Research Article

Fear of Falling and Balance Confidence in Older Adults with Type 2 Diabetes

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Highlights

- High fear of falling and low balance confidence were reported in diabetic seniors

- Aging and diabetes' complications may increase fall-related psychological concerns

- There is a correlation between falling and fall-related psychological concerns

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ABSTRACT

Background and Aim: Each year, millions of older people experience falling which can cause serious injuries such as broken bones, head injuries, or even death. Since Diabetes Mellitus can disrupt the balance system and increase falling, and given that fear of falling and balance confidence are critical fall-related psychological concerns that can be the risk factors of falls in the diabetic elderly, this study aimed to compare fear of falling and balance confidence of diabetic and non-diabetic older adults in Iran.

Methods: Participants were 63 diabetic older patients and 59 non-diabetic peers aged 60 years and over. Data were collected using the Persian versions of falling efficacy scale-international and activities-specific balance confidence-short form questionnaires. In addition, modified Romberg and timed up and go tests were performed to assess subjective balance performance.

Results: The scores of falling efficacy scale-international questionnaire and timed up and go test were significantly higher in diabetic group while the scores of activities-specific balance confidence-short form questionnaire were lower (p<0.001). No significant differences were observed in the modified Romberg test scores between two groups.

Conclusion: Fear of falling and low balance confidence are more common in diabetic older adults compared to non-diabetic peers. They have poor performance in timed up and go test and have more falls during the last 12 months.

Keywords: Type 2 diabetes mellitus; aging; fear of falling; balance confidence

Introduction

Millions of people, especially the elderly over 60-65 years of age, experience a fall each year [1]; 20% of these falls cause serious injuries such as head trauma, broken bones [2], and fall-related psychological concerns including fear of falling (FOF), fall-related efficacy, and balance confidence [3]. The fall-related psychological concerns have been reported in both fallers and non-fallers and can cause more limitation than a fall itself [4]; The FOF and loss of balance confidence can lead to self-imposed postural instability, activity limitation, and consequently social isolation. The FOF is defined as reduced self-efficacy at avoiding falls [5, 6], and balance confidence is defined as individuals' belief in the ability to maintain balance while performing daily living activities [4, 7], which is the best indicator for identifying individuals at risk of falling [4].

Diabetes mellitus (DM) is a chronic metabolic condition that has affected 415 million adults worldwide [8], and is highly prevalent in the elderly aged >65 years [9]. The experience of multiple falls and having hip fractures in the diabetic elderly is more than the non-diabetic elderly [10, 11]. Several risk factors of the FOF and low balance confidence overlap with the complications of DM [9, 12]. The cumulative effects of DM complications may cause higher FOF severity in the diabetic elderly [9]. On the other hand, increased FOF and impaired balance confidence may increase the falling prevalence in the diabetic elderly [13-15]. No study was found on comparing the association between poor balance confidence and increased FOF in the diabetic and non-diabetic elderly. Therefore, this study aimed to assess the FOF and balance confidence in the diabetic elderly and then compare these fall-related psychological concerns between diabetic and non-diabetic groups.

Methods

In this cross-sectional study, participants were 63 older adults aged 60-81 years with DM and 59 healthy older adults aged 60-82 years old. Patients with diagnosed DM type 2 according to a physician or fasting plasma glucose ≥126 mg/dL [16, 17] were included in this study. For diabetic samples, inclusion criteria were: not use of assistive devices, no diabetic foot ulcers, no orthopedic or surgical problems influencing gait, amputation in the lower limbs, any vestibular disease (e.g. Meniere's disease, vestibular migraine) based on patients' medical records, no diabetic peripheral neuropathy, no cognitive impair-

ment and depression, and having enough good vision for completing the questionnaires. Neuropathy was defined based on the clinical subscale score of the Michigan neuropathy screening instrument [17, 18]. Those who were diagnosed with severe cognitive impairment, dementia, or Alzheimer's disease according to a neurologist, a psychiatrist, or based on the mini mental state examination score [19] were excluded. All participants were surveyed for age, gender, highest level of education, and history of cardiovascular disease. All subjects were also asked about their concerns about falling and the number of falls they had in the past 12 months, and were asked to rate their perceived health state on a Likert-type scale. In diabetic samples, disease duration, comorbidities, the type of treatment for DM (insulin therapy, oral medications, and lifestyle modification), and recent (≤3 months) fetal bovine serum and Hemoglobin A1C (HbA1c) levels were recorded from the medical records.

