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Factors that Increase Risk of Falling in Older Men according to Four Different Clinical Methods

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ABSTRACT

Background: Falling is an important health problem for older men. In this study, we aim to identify factors that increase risk of falling in only older men using four different fall risk assessment methods.

Method: 334 men, who attended a geriatric outpatient clinic and underwent comprehensive geriatric assessment, were included in the study. History of falling last year, the Timed Up and Go test, Performance-Oriented Mobility Assessment, and 4-meter walking speed test were carried out on all patients.

Results: The mean age (SD) of patients were 74.99 (7.26) years. According to all of the four clinical assessments to predict risk of falling the following risk factors for falling were identified (all $p < .05$): cerebrovascular disease, urinary incontinence, dizziness and imbalance, high Geriatric Depression Scale (GDS) scores, low Mini-Mental State Examination (MMSE), and The Lawton-Brody Instrumental Daily Living Activity Scale (IADL) and Barthel index (BI) for daily living activities scores. Significant correlations were found between all the assessment methods ($p < .001$).

Conclusion: There is a strong relationship between fall risk and cerebrovascular disease, urinary incontinence, dizziness and imbalance, high GDS scores, low MMSE, BADL and IADL scores in older men. Therefore, older men should be screened for these risk factors to prevent falls.

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Introduction

Falling is one of the most important health problems for older adults. According to World Health Organization data, 28–35% of people over 65 years of age fall each year, and the prevalence of falls is increasing with age. Falling can lead to injury, fracture, mobility disorders, fear of falling, dependency in daily living activities, morbidity, and mortality. Hip fractures are a common outcome from falling in older adults and 20% of patients with hip fractures die within a year (Vieira, Palmer, & Chaves, 2016). Falling is also a source of fear for caregivers. It increases the risk of institutionalization and brings economic burden (Vieira et al., 2016).

After a first fall, about 2 of 3 patients fall again within a year (Vieira et al., 2016). In order to prevent falls in older adults, it is necessary to determine risk factors and to take measures for modifiable factors in clinical practice. Intrinsic (such as cognitive deficits, gait, strength, or balance deficits, sensory impairments, chronic conditions) and extrinsic (such as medications, footwear, assistive devices) risk factors have been identified for risk of falling (Phelan, Mahoney, Voit, & Stevens, 2015). Moreover, risk factors for falls have been shown to differ between sexes (Chang & Do, 2015). Studies have reported that although falls are more common in older women than men, fatal fall rates are known to be higher among men (WHO, 2007). Fall fatality rates are reported as 31.1 and 46.2 per 100 000 in older women and men, respectively (World Health Organization, 2007). The differences in the risk factors among the sexes were attributed to the various sociodemographic, lifestyle/behavioral, and medical factors in the studies (Chang & Do, 2015). Men have more comorbidity than their female counterparts have and are less likely to seek medical assistance until their illness become more serious, which may cause delays in the prevention and treatment of diseases. In addition, men are more likely to engage in more risky physical activities (such as climbing high, ignoring the limits of their physical capacity) (World Health Organization, 2007). Additionally, differences in physical activity levels, bone mass, muscle strength, the speed of muscle contraction and other sex-specific risk factors may play a role in the differences among sexes (Stevens & Sogolow, 2005; Vereeck, Wuyts, Truijen, & Van De Heyning, 2008).

There are conflicting results in the literature regarding fall risk factors. One of the reasons for this may be differences in the methods used to determine the risk of falls (NICE, 2013). There isn't any gold standard method for identify the risk of falling (NICE, 2013). However, history of falling, Performance-Oriented Mobility Assessment (POMA), Timed Up and Go (TUG) test and 4-meter walking speed test are practical, easily applicable, cost-free clinical methods for screening falling risk in daily practice. In this study, due to the fact that falls in older men have much worse negative outcomes, we aim to identify factors that increase risk of falling in only older men by using four different clinical fall risk assessment methods.

Materials and Methods

A total of 334 men who were admitted to geriatric clinic between 06.2018–10.2018, underwent comprehensive geriatric assessment, and had no exclusion criteria, were included in this study. The investigation conformed to the Declaration of Helsinki and was approved by the local ethics committee.

