shankar et al., 2017). According to the Center for Disease Control and Prevention (CDC), in 2012, 2.4 million older people were admitted to the emergency department and more than 722,000 were hospitalized (Centers for Disease Control and Prevention, 2016). The severity of the injuries varies 40–60% of the falling results in major lacerations, fracture or brain damage (Vieira et al., 2016). In a longitudinal study, 68% of people having fallen reported injuries. Health care was needed in 24% of the cases, performance decline of the affected aged was reported in 35% of the cases, and 15% encountered a problem in their social and physical activities (Stel et al., 2004). Nearly 95% of the pelvic fractures occur due to falls, and 95% of the pelvic fracture patients have to be admitted to a nursing home, whereas 20% of these patients die within a year. The management of falls-related injuries is highly challenging for those affected and costly for the health care system. The average cost of admission and post-falling treatment for the elderly in Ireland is reported to be $6000, and in the USA is $13,000 per person. In 2040, the annual treatment cost of these elderly patients is expected to reach $240 billion, considered a very high rate (WHO, 2014). In Iran, the incidence of falling in the elderly is also relatively high (25.5%), with 21.4% of the cases leading to fractures (Tanjani et al., 2015). According to a study conducted in Qom city, the number of cases of the falling-related injuries and hospitalizations in the elderly between the ages of 89 and 91 was reported to be 424 (Gilasi et al., 2015). However, there are no accurate data on the treatment costs following a fall in Iran.

Falling drastically reduces the quality of life and can lead to fear of falling, physical activity reduction, performance decline, loss of daily living activities, social isolation, depression and increased risk of repeated falling (Ozturk et al., 2017; Vieira et al., 2016). Falling risk factors in the elderly are divided into external and inherent factors, but are usually a combination of several influencing factors so that 70% are combinations of several factors (Balzer et al., 2012). Generally, muscular dysfunction, mobility impairment and

CONTACT Majid Barati barati@umsha.ac.ir Department of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran.

the use of medications, especially sedatives, have been identified as major risk factors for falls in previous studies (Sousa et al., 2017).

Many existing studies identify and manage risk factors for falling in the community-dwelling older adults (Bhattacharya & Singh, 2018; Stubbs et al., 2015), but these studies are not relevant to an Iranian population. Identifying the risk factors for falling that are prevalent in the current Iranian older people underpins the development of more effective and better-targeted multifactorial interventions. In the other, an effective prevention measure involves evaluating and managing individual risk factors for the falls (Phelan et al., 2015). Regarding the various risk factors in different societies and the lack of adequate information in Iran, this retrospective study was carried out with the aim of identifying the risk factors for falls in an older people in Qom, Iran. Knowledge of the relevant risk factors could improve target-oriented prevention strategies.

Method

Design and participants

A case-control study was carried out in Qom, Iran, from May to September 2018. The sample size was estimated according to Honeycutt (Honeycutt & Ramsey, 2002), 140 cases and 140 controls in a 1:1 ratio with 99% confidence, 96% power. Accordingly, 140 cases and 140 controls were recruited from the elders who referred to active retirement centres in Qom. Cases were defined via the following inclusion criteria: age 60 years or older, having a history of one or more falls within the last three years, living independently in the community, Persian speaking women and men, able to complete the survey mentally and willing to participate in this study after they got relevant information about the aims of the study. A fall was defined as any event that led to an unplanned, unexpected move on the ground or onto a lower level. The elders who had falls resulting from unavoidable environmental hazards and Road traffic accidents were excluded. Controls were persons of the above criteria but with no history of fall. Data were collected through face-to-face interviews using a structured questionnaire.

Measurements

Based on previous studies, a multi-section questionnaire was developed to assess the risk factors for falls (Ambrose et al., 2013; Pfortmueller et al., 2014; Phelan et al., 2015; Vieira et al., 2016). The questionnaire consisted of the following three categories: socio-demographic information, behavioural and environmental factors, and medical factors.

Socio-demographic information included age, gender, marital status, education level, income, history of falls in the past three years, history of fall-related injuries.

Behavioural and environmental factors included body mass index, smoking status, use an assistive device, physical activity, self-report balance and safety at home.

Physical activity (PA) was assessed with the Rapid Assessment of Physical Activity (RAPA) is a validated nine-item, self-report questionnaire, designed to assess current levels of PA in the clinical setting. The items mentioned cover level and intensity of PA based on illustrations of a variety of light, moderate and vigorous activities. The levels of physical activity are described as sedentary, underactive, light activities, regular underactive and regular active. The RAPA has demonstrated good reliability and validity in older adults in the original and Persian version (Khajavi, 2015; Topolski et al., 2006).