The simplest question for evaluating the FOF is "are you afraid of falling?" [20], but this question does not show the FOF severity; therefore, we used the Persian version of falls efficacy scale-international (FES-I) to quantify the FOF [21]. Although activities-specific balance confidence (ABC-16) questionnaire is a valid and useful tool for evaluating balance confidence in the elderly, it has more items and is time consuming; hence, a shorter version of this questionnaire with 6 items (ABC-6) was used [22, 23]. The assessment of the short version showed that it is as reliable as the long version. The validity and reliability of the Persian version of ABC-6 have been reported by Azizi and Zarrinkoob [24]. The ABC-6 questionnaire is more sensitive than the ABC-16 questionnaire for detecting subtle differences in balance confidence [23, 25]. To assess the dynamic and static balances, the timed up and go (TUG) test and modified Romberg test were used. As the time for completing the TUG test increases, the ability to maintain balance decreases; hence, those with longer time in TUG test are more likely to fall than those with shorter time [12, 26]. The modified Romberg test assesses the subjective standing balance; the normal balance is defined as the ability to maintain tandem stance for 30s [27].

All statistical analyses were carried out in SPSS v.17 software. For examining the normal distribution assumption for the quantitative data, Kolmogorov-Smirnov test was used, which showed the data were not normally distributed. Descriptive data were presented as mean± standard deviation (SD) or median (minimum-maximum). Chi-square test was used for comparing the socio-demographical characteristics; Mann-Whitney U test was for comparing the studied groups, and Spearman correlation

test was for assessing the correlation between the scores of FES-I and ABC-6. In addition, one-way analysis of variance (ANOVA) was used for assessing the effects of gender, presence of retinopathy, and history of falling, and multiple regression analysis was used for assessing the effects of age, disease duration, and number of falling in the past 12 months on the scores of FES-I and ABC-6 were in the diabetic group.

Results

A total of 63 diabetic patients (mean age=65.94±4.80 years) matched for age and gender with 59 non-diabetic group (mean age=65.72±4.66 years) participated in the present study. No significant differences were found between them regarding the educational level, living state, smoking, and history of cardiovascular disease (p>0.05). Diabetic participants had more obesity and number of falls during the last 12 months; they were taking more antihypertensive medications, and reported lower self-perceived health (Table 1).

According to the answers to the question "Are you afraid of falling?". the FOF was significantly more common in the diabetic group; they also reported more degree of FOF in response to the question "How much are you afraid of falling?". The scores of TUG test and FES-I were significantly higher in the diabetic group than in the non-diabetic group, while the scores of ABC-6 was lower in the diabetic group (p<0.001). Moreover, Spearman correlation test showed that the FES-I and ABC-6 questionnaires' scores had a strong significant negative correlation with each other in both study groups (Table 2). The diabetic group had higher total score of FES-I than the non-diabetic group. Both study groups rated the highest scores for items 11, 7, and 14 in FES-I, indicating that they reported the most FOF in walking on a slippery surface (e.g. wet or icy) (item 11), going up or down stairs (item 7), and walking on an uneven surface (e.g. rocky ground, poorly maintained pavement) (item 14). In both groups, the highest score was related to the item 11 and the lowest score was related to the item 10 (going to answer the telephone before it stops ringing) (Figure 1). The total score of ABC-P6 questionnaire in the diabetic group was lower than that of the non-diabetic group. In both groups, the highest score was related to the item 4 (stepping on to or off an escalator while holding onto a railing), and the lowest score was related to the item 6 (walking outside on icy sidewalks) (Figure 2).