Exclusion Criteria

Patients with neuromuscular disease, immobile patients, those patients who have a history of severe illness that may disrupt general health status such as acute cerebrovascular event, sepsis, acute renal failure, acute coronary syndrome, acute liver failure, and acute respiratory failure; those with a pacemaker (because of contraindication to electrical bioimpedance) and those patients who were younger than 65 years were excluded.

Patients' Characteristics

Patients self-reported their age, level of education and year, and comorbidities (hypertension, diabetes mellitus, cerebrovascular disease, depression, osteoarthritis). The Charlson Comorbidity Index, using a walking stick, and the number of the drugs used by the patients were also recorded. Five or more daily drug use was considered polypharmacy and ten or more drugs was considered hyperpolypharmacy (Unutmaz, Soysal, Tuven, & Isik, 2018). Self-reported pain, dizziness and imbalance, urinary incontinence (UI) or falls in the recent year were recorded. Orthostatic hypotension was diagnosed according to the active standing test (Aydin, Soysal, & Isik, 2017). Serum glucose, Thyroid-stimulating hormone, vitamin D, vitamin B12, folic acid levels, and glomerular filtration rates were performed to evaluate metabolic status of the patients.

Comprehensive Geriatric Assessment (Unutmaz et al., 2018)

The following assessments were used for detailed geriatric evaluation: The Mini-Mental State Examination (MMSE) used for neurocognitive assessment, The Geriatric Depression Scale (YGDS) (Durmaz, Soysal, Ellidokuz, & Isik, 2018) for emotional state assessment, The Lawton-Brody Instrumental Daily Living Activity Scale (IADL) and Barthel index (BI) for daily living activities, Mini Nutritional Assessment (MNA) for nutritional evaluation, and The Fried Frailty Index (Fried et al., 2001) for frailty evaluation. In this study for the evaluation of walking speed, muscle strength and muscle mass in patients, 4-meter walking test, handgrip test and bioimpedance were performed for each patient, respectively. Handgrip test was measured by JAMAR branded hand dynamometer, and bioimpedance was established by TANITA (MC-780U Multi Frequency Segmental Body Composition). We considered walking speed <0.8 m/s as slow walking for all cases, and low hand-grip strength was defined as the strength <30 kg. We diagnosed “Sarcopenia”, with decreased muscle strength and/or walking speed together with decreased muscle mass and, “Dynapenia” with decreased muscle strength (Bulut Ates et al., 2017).

Evaluation for Risk of Falling

A fall is defined as an event which results in a person coming to rest unintentionally on the ground or other lower level, not due to any intentional movement, a major intrinsic event or extrinsic force. To perform the TUG test, the patient is timed while they rise from an arm chair (approximate seat height 46 cm), walk at a comfortable and safe pace to a line on the floor three meters away, turn and walk back to the chair and sit down again. The subject walks through the test once before being timed to become familiar with the test (Podsiadlo & Richardson, 1991). Records of ≥ 13.5 seconds are defined as at risk of falling (NICE, 2013). We also used the Tinetti POMA Scale to assess the gait with seven components (initiation of gait, step length, step symmetry, step continuity, path, trunk and walking stance; maximum 12 points) and balance abilities of participants with nine components (sitting balance, arises, attempts to arise, immediate standing balance, standing balance, nudged, eyes closed, turning 360°, and sitting down; maximum 16 points). Each subscale was measured as abnormal = 0 or normal = 1; in some cases, adaptive = 1 and normal = 2. The maximum sum-score of both gait and balance components are 28

points. POMA total scores <19 are defined as high risk of falling (Al-Momani, Al-Momani, Alghadir, Alharethy, & Gabr, 2016; Tinetti, 1986). We instructed the patient to walk at their normal pace. Then we asked the patient to walk down a hallway through a 1-meter zone for acceleration, a central 4-meter “testing” zone, and a 1-meter zone for deceleration (the patient should not start to slow down before the 4-meter mark). We started the timer with the first footfall after the 0-meter line and stop with the first footfall after the 4-meter line. We considered walking speed below 0.8 m/s as a risk factor for falls (BCGGuidelines, 2017).

