ORIGINAL RESEARCH

Bagcilar Med Bull 2021;6(2):198-203
DOI: 10.4274/BMB.galenos.2021.03.034

Sarcopenia and Balance in Community-dwelling Women with Postmenopausal Osteoporosis

Toplumda Yaşayan Postmenopozal Osteoporotik Kadınlarda Sarkopeni ve Denge

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Abstract

Objective: Sarcopenia and osteoporosis share common risk factors and biological pathways. In the present study, patients with postmenopausal osteoporosis were screened for sarcopenia using the algorithm proposed by the European Working Group on Sarcopenia in Older People (EWGSOP) and balance impairment was investigated in sarcopenic patients.

Method: Fifty three postmenopausal osteoporotic patients were evaluated for sarcopenia as per the algorithm proposed by the EWGSOP. Among the parameters included in the algorithm, gait speed was assessed using the timed up&go test (TUG), Jamar hand dynamometer was used to measure grip strength and calf circumference (an anthropometric method) was used for the measurement of muscle mass. Balance was assessed using the Berg balance scale and functional abilities using the TUG.

Results: Fifty three postmenopausal patients with osteoporosis with a mean age of 65.48±9.12 years (range 47-84) were enrolled in the study. Sixteen patients (30.2%) reported a fall within the previous year, 22 patients (41.5%) had a history of fracture and 17 patients (32.1%) had maternal history of hip fracture. Sarcopenia was present in 8 (15.1%) patients. There was no significant difference between balance measurements of sarcopenic and non-sarcopenic patients ($p>0.05$). Only muscle mass showed a positive weak correlation and a significant association with balance ($r=0.28$, $p<0.05$).

Conclusion: Despite low rate of balance impairment, most of our patients had a history of fracture. Balance is not the only risk factor for falls in postmenopausal patients. The use of anthropometry as a screening tool and usage of more objective methods for definitive diagnosis provide more accurate data for the measurement of muscle mass.

Keywords: Balance, osteoporosis, postmenopausal, sarcopenia

Öz

Amaç: Sarkopeni ve osteoporoz, ortak risk faktörlerini ve biyolojik yolları paylaşır. Bu çalışmada postmenopozal osteoporozlu hastalar, Avrupa Yaşlılarda Sarkopeni Çalışma Grubu (EWGSOP) tarafından önerilen algoritma kullanılarak sarkopeni açısından tarandı ve sarkopenik hastalarda denge bozukluğu araştırıldı.

Yöntem: Elli üç postmenopozal osteoporotik hasta, EWGSOP tarafından önerilen algoritmaya göre sarkopeni açısından değerlendirildi. Algoritmada yer alan parametrelerden yürüme hızının değerlendirilmesinde zamanlı kalk&yürü testi (ZKY), kavrama gücü ölçümünde Jamar el dinamometresi ve kas kütlesi ölçümünde baldır çevresi (cm) kullanıldı. Denge, Berg denge ölçeği ve fonksiyonel yeterlilik ZKY kullanılarak değerlendirildi.

Bulgular: Ortalama yaşı 65,48±9,12 (47-84) yıl olan 53 postmenopozal osteoporoz hastası çalışmaya alındı. On altı hasta (%30,2) bir önceki yıl içinde düşme bildirdi, 22 hastada (%41,5) kırık öyküsü ve 17 hastada (%32,1) annede kalça kırığı öyküsü vardı. Sekiz (%15,1) hastada sarkopeni saptandı. Sarkopenik ve sarkopenik olmayan hastaların denge ölçümleri arasında anlamlı bir fark bulunmadı ($p>0,05$). Sadece kas kütlesi denge ile pozitif zayıf bir korelasyon ve anlamlı bir ilişki gösterdi ($r=0,28$, $p<0,05$).

Sonuç: Sarkopenik hastaların oranı çok düşük saptandı ve sarkopenik hastalarda denge bozukluğu anlamlı değildi. Sarkopeni taramasında kas kütlesinin ölçümü için antropometrik ölçümler yerine daha objektif yöntemlerin kullanılması, daha doğru veri sağlayacaktır.