One-way ANOVA results showed the significant effects of being single (p=0.028), history of cardiovascular disease (p=0.001), poor self-perceived health state

(p<0.001), using insulin therapy for DM (p=0.017), and the presence of retinopathy (p=0.010) on the FES-I score. Moreover, the significant effects of poor self-perceived health state (p=0.012), using insulin therapy for DM (p=0.016), hypertension (p=0.010), and history of falling during the last 12 months (p=0.018) on the ABC-6 score was found. The results of multiple regression analysis revealed that age (p=0.002), HbA1C level (p=0.003), duration of diabetes (p=0.010), and body mass index (p=0.032) were the predictors of the FES-I score, while age (p=0.003) and HbA1C level (p<0.001) were the predictors of ABC-6 score in the diabetic group.

Discussion

In this cross-sectional study, the FOF and low balance confidence in diabetic older adults were more common than the non-diabetic group. Diabetic older adults also had the poorest performance in the TUG test and reported a greater number of falls during the last 12 months; therefore, it seems that fall-related psychological concerns are related to the mobility limitations and experiencing more number of falls [4, 6]. It has been reported that higher FOF severity is probably associated with low balance [12, 28, 29], and balance confidence mediates the relationship between FOF, poor balance performance, and physical function [20, 29]. In this study, the scores of the FES-I and ABC-6 questionnaires in two study groups had a high negative correlation with other. In other words, older people who were less confident in their ability to maintain balance while performing their daily living activities also had more FOF. Morrison et al. suggested that poor balance performance and increased FOF can be the warning signs of falls in the diabetic elderly [13]. On the other hand, falling in the elderly impose a significant financial burden on them due to the high costs of treatment, nursing, and long-term care [4, 30]. In addition, fall-related psychological concerns including FOF and low balance confidence negatively affect the quality of life [30, 31]. Thus, prevention of falls and especially the identification of the elderly who are at risk of falling can be one of the important goals of health systems [30]. The score of the ABC-P6 questionnaire is considered as a criterion for predicting the risk of falling in the next 6 months; if its score be low, it indicates that the balance confidence is low which increases the risk of falling in next 6 months [2]. The ABC-P6 questionnaire can be used to predict and continue planning to reduce the risk of falling and finally help reduce the FOF; according to previous studies, people with a history of previous falls report more FOF. Therefore, by reducing
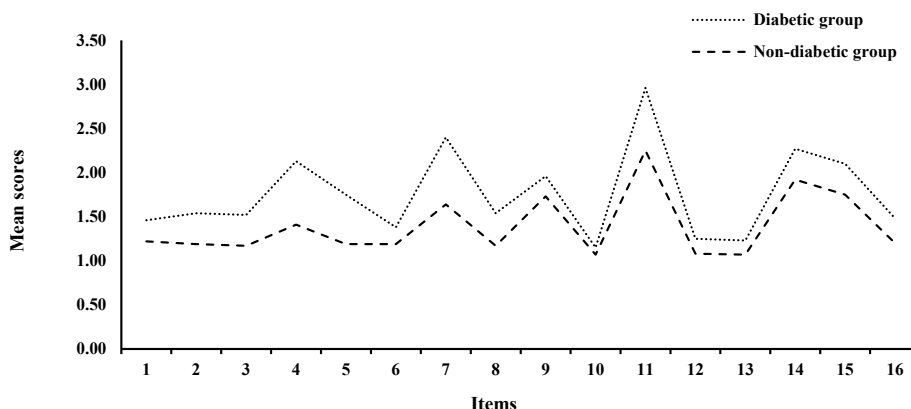
Figure 1. Mean scores of fear of falling in 16 items of the Persian version of falling efficacy scale-international questionnaire in diabetic and non-diabetic groups

the risk of falling and the number of falls, the FOF in the elderly at risk of falling can be reduced [6, 32].