Statistical Analyzes

Analyzes of the data was carried out using the Statistical Package for the Social Sciences 22. Descriptive statistics are shown as means \pm standard deviation for continuous variables, and percentage (%) for nominal variables. The variables related to the risk of falling were adjusted for the age, education level and the living environment of the patients. The variables were modeled using several multiple logistic regression analysis. These multiple individual variable assessments are not corrected for the number of logistic regression models. Relations between the parameters indicating the risk of falling (history of falling, POMA, TUG, low walking speed) were calculated using the chi-square test and Phi-coefficients are provided. Results for $p < .05$ were considered statistically significant. The required number of samples was calculated to be at least 284 patients with an acceptable error of 5% and a 95% confidence level.

Results

In the present study, we included a total of 334 men aged 65 years and over. The mean age (SD) of the patients are 74.99 (7.26). Characteristics and comorbidities of the participants are demonstrated in Table 1. 85 (25.4%) men had a history of falling. There are 20 (5.9%) men who had falling risk according to POMA, 81 (24.2%) men according to TUG and 64 (19.1%) men according to lower walking speed.

The risk factors for falling and their odds ratios according to the history of falling, POMA, TUG and low walking speed are shown in Table 2. Cerebrovascular disease, UI, dizziness and imbalance, high GDS scores, low MMSE, BADL and IADL scores increase the risk of falling in men according to all of the four different clinical methods ($p < .05$). Also using a walking stick and frailty are related to falling risk according to POMA, TUG and Low walking speed ($p < .05$).

Hypertension, diabetes, The Charlson comorbidity index, diuretic use, body mass index, orthostatic hypotension, sarcopenia did not increase the risk of falls according to any risk assessment method ($p > .05$). There was no significant difference in laboratory tests of patients with and without fall risk ($p > .05$). We found significant relationships between all the clinical methods ($p < .001$) (Table 3).

In order to comment on these significant relationships in terms of magnitude and direction Phi coefficients were calculated as given in Table 4.

There was a weak statistically significant positive relationship between risk of falling according to fall history and each of the falling risks according to POMA, TUG and low walking speed. The relationship between risk of falling according to POMA and the risks

Table 1. Characteristics of the participants (n = 334).

CHARACTERISTICS	VALUES	CHARACTERISTICS	VALUES
Age-Mean (SD)	74.99(7.26)		
Level of education			
• Equal or less than 5 years	5.2 (%)	• More than 5 years	94.8 (%)
Living status			
• Alone	5.1 (%)	• Roommate/Caregiver	94.9 (%)
Comorbidities			
• Hypertension	54.5 (%)	• Diabetes	24.0 (%)
• Cerebrovascular disease	8.1 (%)	• Osteoarthritis	24.8 (%)
• Dementia	19.5 (%)	• Charlson comorbidity index (SD)	1.29 (1.44)
Geriatric Syndromes and Comprehensive Geriatric Assessment			
• Polypharmacy	55.7 (%)	• Hyper-polypharmacy	7.8 (%)
• Orthostatic Hypotension	36.9 (%)	• Dizziness/Dysbalance	38.9 (%)
• Urinary Incontinence	33.2 (%)	• Falls	25.4 (%)
• GDS score ≥ 5	18.8 (%)	• Frailty	17.4 (%)
• Sarcopenia	38.9 (%)	• Dynapenia	51.9 (%)
• Malnutrition	1.8 (%)	• BMI (SD)	27.03(8.61)
• BADL (SD)	92.62(12.1)	• IADL (SD)	17.89(5.88)
• MMSE (SD)	22.92 (7.1)		
Laboratory findings			
• Vitamin D (ng/mL) (SD)	25.8(10.1)	• Vitamin B12 (pg/mL) (SD)	405.7(281)
• GFR (CKD-EPI) (SD)	74.8(17.1)	• Folate (ng/mL) (SD)	9.76(4.86)

BADL: Basic Activities of Daily Living, BMI: Body mass index, GFR: Glomerular filtration rate, GDS: Geriatric depression score, IADL: Instrumental Activities of Daily Living, POMA: Performance-Oriented Mobility Assessment

according to TUG and low walking speed were moderate and the relationship between the risk of falling according to TUG and the risk of falling according to low walking speed was strong significant.