The Activities-Specific Balance Confidence (ABC) Scale is a validated self-report scale that evaluates an individual's confidence in doing different activities without falls. Participants rate their confidence in doing tasks on a scale that ranges from 0% (not confident) to 100% (completely confident). The total score is the sum of scores from each question, with higher scores indicating greater balance. The original and Persian versions of this scale have good reliability and validity in older adults (Azizi & Zarrinkoob, 2017; Schepens et al., 2010).

Home safety information was collected using 12 questions about potential falls risks at one's homes developed by the CDC (Centers for Disease Control and Prevention National Center for Injury Prevention and Control, 2004). This information was scored based on the sum number of items checked 'no' (e.g. 'Do you have grab bars in your bath?' yes or no). Because the checklist identified possible home hazards, the more 'no' responses indicated a higher environmental falls risk score. The content validity ratio (CVR) and the content validity index (CVI) were used to evaluate the content validity. In the expert panel review, all tasks received a CVI and CVR above 0.80, representing good content validity. Reliability measured by Cronbach's alpha coefficient was 0.71, which shows the questionnaire is reliable.

Medical factors, the following chronic conditions were defined as medical factors: cardiovascular disease, hypertension, arthritis, neurological disorder, diabetes, dementia, depression, dizziness or vertigo, visual impairment, hearing loss and losing strength. Medication included sedatives, antidepressants, diuretics and cardiac drugs.

Ethical considerations

Approval to conduct the study was obtained from the Medical Ethics Committee at Hamadan University of Medical Sciences (registration number: IR.UMSHA.REC.1396.911). For data collection, the study was explained to the eligible participants. Then, consent to participate in the study was obtained. All participants were informed that they could withdraw from the study at any time.

Statistical analysis

Statistical analysis was performed using Stata 14 software program. Falls history was used as an outcome and socio-

Table 1. Demographic factors and risk of falls in people 60 years of age and older.

Factor	Cases ($n = 140$)[a]	Controls ($n = 140$)[a]	Unadjusted OR (95% CI)	*P* value
Age (yr)				
60–64	84	84	1	
65–69	32	35	0.91 (0.51, 1.61)	0.757
≥70	24	21	1.14 (0.59, 2.21)	0.691
Gender				
Male	103	111	1.00	
Female	37	29	1.37 (0.79–2.32)	0.261
Marital status				
Married	122	124	1.00	
Widow and divorced	18	16	1.14 (0.55–2.34)	0.715
Educational level				
Illiterate	38	35	1.00	
Primary school	42	50	0.57 (0.17–1.92)	0.370
Secondary school	10	9	1.65 (0.51–2.30)	0.173
High school	15	21	0.65 (0.29–1.47)	0.309
University	34	25	1.25 (0.62–2.50)	0.523
Income (Rials)				
≥20,000,000	97	95	1.00	
<20,000,000	35	43	0.76 (0.45–1.26)	0.305

Note: OR, odds ratio; CI, confidence interval.
[a]Percentages may not total 100% because of missing values.

Table 2. Behavioural and environmental factors and risk of falls in people 60 years of age and older.

Factor	Cases ($n = 140$)[a]	Controls ($n = 140$)[a]	Unadjusted OR (95% CI)	*P* value
Body mass index (kg/m^2)				
Normal weight (<24.9)	49	45	1.00	
Overweight (25.0–29.9)	59	70	0.80 (0.47–1.37)	0.431
Obesity (≥30.0)	28	19	1.41 (0.69–2.86)	0.337
Activity score level (RAPA)[a]				
Sedentary	36	29	2.42 (1.09–4.56)	0.011
Underactive	33	30	1.82 (0.49–2.79)	0.286
Light activities	27	25	1.56 (0.41–2.61)	0.403
Regular underactive	15	17	0.78 (0.31–3.36)	0.617
Regular active	28	35	1.00	
Balance (ABC)[a]				
adequate (>50)	93	95	1.00	
Inadequate (<50)	45	41	1.12 (0.67–1.86)	0.561
Use assistive device				
No	127	128	1.00	
Yes	9	11	0.82 (0.33–2.05)	0.672
Smoking status				
Nonsmoker	118	122	1.00	
Smoker	21	19	1.10 (0.43–2.05)	0.372
Home safety				
No	64	63	1.00	
Yes	46	52	1.14 (0.77–1.94)	0.507

Note: RAPA, rapid assessment of physical activity; ABC, Activities-specific Balance Confidence.
[a]Percentages may not total 100% because of missing values.

demographic information, behavioural, environmental and medical factors as independent variables. Chi-square test and bivariate logistic regressions were used to compare the cases and controls to examine the risk factors associated with falls. Finally, multivariate logistic regression was applied to explore the risk factors and falls, controlling significant variables in the bivariate analysis. A p-value less than 0.05 was considered significant.