The diabetic elderly in our study had higher scores of FES-I and lower scores of ABC-6 compared to the non-diabetic elderly, indicating their more FOF and lower balance confidence. Consistent with previous studies [12, 14, 33], the severity of FOF in the diabetic group was higher than in the non-diabetic group. The higher severity of FOF can lead to activity restriction, postural instability, social isolation, and ultimately increased risk of falling [14]. Like Lajoie and Gallagher's study who suggested that lower scores in ABC questionnaire can predict higher risk of falling [34], the DM group in the present study reported lower scores of ABC-6, indicating lower balance confidence and higher risk of falling in this group. Therefore, both FOF and low balance confidence can cause falling and activity restriction, and

increased number of falls which creates a loop, because falling itself would increase fall-related psychological concerns [35, 36]. In some studies, the relationship between FOF and the inability to maintain balance and slow walking has been reported in the diabetic elderly [37-39].

For evaluating the older adults' balance, modified Romberg and TUG tests were used in this study. Although Agrawal et al. reported that the diabetic group performed worse in the modified Romberg test than non-diabetic group [40], all participants in our study were able to maintain balance in this test, and there was no difference between the two groups in the modified Romberg test score, which may be due to differences in the inclusion criteria between the two studies. Diabetic group in Agrawal et al.'s study had many diabetes-related complications such as peripheral neuropathy, acute retinopathy,
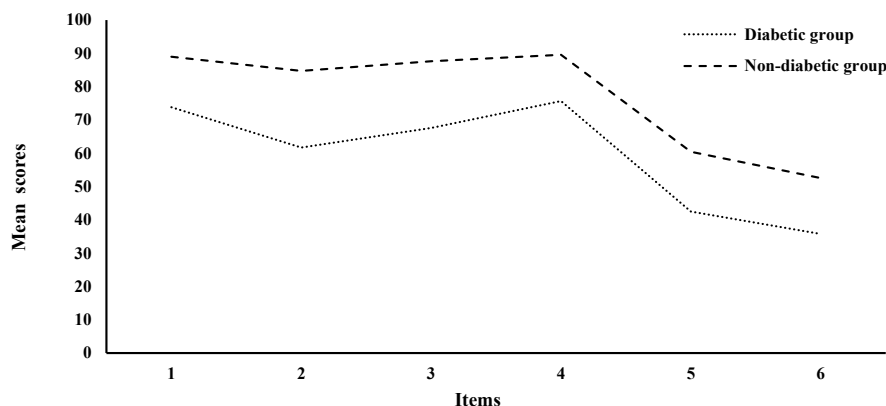
Figure 2. Mean scores of confidence in the ability to maintain balance in 6 items of the Persian version of activities-specific balance confidence-short form questionnaire in diabetic and non-diabetic groups

Table 1. Demographic, clinical, and fear of falling variables in diabetic and non-diabetic groups

Variables	Diabetic group (n=63)	Non-diabetic group(n=59)	p
Age (years)	65.94±4.80 (60-81)	65.72±4.66 (60.00-82.00)	0.776
FBS (mg/dL)	190.61±45.55 (127-350)	92.20±29.40 (83.00-99.00)	<0.001
HbA1c (%)	8.92±1.99 (6.50-13.50)	5.60 (5.40-5.80)	<0.001
Sex (% female/male)	51.92/48.07	44.06/55.93	0.410
Educational level (% primary school/secondary school/college or university)	63.46/26.92/9.61	72.27/22.03/5.69	0.099
Smoking status (% never/ex/current)	30.80/15.40/53.80	30.50/10.20/59.30	0.689
BMI (kg/m2)	30.16±5.10 (21.22-43.90)	28.28±7.80 (20.78-38.61)	0.005
Living state (% alone/with family/in child's house)	11.53/86.53/1.78	3.38/93.22/3.38	0.104
Antihypertensive medications (%)	65.38	37.28	0.002
Retinopathy (%)	11.53	0.00	<0.001
Cardiovascular disease (%)	19.23	13.55	0.052
History of fall during last 12 months (%)	30.76	13.55	0.029
Self-perceived health state (% poor/good/very good/excellent)	21.20/44.20/34.60/0.00	1.70/33.90/54.20/10.20	<0.001
Fear of falling (%)	36.27	18.68	0.017
Degree of fear of falling (% none/slightly/approximately/a lot)	63.84/15.20/9.61/11.33	78.57/14.94/3.08/3.38	<0.001
Performing Romberg test (%)	100.00	100.00	NA
Timed up and go (s)	11.51±1.02	10.51±1.37	<0.001