Discussion

In this prospective, cross-sectional study, it was demonstrated that the prevalence of falls in older men was 25.4%, similar to the literature (Gale, Cooper, & Aihie Sayer, 2016), and that increased risk of falling in men are related to seven clinical conditions including cerebrovascular disease, UI, dizziness and imbalance, high GDS scores, low MMSE, BADL and IADL scores. Additionally, although there were some differences between risk factors and risk rates according to the method used in risk assessment, there was a significant correlation between the four methods in determining the risk of falling.

As a geriatric syndrome, falling is of paramount significance for geriatric practice, and reported risk factors for fall so far vary according to assessment method and methodology (NICE, 2013; Vieira et al., 2016). Besides this, risk factors for falls have been shown to differ between sexes. Similarly, when we compare our results with our previous study on risk factors for falls in women, we identified different risk factors between sexes (dynapenia and multiple comorbidities for women and cerebrovascular diseases for men) in addition to common risk factors for both sexes (Dokuzlar et al., 2019). Also, in both studies, we found that comprehensive geriatric assessment were more effective than the laboratory tests those performed in these studies for determining the risk of falls. (Dokuzlar et al., 2019). Cerebrovascular disease is one of the possible risk factors related to the falling determined in this study. The older adults who have suffered a cerebrovascular event have more asymmetrical and unstable gait and are more physically inactive than others, which likely causes the increased risk of falls (Punt et al.,

Table 2. Odds ratios for falling risk factors.

	Risk of falling according to Fall history			Risk of falling according to POMA score			Risk of falling according to Timed up and go test			Risk of falling according to Lower walking speed		
	Coefficient	Odds ratio	P value	Coefficient	Odds ratio	P value	Coefficient	Odds ratio	P value	Coefficient	Odds ratio	P value
Hypertension	0.353	1.423	.192	-0.398	0.672	.414	-0.007	0.993	.981	-0.550	0.577	.071
Cerebrovascular disease	1.021	2.775	.016	2.002	7.405	.001	1.345	3.839	.003	1.292	3.641	.004
Dementia	0.442	1.556	.169	1.157	3.181	.028	0.530	1.699	.125	0.776	2.173	.026
Diabetes	-0.093	0.911	.766	-0.514	0.598	.437	0.003	1.003	.992	0.002	1.002	.995
CCI	0.120	1.127	.176	0.211	1.235	.128	0.144	1.155	.122	0.091	1.096	.343
Osteoarthritis	-0.401	0.669	.208	0.609	1.839	.225	0.628	1.875	.041	0.582	1.798	.069
Polyparmacy	0.465	1.593	.096	0.368	1.444	.489	0.710	2.035	.020	0.405	1.500	.202
Hyper-polypharmacy	0.456	1.578	.318	-0.665	0.514	.540	0.868	2.382	.073	0.996	2.708	.039
Diuretic	-0.013	0.988	.967	-0.699	0.497	.255	-0.427	0.652	.204	-0.503	0.605	.165
Orthostatic hypotension	-0.150	0.861	.617	-0.279	0.756	.604	-0.323	0.724	.309	-0.421	0.657	.225
Nocturia	0.826	2.285	.016	0.654	1.923	.329	0.646	1.907	.069	0.137	1.146	.698
Urinary Incontinence	0.903	2.468	.001	2.017	7.518	.001	1.073	2.923	<.001	1.337	3.808	<.001
Vertigo/Dysbalance	1.611	5.009	<.001	1.642	5.164	.006	1.298	3.660	<.001	1.024	2.784	.001
Walking Stick	0.375	1.455	.343	1.706	5.504	.002	2.459	11.689	<.001	1.944	6.989	<.001
Sodium	-0.025	0.975	.541	-0.065	0.937	.337	-0.052	0.949	.217	-0.044	0.957	.304
Vitamin D	0.005	1.005	.717	-0.003	0.997	.902	0.005	1.005	.717	-0.018	0.982	.226
Vitamin B12	<0.001	1.000	.435	<0.001	1.000	.824	-0.001	0.999	.191	<0.001	1.000	.681
Folate	-0.003	0.997	.947	0.056	1.058	.342	-0.027	0.973	.505	-0.046	0.955	.294
MMSE	0.821	2.274	.010	1.872	6.502	.006	1.162	3.197	<.001	1.391	4.018	<.001
GDS \geq 5	0.917	2.501	.025	3.396	29.856	.003	0.840	2.317	.041	1.609	5.000	<.001
BADL	-0.050	0.951	<.001	-0.165	0.848	<.001	-0.151	0.860	<.001	-0.124	0.884	<.001
IADL	-0.077	0.926	.001	0.044	1.045	.035	-0.153	0.858	<.001	-0.155	0.856	<.001
BMI	0.049	1.050	.120	1.084	2.957	.334	0.052	1.053	.124	0.004	1.004	.813
Malnutrition	0.016	1.016	.986	1.090	2.974	.167	2.997	20.029	.020	0.822	2.276	.416
Sarcopenia	0.016	1.017	.953	0.469	1.598	.402	0.018	1.019	.951	0.527	1.694	.106
Dynapenia	0.566	1.760	.215	1.090	2.974	.167	1.217	3.376	.034	0.668	1.950	.320
Frailty	0.506	1.659	.131	-0.107	0.898	<.001	1.464	4.322	.002	2.504	12.235	.001

