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Original Article

Risk factors for fall in elderly with diabetes mellitus type 2

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ABSTRACT

Aims: Diabetes mellitus type 2 (DMT2) is a major chronic condition that also common in older people, and associated with an increased risk of falling. This study aimed to determine the risk factor of fall in elderly with DMT2.

Methods: In this cross-sectional study, 220 elderly diabetic patients who had referred to diabetes center in Kerman were chosen via convenience sampling method. To collect data, Semi-structured Fall Risk questionnaire and the Pittsburgh Sleep Quality Index (PSQI) were used.

Findings: The mean age was estimated to be 69.82 (SD: 9.9) years. Among the participants, 38.5% suffered falls in the past one year. Good sleep quality (OR = 0.45, 95% CI = 0.1–0.85) and appropriate environment (OR = 0.6, 95% CI = 0.1–0.77) were significantly associated with a lesser odd of having recurrent falls. Gait problem (OR = 1.8, 95% CI = 1.1–4.9), balance difficulties (OR = 2.1, 95% CI = 1.24–7.12), hypotension (OR = 1.7, 95% CI = 1.2–5.6), and medication above three medicine (OR = 1.55, 95% CI = 1.12–6.34) were significantly associated with a greater odd of having recurrent falls.

Conclusion: It would therefore appear that older diabetic patients would be a suitable target group for a strategy aimed at preventing falls. Early recognition of the multiple causes of falls in the older diabetic patient and prompt referral of this group of patients to a specialist falls clinic is recommend.

1. Introduction

Worldwide, the proportion of elderly population is increasing. In Iran, the global proportion of people aged ≥ 60 years increased from 7.2% in 2006 to 9.3% in 2016 and is expected to reach more than 25% by 2040 [1]. Diabetes mellitus type 2 (DMT2) is a major public health problem and the prevalence of DMT2 increases exponentially with age worldwide [2]. Diabetes is now one of the most salient and fatal diseases in the world, and it causes a lot of expenses for patients, their families and governments, yet not enough measures have been taken to control and manage the disease [3]. Diabetes is associated with premature morbidity, mortality, and is a substantial health burden on individuals, health systems, and society. Diabetes is the seventh-leading cause of death in the US mainly due to the increased cardiovascular risk [4]. DMT2 is also common in older people and it has been estimated that approximately 25% of the patients with diabetes are over 65 years of age [5]. Prevalence of DMT2 in Iranian older adults based on a findings from a large population-based survey (Urban HEART-2) was 14.4% [6].

Diabetes is associated with an increased risk of falling [7,8]. Falls leading to serious injuries are more common in elderly with diabetes and result in higher healthcare costs and longer hospital stays [9]. Falls are a major cause of disability and a preventable cause of death in older people. About 30% of people over 65 years of age fall each year; the incidence of falls in those over 75 years of age is 32–42% [10]. Several established risk factors for falls are more common in elderly with diabetes, including peripheral neuropathy, decreased physical performance, decreased cognitive performance, poor vision, and increased use of antidepressant medication [11,12]. In a case-control study conducted by Jafari et al., in 2016, there was a relationship between postural blood pressure, dizziness, fecal incontinency, auditory disorder, visual disorder, pain in the lower extremity, taking anti-coagulation

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medicine had a significant correlation with falling in Iranian older adults with DMT2 [13].

Despite the increased costs and loss in quality of life that are associated with fall-related events and exacerbated by higher prevalence of diabetes and its complications in the older population, very few studies have specifically evaluated the association between DMT2 and fall related outcomes [14]. Moreover, there is a knowledge gap regarding the risk factors for falls specific to the elderly with diabetes, because no such studies exist in Iranian population. Understanding and acting on these risk factors could help to reduce the burden of falls in the population with diabetes. Since diabetes complications can lead to falls in the elderly and according to the fact that the risks associated with falling are multifactorial, the aim of this study was to determine the risk factor of fall in elderly with DMT2.

2. Methods

2.1. Study area and period

This cross-sectional study performed in Kerman city, Iran in 2018. Kerman is the capital city of Kerman Province, located in the southeast of Iran. At the 2016 census, its population was 537,718, making it the 14th most populous city of Iran.

2.2. Study design

We performed an observational cross-sectional population-based survey among elderly (≥60 years) subjects with diagnosed diabetes mellitus.

2.3. Populations and sample size

Participants were obtained from diabetes center of the Kerman city which are responsible for the implementation of 'National program on the prevention and control of diabetes' in this city and cover all diabetes patients. The aim of this program is primary, secondary, and tertiary prevention, through community and high-risk screening, and the integration of diabetes care into the primary healthcare network. Other details of this program are covered in previous work [15].