FBS; fast blood sugar, HbA1C; hemoglobin A1C, BMI; body mass index, NA; not applicable

and foot ulcers [40]. These complications can reduce the ability to walk and maintain balance, and may lead to poorer performance in both static and dynamic balance tests [41, 42]. In the present study, diabetic patients with peripheral neuropathy and foot ulcers were not included in the study and those with retinopathy had enough good vision for completing the questionnaires and does not seem to have considerable effect on the patients' balance abilities.

In our study, the duration of TUG test in diabetic older adults was longer than in non-diabetic peers. Participants with higher scores of FES-I had a slower walking pace under the TUG test and decreased balance confidence. It seems that, in our study, only the dynamic balance in the diabetic patients was affected; their static balance under the modified Romberg test was not affected. Although the increased prevalence of fall-related psychological concerns in the diabetic group is probably explained

Table 2. Spearman correlation coefficient values for scores of the Persian versions of falling efficacy scale-international and short version of activities-specific balance confidence in diabetic and non-diabetic groups

		Persian version of FES-I	
		r	p
ABC-P6	Diabetic group	−0.842	<0.001
	Non-diabetic group	−0.764	<0.001

FES-I; falling efficacy scale-international, ABC-P6; Persian version of activities-specific balance confidence-short form including 6 items

by the excess balance and mobility impairments, other relevant variables including obesity and diabetes-related complications may have had a role. The participants who expressed FOF in response to the question "Are you afraid of falling?" had higher scores in the FES-I but it was not statistically significant, while participants expressed moderate and high FOF in response to the question "How much are you afraid of falling?" had significantly higher scores compared to those who reported less than moderate FOF for this question, indicating that the simple question "Are you afraid of falling?" cannot detect the FOF. The question "How much are you afraid of falling?" seems to be more appropriate than the question "Are you afraid of falling?"

In patients with DM, we found that being single, history of cardiovascular disease, poor self-perceived health state, using insulin, and the presence of retinopathy affected significantly on the Persian version of FES-I. Poor self-perceived health state, using insulin therapy for DM, the presence of hypertension, and number of falling during the last 12 months had significant effects on the ABC-6 score. Although it has been reported that being female is highly associated with the FOF [9, 10], we could not find any significant differences in the FOF and balance confidence between men and women. The Age, HbA1C level, duration of diabetes, and body mass index were the predictors of with the FES-I score, while age and HbA1C level were the predictors of the ABC-6 score. These findings indicate that the uncontrolled DM is one of the most important factors in the development of both FOF and poor balance confidence.

The strengths of this study included the detailed assessments and strict inclusion criteria, such that those with serious complications such as peripheral neuropathy and foot ulcer were not included because such complications affect walking and cause activity restrictions. The limitations of this study included the cross-sectional design, small sample size, participants' problems in remembering the number of falls in the last 12 months, and not evaluation of the participants' depressive symptoms.

Conclusion

Increasing age, duration of disease, and diabetic co-morbidities (cardiovascular disease, hypertension, and retinopathy) are significantly associated with fear of falling (FOF) and low balance confidence in diabetic older adults. As FOF is strongly associated with low balance confidence and it seems that the balance confidence mediates the relationship between FOF and balance and physical function, and also as diabetic older adults re-

ported higher FOF and poorer balance confidence compared to non-diabetic peers, strategies for preventing falls, maintaining balance, and reducing FOF in diabetic older adults are recommended.