BADL: Basic Activities of Daily Living, BMI: Body mass index, CCI: Charlson comorbidity index, GDS: Geriatric depression score, IADL: Instrumental Activities of Daily Living, POMA: Performance-Oriented Mobility Assessment *All data are adjusted for age, education level and living environment

Table 3. Chi-square test of association between the variables.

	Risk of falling according to Fall history	Risk of falling according to POMA	Risk of falling according to Timed Up and Go test
Risk of falling according to POMA	17.540 ($p < .001$)		
Risk of falling according to Timed Up and Go test	23.066 ($p < .001$)	57.965 ($p < .001$)	
Risk of falling according to Low Walking Speed	4.590 ($p:0.032$)	59.532 ($p < .001$)	97.745 ($p < .001$)

Table 4. Phi coefficients between the variables.

	Risk of falling according to Fall history	Risk of falling according to POMA	Risk of falling according to Timed Up and Go test
Risk of falling according to POMA	0.229 (<0.001)		
Risk of falling according to Timed Up and Go test	0.263 (<0.001)	0.417 (<0.001)	
Risk of falling according to Low Walking Speed	0.117 (0.032)	0.422 (<0.001)	0.541 (<0.001)

2016). Other gait and balance disorders are also important intrinsic risk factors that increase the risk of falling (Phelan et al., 2015). For example, self-reported dizziness and imbalance are a subjective sensation that can be caused by various factors and have increasing prevalence with advancing age (Kollén, Hörder, Möller, & Frändin, 2017). Although dizziness and imbalance are less common in males than females (Kollén et al., 2017), the prevalence in the present study was 30%. We determine that dizziness and imbalance are associated with an increase in the risk of falling according to all four clinical methods. Both symptoms lead to an increase in the risk of falling and a limitation of ADL (Kollén et al., 2017), and this restriction of ADL may increase due to fear of falling in older men.