Anahtar kelimeler: Denge, osteoporoz, postmenopozal, sarkopeni

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Cite this article as: Doğruöz Karatekin B, Yasin Ş, Yumuşakhuylu Y, Bayram F, İçağasioğlu A. Sarcopenia and Balance in Community-dwelling Women with Postmenopausal Osteoporosis. Bagcilar Med Bull 2021;6(2):198-203

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Introduction

Osteoporosis is an important public health problem concern due to aging of the global population (1). In the recent FRACTURK study, the prevalence of osteoporosis at the femoral neck in women over the age of 50 years was reported to be 33.3% in Turkey (2).

Postural control is the natural ability to maintain the center of gravity of an individual within the base of support (3). Postural imbalance is common in older women with osteoporosis, who also have an increased tendency to fall (4,5).

Sarcopenia is characterized by progressive reduction in muscle strength and fat-free mass with advancing age (6). Although the negative effects of reduced muscle mass and strength on function and autonomy in geriatric population have been recognized, there have been no clear criteria for the classification of sarcopenia until recently. Thus, the European Working Group on Sarcopenia in Older People (EWGSOP) was established to formulate a common definition of sarcopenia (6). A recent systematic review and meta-analysis showed that the EWGSOP classification was associated with reduced physical function and high mortality (7). The prevalence of sarcopenia in people living in nursing home aged over 65 years in Turkey was reported to be 29% (8).

Sarcopenia and osteoporosis share common risk factors and biological pathways and are associated with physical disability resulting in the loss of independence in advanced age (9).

There is evidence to suggest that both muscle strength and muscle mass are related to the risk of falls. However, a limited number of studies are available on the association between sarcopenia defined by the EWGSOP and osteoporosis and balance impairment (10).

In the present study, patients with postmenopausal osteoporosis were screened for sarcopenia using the algorithm proposed by the EWGSOP. The timed up&go (TUG) and calf circumference, which are easy to use and uncostly parameters for clinic practice, were chosen as parameters and tested for suitability, and balance impairment was investigated in sarcopenic patients.

Materials and Methods

The study was conducted in 53 community-dwelling older women with postmenopausal osteoporosis, who presented to a tertiary care hospital's physical medicine and rehabilitation, osteoporosis outpatient clinic between January and April 2019. Patients diagnosed with secondary osteoporosis, patients with malignancy, inflammatory joint disease, diabetes mellitus, neuromuscular disorder, generalized cardiovascular disease, and thyroid/parathyroid dysfunction, and those using antiepileptics, steroids, anticoagulants and antiandrogenic medications were excluded. Out of 70 patients, 10 were excluded from the study because of inflammatory joint diseases, 5 because of inability to walk, and 5 because of multiple comorbidities (diabetes mellitus, thyroid disease, cardiovascular disease). And, the study was conducted with 53 patients. This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of our university (decision no: 2018/0235) and the study is registered in clinicaltrials.gov (NCT03832088). Patients were evaluated for sarcopenia as per the algorithm proposed by the EWGSOP after they gave written informed consent (Figure 1).

Among the parameters included in the algorithm, gait speed was assessed using the TUG, Jamar hand dynamometer was used to measure grip strength, and calf circumference (an anthropometric method) was used for the measurement of muscle mass. These parameters were chosen because they were easy to use, cheap and practical.

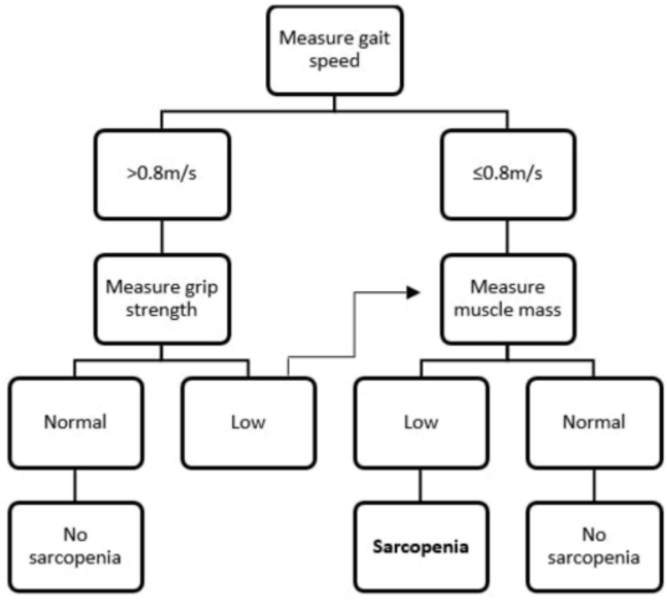

Figure 1. EWGSOP-suggested algorithm for findings of sarcopenia case (6)