Ethical Considerations

Compliance with ethical guidelines

This article was extracted from a research project and obtained its ethical approval from the Research Ethics Committee of Shahid Beheshti University of Medical Sciences (Code: IR.SBMU.RETECH.REC.1399.442).

Conflict of interest

The authors declare that they have no conflict of interest.

References

[1] Bergen G, Stevens MR, Burns ER. Falls and Fall Injuries Among Adults Aged ≥65 Years - United States, 2014. MMWR Morb Mortal Wkly Rep. 2016;65(37):993-8. [DOI:10.15585/mmwr.mm6537a2]

[2] Sterling DA, O'Connor JA, Bonadies J. Geriatric falls: injury severity is high and disproportionate to mechanism. J Trauma. 2001;50(1):116-9. [DOI:10.1097/00005373-200101000-00021]

[3] Hughes CC, Kneebone II, Jones F, Brady B. A theoretical and empirical review of psychological factors associated with falls-related psychological concerns in community-dwelling older people. Int Psychogeriatr. 2015;27(7):1071-87. [DOI:10.1017/S1041610214002701]

[4] Moore DS, Ellis R. Measurement of fall-related psychological constructs among independent-living older adults: a review of the research literature. Aging Ment Health. 2008;12(6):684-99. [DOI:10.1080/13607860802148855]

[5] Dewan N, MacDermid JC. Fall Efficacy Scale-International (FES-I). J Physiother. 2014;60(1):60. [DOI:10.1016/j.jphys.2013.12.014]

[6] Stojanovic Z, Kocic M, Balov B, Milenkovic M, Savic N, Ivanovic S. Fear of falling. Prax Med. 2015;44(3):61-6.

[7] Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. J Gerontol A Biol Sci Med Sci. 1995;50A(1):M28-34. [DOI:10.1093/gerona/50a.1.m28]

[8] Diabetes Canada Clinical Practice Guidelines Expert Committee; Punthakee Z, Goldenberg R, Katz P. Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome. Can J Diabetes. 2018;42 Suppl 1:S10-5. [DOI:10.1016/j.jcjd.2017.10.003]

[9] Bruce D, Hunter M, Peters K, Davis T, Davis W. Fear of falling is common in patients with type 2 diabetes and is associated with increased risk of falls. Age Ageing. 2015;44(4):687-90. [DOI:10.1093/ageing/afv024]

[10] Volpato S, Leveille SG, Blaum C, Fried LP, Guralnik JM. Risk factors for falls in older disabled women with diabetes: the women's health and aging study. J Gerontol A Biol Sci Med Sci. 2005;60(12):1539-45. [DOI:10.1093/gerona/60.12.1539]

[11] Janghorbani M, Van Dam RM, Willett WC, Hu FB. Systematic review of type 1 and type 2 diabetes mellitus and risk of fracture. Am J Epidemiol. 2007;166(5):495-505. [DOI:10.1093/aje/kwm106]

[12] Tander B, Atmaca A, Ulus Y, Tura C, Akyol Y, Kuru Ö. Balance Performance and Fear of Falling in Older Patients with Diabetes Mellitus: A Comparison with Patients without Diabetes Mellitus. Turk J Phys Med Rehabil. 2016;62(4):314-22. [DOI:10.5152/tftrd.2015.77861]

[13] Morrison S, Colberg SR, Mariano M, Parson HK, Vinik AI. Balance training reduces falls risk in older individuals with type 2 diabetes. Diabetes Care. 2010;33(4):748-50. [DOI:10.2337/dc09-1699]

[14] Hewston P, Deshpande N. Fear of Falling and Balance Confidence in Older Adults with Type 2 Diabetes Mellitus: A Scoping Review. Can J Diabetes. 2018;42(6):664-70. [DOI:10.1016/j.jcjd.2018.02.009]

[15] Maurer MS, Burcham J, Cheng H. Diabetes mellitus is associated with an increased risk of falls in elderly residents of a long-term care facility. J Gerontol A Biol Sci Med Sci. 2005;60(9):1157-62. [DOI:10.1093/gerona/60.9.1157]