Results

A total of 280 elders (140 cases and 140 controls) were included in the study. The demographic characteristics and controls are presented in Table 1. The mean (SD) age of the elders was 64.6 (5.5) years for the cases and 64.5 (5.4) years for the controls. The samples included more males than females (76.4%:23.6%). Most individuals in the control and case groups were married (89.9%) and had low literacy (59%). 6.1% of cases reported one or more injurious falls. There was no statistically significant difference between the risk of falls and socio-demographic factors between the two groups (Table 1).

The unadjusted factors of behavioural and environmental factors in the cases and controls are presented in Table 2. The cases were significantly more likely to have a sedentary activity level (OR: 2.42; 95% CI: 1.09, 4.56), as compared to the controls. The other behavioural factors showed no significant association with elders falls.

An analysis of the medical factors and the medication showed that three medical conditions significantly increased the risk of falls: visual impairment (OR: 2.06; 95% CI: 1.28, 3.32), vertigo or dizziness (OR: 2.18; 95% CI: 1.26, 3.76) and hearing loss (OR: 2.17; 95% CI: 1.23, 3.83). Our results

Table 3. Medical conditions factors and risk of falls in people 60 years of age and older.

Factor	Cases ($n = 140$)[a]	Controls ($n = 140$)[a]	Unadjusted OR (95% CI)	*P* value
Cardiovascular disease				
No	106	108	1.00	
Yes	34	32	1.05 (0.56, 1.96)	0.873
Hypertension				
No	91	101	1.00	
Yes	49	39	1.39 (0.84, 2.31)	0.199
Diabetes				
No	110	107	1.00	
Yes	30	33	0.88 (0.51, 1.55)	0.668
Neurological disorder				
No	135	136	1.00	
Yes	5	4	1.25 (0.33, 4.79)	0.735
Dementia				
No	138	139	1.00	
Yes	2	1	2.01 (0.18, 22.47)	0.569
Depression				
No	130	133	1.00	
Yes	10	7	1.46 (0.54, 3.95)	0.455
Visual impairment				
No	53	78	1.00	
Yes	87	62	2.06 (1.28, 3.32)	0.003
Vertigo, dizziness				
No	113	129	1.00	
Yes	27	11	2.18 (1.26, 3.76)	0.005
Strength decreased				
No	124	130	1.00	
Yes	16	10	1.67 (0.73–3.83)	0.221
Hearing loss				
Yes	48	27	2.52 (1.34, 4.75)	0.004
No	92	113	1.00	
Arthritis				
Yes	32	26	1.29 (0.72, 2.32)	0.337
No	108	114	1.00	
Medication				
Sedatives				
Yes	23	19	1.18 (0.57, 1.68)	0.285
No	53	52	1.00	
Antidepressants				
Yes	10	7	1.46 (0.54, 3.95)	0.454
No	130	133	1.00	
Cardiac				
Yes	51	43	1.28 (0.78, 2.12)	0.312
No	89	97	1.00	
Diuretic				
Yes	3	2	1.16 (0.15, 7.39)	0.861
No	91	81	1.00	

Note: OR, odds ratio; CI, confidence interval.
[a]Percentages may not total 100% because of missing values.

showed no evidence of an association between medications and falls (Table 3).

A multivariate logistic analysis was performed using the findings of the univariate analysis for identifying the most important risk factors for falls in the older adult (Table 4). The results showed that sedentary activity level (OR: 2.14; 95% CI: 1.85, 3.23), hearing loss (OR: 2.17; 95% CI: 1.23, 3.83), vertigo or dizziness (OR: 2.24; 95% CI: 1.02, 4.91) and visual impairment (OR: 1.63; 95% CI: 1.01, 2.67) were still significantly associated with the falls among older people.

Table 4. Results from multivariate logistic regression analyses of predictors' falls.

Factor	Adjusted OR (95% CI)[a]	*P* value
Visual impairment		
Yes	1.63 (1.01, 2.67)	0.049
Hearing loss		
Yes	2.17 (1.23, 3.83)	0.007
Vertigo, dizziness		
Yes	2.24 (1.02, 4.91)	0.006
Activity score level		
Sedentary	2.14 (1.85, 3.23)	0.021

[a]Adjustments made for significant variables in the bivariate analysis. The outcome is falls in the past three years (yes vs. no).