Sample size was calculated by using assumptions as follows: prevalence of fall of 33% [16] and a precision of 6% which gave an estimated sample size about 220; subjects meeting inclusion criteria were aimed to be included during this survey. All participants were selected with convenience sampling method from the diabetes center. Inclusion criteria were: age equal or above 60 years, complete patient record file, diagnosed with type 2 diabetes for at least one year, citizen of Iran, and ready to provide informed consent to use data and participate. Those not meeting these requirements were not included in our survey. All invited subjects were explained about the purpose of this survey and those willing to participate were included in the survey. Ethical permission was obtained from the Institutional Review Board of the Kerman University of Medical Science (NO.: IR.KMU.REC.1396.2039).

2.4. Instrument

The instruments used to collect data was a form addressing socio-demographic variables, semi-structured Fall Risk questionnaire and The Pittsburgh Sleep Quality Index (PSQI).

Semi-structured Fall Risk questionnaire including: History of falls in the previous one years, medications, medical history, environmental hazards. Medications and medical history extracted from patient's record. Face validity of this questionnaire established using a panel of experts. Five experts on the research subject reviewing the questionnaire and concluded that it measures the trait of interest.

The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in the older adult. It differentiates "poor" from "good" sleep by measuring a total of 18 items (ranging from 0 to 3) sum up to seven different sub-scales including sleep quality, sleep-onset latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, daytime dysfunction over the last month. The total score is calculated by summing all sub-scale scores with a cut-off score of > 5 indicating "bad sleepers" in comparison to "good sleepers" (≤5). A total score > 10 indicated a severe sleep problem or sleep disorder [17]. Reliabilities for the PSQI sum score between 0.82 and 0.89 and good specificity and sensitivity and were reported [18].

In the final analysis, to measure internal consistency, we used Cronbach's alpha coefficient. It was found that Cronbach's alpha for questionnaire was as follow: Fall questionnaire (0.87) and PSQI (0.81).

2.5. Data analysis

Our data analysis used the Statistical Package for the Social Sciences (SPSS), version 21 (Armonk, NY: IBM Corp.). Descriptive statistics such as mean and percentages were used for variables. Univariate logistic regression was used to examine the association between each independent variable and having fall. Variables that were associated with history of falling with a $P < 0.2$ were included in a multivariable model [19]. The association between falls and quality of sleep was examined using multiple logistic regression, presented as odds ratios (OR) with 95% confidence intervals (CI).

3. Results

Finally, 200 questionnaires that was completed correctly were analyzed. The mean age was estimated to be 69.82 (SD: 9.9) years. 116 (58%) female participated in our survey. 62.5% (n = 125) were Married. Overall 78 (39%) were illiterate. Among the participants, 38.5% suffered falls in the past one year. Prevalence of falls was higher in women than in men, but there wasn't significant relationship between gender ($p = 0.8$) with fall (Table 1).

Table 2 shows the relation between fall history (Yes/No) with medications, medical history, environmental hazards and quality and patterns of sleep. There was significant relationship between gait problem ($p = 0.02$), balance difficulties ($p < 0.001$), vision problems ($p = 0.002$), neurological and cognitive impairments ($p = 0.03$), osteoporosis ($p = 0.003$), hypertension ($p = 0.04$), hypotension ($p = 0.002$), medication ($p = 0.02$) and quality of sleep ($p < 0.001$) with fall.

Table 3 shows comparison fall history (Yes/No) and independent variables (gait problem, balance difficulties, vision problems, neurological and cognitive impairments, osteoporosis, hypertension, hypotension, medication and quality of sleep). After adjustment in final model, good sleep quality ($p < 0.001$) and appropriate environment ($p = 0.04$) were significantly associated with a lesser odd of having fall. Gait problem ($p = 0.002$), balance difficulties ($p = 0.01$), hypotension ($p = 0.03$), and medication above three medicine ($p < 0.001$) were significantly associated with a greater odd of having fall.

4. Discussion

The present study was designed to determine the risk factor of

Table 1
Characteristics of participants.

Variables		N (%)	P
Gender	Female	116(58)	0.8
	Male	84(42)	
Marital Status	Single	75(37.5)	0.7
	Married	125(62.5)	
Education	Illiterate	78(39)	0.3
	Primary	54(27)	
	Under Diploma	22(11)	
	Diploma and above	46(23)	
Self-reported health	Very bad	9(4.5)	0.5
	bad	31(15.5)	
	Not bad not good	99(49.5)	
	good	54(27)	
	Very good	7(3.5)	

Table 2
Independent risk factors for falls.