EWGSOP: European Working Group on Sarcopenia in Older People

TUG is commonly used in geriatrics clinics for assessing functional mobility. TUG has been shown as a sensitive and specific measurement assessing the risk of falling (11). Grip strength is shown to be used as diagnostic component in frailty (12) and sarcopenia (13).

Decreased calf circumference can reflect a decrease in muscle mass with limited physical activity. Recently, calf circumference measurement has been validated and result of more than 33 cm for females and 34 cm for males is considered as normal (14). Calf circumference was measured with inelastic tape in standing position, at the maximum circumference in the plane perpendicular to the longitudinal line of the calf. Three measurements were performed to obtain the average of three measurements.

Balance was assessed using the Berg balance scale (BBS), a 14-item scale designed to measure balance of an older adult in a clinical setting. Total score was 56. score of 41-56 indicated low fall risk, 21-40 indicated medium fall risk, and 0-20 indicated high fall risk. A cut-off score of 45/56 was supported for independent safe ambulation (15).

Other clinical parameters, including age, body mass index (BMI), 25-hydroxy-vitamin D level, menopausal age, history of falls within the previous year, history of fracture and maternal history of hip fracture, were also evaluated.

Statistical Analysis

All statistical analyses were performed using the SPSS Statistics Version 25.0 software package (IBM, Chicago, IL). Descriptive statistics were presented as mean ± standard deviation and minimum-maximum values for continuous variables. Frequencies (number of cases) were provided with their percentages for categorical variables. Pearson r correlation analysis was used to test the level of correlation between two continuous variables if normality assumptions were met and Spearman rho correlation analysis if not. The size of the effect was interpreted based on the Cohen's classification (1988), where a correlation coefficient between 0.10 and 0.29 indicated a weak association, a correlation coefficient between 0.30 and 0.49 represented a moderate association and a correlation coefficient between 0.50 and 1.0 represented a strong association. Since normality assumptions were not met due to the number of patients with or without sarcopenia, the Mann-Whitney U test was used for continuous variables and chi-square test for categorical variables when comparing the two groups. For all analyses, the statistical significance was set at 0.05.

Results

A total of 53 postmenopausal patients with osteoporosis with a mean age of 65.48±9.12 years (range 47-84) were enrolled in the study. The mean menopausal age of the patients was 49.09±5.57 years (range 32-57). Sixteen patients (30.2%) reported a fall within the previous year. Among 53 patients, 22 (41.5%) had a history of fracture and 17 (32.1%) had maternal history of hip fracture.

Patients had a mean BMI (n=50) of 26.97±5.06 kg/m^2 (16.60-43.60). Based on BMI values, 1 (2%) patient was lean, 18 (36%) patients had normal weight, 18 (36%) were overweight, 11 (22%) had class I obesity and 2 (4%) had class II obesity. Vitamin D status was determined and the average vitamin D concentration was found to be 23.84±12.43 ng/mL (6.60-56.80). According to their vitamin D status, 20 (41.7%) patients had vitamin D deficiency, 17 (35.4%) had vitamin D insufficiency, and 11 (22.9%) had normal vitamin D levels.

Sarcopenia screening was conducted using the algorithm suggested by EWGSOP and patient assessment included the measurements of 3 parameters. Gait speed was evaluated with the TUG test, muscle strength with Jamar hand dynamometer and muscle mass with the calf circumference measurement. Thus, sarcopenia was present in 8 (15.1%) patients and absent in 45 (84.9%) patients. The relationship between sarcopenia and balance was investigated and no significant difference was found between balance measurements of sarcopenic and non-sarcopenic patients (Table 1).

Additionally, correlations of balance with diagnostic variables of sarcopenia (balance and gait speed, muscle strength and muscle mass) were examined (Table 2). Statistically, only muscle mass showed a positive weak correlation and a significant association with balance.