Discussion

The purpose of this research was to identify falls risk factors among Iranian community-dwelling older adults. To our knowledge, this retrospective study is the first to be conducted on risk factors of falls in older adults in Iran. Our findings provide information regarding falls among community-dwelling older adults. Several factors were considered as possible predictors of fall risk, based on a review of the literature (Ambrose et al., 2013; Pfortmueller et al., 2014; Phelan et al., 2015; Vieira et al., 2016). These factors included a range of demographic, medical, behavioural and environmental factors. Our results showed that vertigo or dizziness, sedentary activity level, hearing loss and visual impairment predicted fall risk among Iranian older adults.

Sedentary activity level was found to be one of the most important predictors of falls in this study. In other words, elders in the sedentary activity level had significantly greater falls risk. This result supports previous evidence that physical activity level results in an increased risk for fall and, therefore, activating elderly people physical activity was the most promising prevention strategy (Jefferis et al., 2015; Salehi et al., 2014; Stahl & Albert, 2015). The findings of a study in Iran showed that the most participants had low levels of physical activity and this was about 50% lower than for elderly who had not fallen (Salehi et al., 2014). In the study of Kistler et al. (2018), physical function and recent exercise were related to reduced risk for falls and fall-related injuries.

Studies show that specific exercises such as strength and balance exercises reduce falls risk, significantly (Arnold et al., 2008; Granacher et al., 2013). Unfortunately, we could not find a significant association between self-report balance and falls in our study population. An explanation could be the self-reported balance scale we used in our study, because of the differing perceptions of the participants. A valid balance assessment tool such as the Berg Balance Scale or the Four-Stage Balance Test may be more predictive in the risk assessment of falls. In other words, a functional evaluation provides information about the subject's ability to act independently and can be used as a screening test to identify the risk of fall (Pourmahmoudian et al., 2018). Balance is a good parameter, because it is necessary for any total body movement or action and requires a multisystem function that must operate effectively, particularly sensory, motor and vision systems.

In this study, the greater hearing loss was significantly associated with self-reported falls. Contributing to the literature, our results assess the association between hearing loss and fallings. Several mechanisms could be used to explain the association between hearing loss and fallings. There may be a concomitant dysfunction of both the cochlear and vestibular structures regarding their shared location within the bony labyrinth of the inner ear. Finally, the association of hearing loss with fallings may be mediated through reduced cognitive resources (Jiam et al., 2016; Kamil et al., 2016).

Self-report dizziness/vertigo was another predictor of falls. Other studies have reported dizziness as a risk factor for falls and it has been recognized as a possible geriatric syndrome (Paiva et al., 2017; Walther et al., 2010). The dizziness is recurrent in the older adults because of the body systems functions decreasing, especially, the balance, which includes the integration of vestibular, visual and somatic sensory system (Paiva et al., 2017). However, dizziness has multi-factorial causation and it can be due to defect of inner ear, neurological, psychiatric or medical factors.

Finally, elders who had a visual deficit are about 1.7 times more likely for falls than those who do not. This finding is similar to findings of a study that visual impairment was associated with an increased likelihood of fall-related injuries (Hong et al., 2014). Vision makes the main contribution to balance, and visual impairment resulting from eye diseases is a significant independent risk factor for falls and injuries in older people. It is, therefore, necessary older people undergo regular eye examinations by eye care providers (Lord, 2006; Reed-Jones et al., 2013).

There are several limitations to be noted related to our results. Given that all our participants were members of elderly centres, the findings of this study might not be generalized to the whole population of the elderly. Using self-reported data also led limitations by stressing the memory capabilities of older adults. Finally, a great number of participants were not able to give detailed information concerning their medication.

Conclusion

In conclusion, the current comprehensive assessment study of fall risk factors revealed that several behavioural factors (i.e. physical activity level), chronic health problems (i.e. hearing loss, vertigo or dizziness and visual impairment) were significant factors contributing to falls among community-dwelling older adults. Whenever health professionals identify these factors in older people, this could lead to referrals to appropriate falls prevention programmes.

Acknowledgments

This research is extracted from a part of a dissertation project with the code number of 9612228374 at the Social Determinants of Health Research Center of Hamadan University of Medical Sciences. The researchers want to thank all participants in this study as well as the research Deputy of Hamadan University of Medical Sciences to support this project.

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