Variables			N (%)	P
Fall		No	123(61.5)	–
		Yes	77(38.5)	–
Frequency Fall		One	31(40.2)	–
		Two	29(37.7)	–
		Three ≥	17(22.1)	–
Gait problem		No	107(56)	0.02
		Yes	84(44)	
Balance difficulties		No	112(58)	<0.001
		Yes	81(42)	
Vision problems		No	105(54.1)	0.002
		Yes	89(45.9)	
Neurological and/or cognitive impairments		No	150(78.5)	0.03
		Yes	41(21.5)	
Musculoskeletal Disorders	Osteoporosis	No	127(66.5)	0.003
		Yes	64(33.5)	
	Arthritis	No	137(71.3)	0.13
		Yes	55(28.7)	
	Pain	No	74(38.3)	0.12
		Yes	119(61.7)	
Cardiovascular disease	Hypertension	No	115(58.6)	0.04
		Yes	81(41.4)	
	Arrhythmia	No	150(78.5)	0.2
		Yes	41(21.5)	
	Heart attack	No	162(84.3)	0.045
		Yes	30(15.6)	
	Hypotension	No	142(73.9)	0.002
		Yes	50(26.1)	
Environment		Inappropriate	77(38.5)	0.09
		Appropriate	123(61.5)	
Medication		>3	69(34.5)	0.01
		≤3	121(60.5)	
Quality of sleep		Poor	127(63.5)	<0.001
		Good	73(36.5)	

Table 3
Final Model for falls in the last one years by independent variables.

Variable		OR	CI	P
Quality of sleep	Poor (ref)	–	–	–
	Good	0.45	0.1–0.85	<0.001
Gait problem	No (ref)	–	–	–
	Yes	1.8	1.1–4.9	0.002
Balance difficulties	No (ref)	–	–	–
	Yes	2.1	1.24–7.12	0.01
Hypotension	No (ref)	–	–	–
	Yes	1.7	1.2–5.6	0.03
Environment	Inappropriate (ref)	–	–	–
	Appropriate	0.6	0.1–0.77	0.04
Medication	>3 (ref)	–	–	–
	≤3	1.55	1.12–6.34	<0.001

fall in elderly with DMT2. As previously indicated, fall incidents are a major health problem in older adults and approximately one third of the older individuals encounters at least one fall yearly [20]. Consistent with findings by Kawamoto and Doi [21], we found that quality of sleep has significant relationship with falling. Older adults with sleep problems may be susceptible to falling. Research has shown that sleep problems (e.g., abnormal sleep hours and insomnia) are associated with several risk factors of falls [22], such as functional limitations [23], slower reaction time [24], and physical functions (e.g., postural control and walking speed) [25]. Sleep problems impair the control of postural balance and cause falls, and lack of sleep induces sleepiness, which in turn causes inattentiveness.

Montero-Odasso [26] found that older adults with gait problem at higher risk of experiencing mobility decline and falls, which is in good agreement with the results of the present study. Gait is a complex motor phenomenon with many other measurable facets besides speed that might identify fall risk [27]. Gait training is a key component of fall prevention interventions, and gait evaluation is recommended in current fall guidelines [28].

Our finding indicated that balance difficulties is a risk factor for falls. This is consistent with the results of Robitaille et al. in Canada [29], Cebolla et al. in Barzil [30], and De Rekeneire et al. in the US [31], which showed that the strength, balance, and decreased fear of falling improve older adults' quality of life and independence. The maintenance of balance does not depend only on the neuromuscular system, but on the integrity and interaction of several systems involved in postural control (e.g., visual and vestibular systems).

The results reveal that, hypotension has significant relationship with falling. The above finding is consistent with the study by Bromfield et al. [32]. They examined low blood pressure and use of antihypertensive medication have been associated with an increased risk for falls among older adults. Furthermore, Duthie and Katz concluded that in the nursing home setting, orthostatic hypotension and related symptoms of dizziness have been identified as key predictors in falls among residents [33].

The evidence from this study suggests that inappropriate environment is a risk factor for falls among older adults. The result is in the lines of earlier literature by Letts et al. [34] and Chippendale et al. [35]. Kanzaki-Sooudi argued that, healthy, active older adults have a higher risk for outdoor falls while walking and participating in vigorous activity. However, limiting time spent outdoors can also increase fall risk [36]. Key environmental factors may include lighting, the need for stair and bath rails, clutter and other hazards, such as wet surfaces.

Medication use is one of the potentially modifiable risk factors for falls. They may affect fall risk by inducing dizziness, sedation, instability, and hypotension [37–39]. Similar to prior research, it was found that taking medication has significant relationship with falling. In National Health and Aging Trends Study (NHATS), Watanabe observed that older adults who use medications are more likely to fall and to be concerned about falling [40]. Research finding by Umıt et al. in Turkey [41], de Jong et al. in Netherlands [42], Dhalwani et al. in England [43], and Leonetti and Lee in the US [44] also points towards.

5. Conclusion

It would therefore appear that older diabetic patients would be a suitable target group for a strategy aimed at preventing falls. Early recognition of the multiple causes of falls in the older diabetic patient and prompt referral of this group of patients to a specialist falls clinic is recommend.

Conflicts of interest

No potential conflicts of interest relevant to this article were reported.

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