[16] Cameron NE, Eaton SE, Cotter MA, Tesfaye S. Vascular factors and metabolic interactions in the pathogenesis of diabetic neuropathy. Diabetologia. 2001;44(11):1973-88. [DOI:10.1007/s001250100001]

[17] Davis TM, Yeap BB, Davis WA, Bruce DG. Lipid-lowering therapy and peripheral sensory neuropathy in type 2 diabetes: the Fremantle Diabetes Study. Diabetologia. 2008;51(4):562-6. [DOI:10.1007/s00125-007-0919-2]

[18] Moghtaderi A, Bakhshipour A, Rashidi H. Validation of Michigan neuropathy screening instrument for diabetic peripheral neuropathy. Clin Neurol Neurosurg. 2006;108(5):477-81. [DOI:10.1016/j.clineuro.2005.08.003]

[19] Arevalo-Rodriguez I, Smailagic N, I Figuls MR, Ciapponi A, Sanchez-Perez E, Giannakou A, et al. Mini-Mental State Examination (MMSE) for the detection of Alzheimer's disease and other dementias in people with mild cognitive impairment (MCI). Cochrane Database Syst Rev. 2015;2015(3):CD010783. [DOI:10.1002/14651858.CD010783.pub2]

[20] Hadjistavropoulos T, Delbaere K, Fitzgerald TD. Reconceptualizing the role of fear of falling and balance confidence in fall risk. J Aging Health. 2011;23(1):3-23. [DOI:10.1177/0898264310378039]

[21] Baharlouei H, Salavati M, Akhbari B, Mosallanezhad Z, Mazaheri M, Negahban H. Cross-cultural validation of the Falls Efficacy Scale International (FES-I) using self-report and interview-based questionnaires among Persian-speaking elderly adults. Arch Gerontol Geriatr. 2013;57(3):339-44. [DOI:10.1016/j.archger.2013.06.005]

[22] Hassan H, Zarrinkoob H, Jafarzadeh S, Akbarzade Baghban A. Psychometric evaluation of Persian version of Activities-specific Balance Confidence scale for elderly Persians. Aud Vestib Res. 2015;24(2):54-63.

[23] Schepens S, Goldberg A, Wallace M. The short version of the Activities-specific Balance Confidence (ABC) scale: its validity, reliability, and relationship to balance impairment and falls in older adults. Arch Gerontol Geriatr. 2010;51(1):9-12. [DOI:10.1016/j.archger.2009.06.003]

[24] Azizi F, Zarrinkoob H. [A Review of the Role of the Shortened Activities-Specific Balance Confidence Questionnaire in Predicting the Risk of Falling in the Elderly]. Scientific Journal of Rehabilitation Medicine. 2017;6(1):279-88. Persian. [DOI:10.22037/JRM.2017.1100273]

[25] Hewston P, Deshpande N. The Short Version of the Activities-Specific Balance Confidence Scale for Older Adults with Diabetes-Convergent, Discriminant and Concurrent Validity: A Pilot Study. Can J Diabetes. 2017;41(3):266-72. [DOI:10.1016/j.jcjd.2016.10.007]

[26] Greene BR, O'Donovan A, Romero-Ortuno R, Cogan L, Scanaill, CN, Kenny RA. Quantitative falls risk assessment using the timed up and go test. IEEE Trans Biomed Eng. 2010;57(12):2918-26. [DOI:10.1109/TBME.2010.2083659]

[27] Khasnis A, Gokula RM. Romberg's test. J Postgrad Med. 2003;49(2):169-72.