Table 1. Summary of descriptive statistics for balance measurements and results of Mann-Whitney U test

Sarcopenia	Balance					
	n	Mean ± SD	Minimum	Maximum	U	p
Yes	8	51.50±4.20	44.00	55.00	172.00	0.84
No	45	51.31±4.70	39.00	56.00		

SD: Standard deviation

In order to examine whether sarcopenia was associated with other clinical parameters, the difference in clinical data between sarcopenic and non-sarcopenic patients was analyzed using the Mann-Whitney U test for continuous variables and the chi-square test for categorical variables. Among all continuous variables, a between-group difference was observed only for BMI values. Non-sarcopenic patients had significantly greater BMI values (27.75±4.98 kg/m^2) versus sarcopenic patients (22.89±3.71 kg/m^2) (U=71.5, p<0.05). No statistically significant differences were found for other variables.

Correlations among the measures of diagnostic variables of sarcopenia (balance and gait speed, muscle strength and muscle mass) and other variables were also analyzed. Table 3 presents the continuous variables and correlation levels.

Whether there was any difference between sarcopenic and non-sarcopenic patients in terms of diagnostic variables of sarcopenia (balance and gait speed, muscle strength and muscle mass) was analyzed by evaluating the difference among respective values of the variables. The results revealed that gait speed and muscle strength values were not significantly different between sarcopenic and non-sarcopenic patients but muscle mass values were significantly greater in non-sarcopenic patients than in sarcopenic patients (Table 4).

The correlation between the BBS scores and 10-year risk of a major fracture or hip fracture was investigated using the Spearman rho coefficients of correlation. The findings showed that BBS scores were not correlated with 10-year risk of a major fracture or 10-year risk of a hip fracture. In addition, the relationship of balance with other clinical data of patients was examined and a moderate negative correlation was found between age and balance (n=52, rho=-0.39, p<0.01).

Discussion

Sarcopenia is a syndrome characterized by generalized progressive loss of muscle mass and muscle strength that is associated with consequences like physical disability, poor quality of life, and death (13). Sarcopenia occurs with the interaction of many factors. In addition to aging, female gender, muscle development in younger ages and basal muscle mass, nutritional disorders, physical inactivity,

Table 2. Spearman rho correlations among balance, gait speed, muscle strength and muscle mass

Variables	Balance	Gait speed	Muscle strength	Muscle mass
Balance	1.00	-0.19	-0.04	0.28*
Gait speed	-	1.00	0.06	-0.24
Muscle strength	-	-	1.00	0.09
Muscle mass	-	-	-	1.00

*p<0.05

Table 3. Spearman rho correlations among diagnostic variables of sarcopenia and other variables

	Age (n=52)	Menopausal age (n=46)	BMI (n=50)	L1-4 (n=52)	L2-4 (n=52)
Gait speed	0.35*	-0.29*	0.02	-0.22	-0.19
Muscle	0.07	0.07	0.74**	0.36**	0.31*
Mass muscle strength	-0.40**	0.275	-0.01	-0.15	-0.20

*p<0.05, **p<0.0, BMI: Body mass index

Table 4. Results of Mann-Whitney U test based on sarcopenia

Variables	Sarcopenia	n	Mean ± SD	Minimum	Maximum	p
Gait speed	Yes	8	9.59±2.21	6.26	12.83	0.98
	No	45	9.72±2.20	4.75	16.65	
Muscle mass	Yes	8	30.13±1.46	27.00	31.00	<0.001
	No	45	36.63±3.05	32.00	46.00	
Muscle strength	Yes	8	30.63±11.48	45.00	30.63	0.74
	No	45	33.29±13.55	5.00	80.00	

SD: Standard deviation

vitamin D deficiency, and comorbid chronic diseases play a role in the development of sarcopenia. In 2017, the prevalence of sarcopenia in the age group of 60-69 years in Turkey was found to be 15.4% (16). The rate of sarcopenia in our study was consistent with these data.