Gait and balance, disturbances and weakness are among the major components of physical frailty (Kojima, 2015). Frailty was determined as a possible fall risk factor for older men in this study. The effect of frailty on the risk of falling is multifactorial. In older adults, multiple comorbidities may be a single risk factor for frailty. However, this is often accompanied by polypharmacy and older adults are vulnerable to the adverse effects of the drugs (Kojima, 2015). In addition, when they encounter such conditions as accidents, the functional reserve capacities are not enough to prevent falls by providing balance, position, and coordination (Kojima, 2015). It has been shown that frailty increases the risk of falling in men more than women. This is explained by many factors related to older men such as, physical components, lifestyle, different behavior patterns, physically activity, and a relatively higher center of gravity (Kojima, 2015). Older adults often use walking aids to assist their balance and mobility. Although the use of a walking aid is protective against falling, a significant relationship between risk of falling and using a walking aid was found in the present study. This is explained by the underlying reasons of gait and balance problems, and the use of a walking aid related improvement in mobility of the patients (Costamagna et al., 2017).

Gait is a complex process organized with high cognitive functions as well as motor and sensory systems (Muir, Gopaul, & Montero Odasso, 2012). It was found that especially executive functions were important in the control of gait and balance, and many older adults could not perform dual tasks such as walking and talking at the same time (Bridenbaugh &

Kressig, 2015). Gait and balance disturbances are the main causes of falls (Bridenbaugh & Kressig, 2015). As compatible with this information, the decrease in MMSE scores was found to be related to falling risk according to all four assessment tools in our study. However, while dementia was associated with risk of falling according to POMA and walking speed, it was found that it did not increase the risk of falling according to TUG and fall history. The reason is that although TUG may seem like a simple test, it requires the integration of many systems such as attention, memory, and execution functions, and therefore it has been shown that TUG is not an appropriate test to assess patients with dementia (Ibrahim, Singh, & Shahar, 2017). In addition, history of fall does not seem to be appropriate for the evaluation of these patients because of the difficulty in recalling whether or not they fell. Another factor that leads to cognitive impairment and falling is depression (Anstey, Burns, Von Sanden, & Luszcz, 2008; Liao et al., 2017). In the present study, a significant association between low GDS scores and fall risk in older men was found this finding is in accordance with the wider literature. This may be due to poor concentration and reduction in energy levels, worse self-monitoring, and worse chronic disease management seen in those with depression (Anstey et al., 2008). On the other hand, studies show a decrease in executive functions, attention, and processing speed in older adults with depression (Liao et al., 2017). It is also known that the drugs used in the treatment of depression are also important in increasing the risk of falling (Anstey et al., 2008).

BADL and IADL are the tools that reflect the patient's functional capacity as well as cognitive status (Weiss, Mirelman, Buchman, Bennett, & Hausdorff, 2013), which are risk factors for falls (Phelan et al., 2015). In older men, as compatible with the literature, the decrease in BADL and IADL are factors that increase the risk of falling in this study (Langlois et al., 1995; Weiss et al., 2013). In a previous study, individuals without mobility disability but with IADL disability had difficulties with turns, had lower yaw amplitude during turns, were slower and had less consistent gait (Weiss et al., 2013). Cognitive impairment, another factor that led to a decline in IADL, is another risk factor for falls. Another risk factor for falls in older men, according to the all four methods, is UI which has an increasing prevalence with advancing age. It is a risk factor for falls and often hidden. In men, especially over-active bladder induced incontinence is highly associated with falls. This suggests that UI leads to a fall due to sudden movements other than a daily routine to reach the toilet (Noguchi et al., 2016; Soliman, Meyer, & Baum, 2016).

The strengths of this study are the sample size which is sufficient enough to define sex-specific risk factors in older men, and the use of four different fall risk assessment methods. Thus, falling history, balance, walking, and walking speed were evaluated and possible differences between these clinical methods were identified. One of the limitations of this study is retrospective design. Second, fear of falling could not have been assessed. Third, cutoff points of some instruments used in this study varies in the literature, but we used the common cut points based on the literature.

Falling is a factor that leads to negative health outcomes and limits the quality of life in older men. It also negatively affects the caregivers and health-care systems. In the present study, it was demonstrated that seven risk factors, including cerebrovascular disease, urinary incontinence, dizziness and imbalance, high GDS scores, low MMSE, BADL and IADL scores, are related to the increased risk of falling via four different clinical methods in older men. In order to avoid the negative consequences of the falls, sex-specific fall risk factors should be identified and modified.

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