[28] Morgan MT, Friscia LA, Whitney SL, Furman JM, Sparto PJ. Reliability and validity of the Falls Efficacy Scale-International (FES-I) in individuals with dizziness and imbalance. Otol Neurotol. 2013;34(6):1104-8. [DOI:10.1097/MAO.0b013e318281df5d]

[29] Fuzhong L, McAuley E, Fisher KJ, Harmer P, Chaumeton N, Wilson NL. Self-efficacy as a mediator between fear of falling and functional ability in the elderly. J Aging Health. 2002;14(4):452-66. [DOI:10.1177/089826402237178]

[30] Schott N. Reliability and validity of the German short version of the Activities Specific Balance Confidence (ABC-D6) scale in older adults. Arch Gerontol Geriatr. 2014;59(2):272-9. [DOI:10.1016/j.archger.2014.05.003]

[31] Legters K. Fear of falling. Phys Ther. 2002;82(3):264-72. [DOI:10.1093/ptj/82.3.264]

[32] Mendes da Costa E, Pepersack T, Godin I, Bantuelle M, Petit B, Levêque A. Fear of falling and associated activity restriction in older people. results of a cross-sectional study conducted in a Belgian town. Arch Public Health. 2012;70(1):1. [DOI:10.1186/0778-7367-70-1]

[33] de Souza Moreira B, Sampaio RF, Diz JB, de Carvalho Bastone A, Ferriolli E, Neri AL, et al. Factors associated with fear of falling in community-dwelling older adults with and without diabetes mellitus: Findings from the Frailty in Brazilian Older People Study (FIBRA-BR). Exp Gerontol. 2017;89:103-11. [DOI:10.1016/j.exger.2017.01.004]

[34] Lajoie Y, Gallagher SP. Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and the Activities-specific Balance Confidence (ABC) scale for comparing fallers and non-fallers. Arch Gerontol Geriatr. 2004;38(1):11-26. [DOI:10.1016/s0167-4943(03)00082-7]

[35] Curcio C-L, Gomez F, Reyes-Ortiz CA. Activity restriction related to fear of falling among older people in the Colombian Andes mountains: are functional or psychosocial risk factors more important? J Aging Health. 2009;21(3):460-79. [DOI:10.1177/0898264308329024]

[36] Donoghue OA, Cronin H, Savva GM, O'Regan C, Kenny RA. Effects of fear of falling and activity restriction on normal and dual task walking in community dwelling older adults. Gait Posture. 2013;38(1):120-4. [DOI:10.1016/j.gaitpost.2012.10.023]

[37] Allet L, Armand S, de Bie RA, Golay A, Pataky Z, Aminian K, et al. Clinical factors associated with gait alterations in diabetic patients. Diabet Med. 2009;26(10):1003-9. [DOI:10.1111/j.1464-5491.2009.02811.x]

[38] Allet L, Armand S, de Bie RA, Golay A, Monnin D, Aminian K, et al. The gait and balance of patients with diabetes can be improved: a randomised controlled trial. Diabetologia. 2010;53(3):458-66. [DOI:10.1007/s00125-009-1592-4]

[39] Kelly C, Fleischer A, Yalla S, Grewal GS, Albright R, Berns D, et al. Fear of falling is prevalent in older adults with diabetes mellitus but is unrelated to level of neuropathy. J Am Podiatr Med Assoc. 2013;103(6):480-8. [DOI:10.7547/1030480]

[40] Agrawal Y, Carey JP, Della Santina CC, Schubert MC, Minor LB. Diabetes, vestibular dysfunction, and falls: analyses from the National Health and Nutrition Examination Survey. Otol Neurotol. 2010;31(9):1445-50. [DOI:10.1097/MAO.0b013e3181f2f035]

[41] Dixon CJ, Knight T, Binns E, Ihaka B, O'Brien D. Clinical measures of balance in people with type two diabetes: A systematic literature review. Gait Posture. 2017;58:325-32. [DOI:10.1016/j.gaitpost.2017.08.022]

[42] Canadian Diabetes Association Clinical Practice Guidelines Expert Committee; Imran SA, Rabasa-Lhoret R, Ross S. Targets for glycemic control. Can J Diabetes. 2013;37 Suppl 1:S31-4. [DOI:10.1016/j.jcjd.2013.01.016]