A vicious circle begins in elderly individuals, contributing to sarcopenia and osteoporosis. This vicious cycle begins with a decrease in physical performance and loss of balance, continues with the fear of falling and consequently avoiding physical activity, resulting in a further increase in osteoporosis and sarcopenia (17). A recent study has reported that the incidence of sarcopenia and osteoporosis is very high, and osteoporosis treatment is shown to gain favor not only for osteoporosis itself but also for the sarcopenia clinic (18).

The musculoskeletal system has an important contribution to the maintenance of balance. Muscle weakness is one of the major factors for the loss of balance, so the maintenance of balance becomes challenging in sarcopenia. Although it is not known whether it is a cause or effect in osteoporosis, the relationship between decreased muscle strength and bone mineral density has been shown (19). Although no significant relationship between muscle strength and BMD was detected in our study, a correlation between lumbar BMD and muscle mass was found.

Several studies have reported impaired postural balance in osteoporotic and sarcopenic patients (19-22). However, there are other studies demonstrating otherwise (23,24). Balance impairment was found at a rate of 1.9% in our study sample. However, although BBS scores yielded this rate of balance impairment, 30.2% of our patients had a history of fall within the previous year and 41.5% had a history of fracture. Many intrinsic and extrinsic factors contribute to the increased risk of falls. Risk factors accumulate with age and also, aging is an independent risk factor for falls. The increased risk of falls among our patients may be explained by other risk factors.

Balance was investigated using the BBS in our study and the BBS was not found to effectively predict the risk of falls or fracture. It can be considered that the threshold BBS scores may not be applicable for Turkish population.

A recent study has showed that task items in BBS are not challenging to discriminate less severe balance disorders and are less useful for detecting balance and falling risk in community dwelling older adults (25). Schaubert and Bohannon (25) also examined the BBS and showed that most of the items were considered as easy to perform by geriatric population since they obtained high scores. Only a few items, such as putting one foot in front of the other and standing on one foot, caused some difficulties for older subjects and this is consistent with our findings.

Participants' 25-hydroxy-vitamin D levels were measured during winter. Participants were selected from the patients who came to the outpatient clinic for annual postmenopausal osteoporosis follow-up. Last controls of the patients were 1 year ago and therefore, most of them did not take vitamin D supplements for a long time. This may be one of the reasons for the high rate of vitamin D insufficiency and deficiency (58.3% in total).

Grip strength was reduced in 94.1% of our patients but despite this high rate of diminished muscle strength, sarcopenia was present at a relatively low rate (15.1%).

Anthropometric measurements offer convenience and cost-effectiveness, and provide fast results but their reproducibility is low. While calf circumference was reported to be correlated with muscle mass in the literature (26,27), fat deposits and loss of skin elasticity in the elderly due to aging make it difficult to obtain accurate measurements. Since the average BMI value was high in our sample, the mean calf circumference values were also high. The reason for the low number of patients with sarcopenia detected by the sarcopenia screening algorithm in our study was resulted from high muscle mass values of the patients. This might have affected our findings.

Study Limitations

The sample size of our study was relatively small. Studies with a higher number of patients may yield significant results. The study was carried out in a single center and the results cannot be generalized. Although the diagnosis of sarcopenia by anthropometric measurement is not recommended, it may serve as a screening tool. Calf circumference was used as an anthropometric measurement in our study. However, it should be considered that the calf circumference is high in obese patients and may cause false results. It is also recommended to include non-osteoporotic sarcopenic patients as a group in future studies.

Conclusion

The rate of sarcopenia in our sample was very low and balance disorder was not significant in sarcopenic patients. We believe that for the purpose of sarcopenia assessment, calf circumference may be useful in measuring muscle mass as a screening criterion. Bioelectric impedance analysis or dual energy X-ray absorptiometry should be used for

definitive diagnosis as they provide more accurate data for the measurement of muscle mass.

Ethics

Ethics Committee Approval: This study was approved by the university Ethics Committee on June 27, 2018 (decision no: 2018/0235).

Informed Consent: All participants signed an informed consent form prior to the study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: B.D.K., Ş.Y., A.İ., Design: B.D.K., A.İ., F.B., Y.Y., Data Collection or Processing: B.D.K., F.B., Ş.Y., Y.Y., Analysis or Interpretation: B.D.K., A.İ., Y.Y., Literature Search: B.D.K., F.B., Ş.Y., Writing: B.D.K., A.İ.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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