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Original Article GERIATRICS

Sarcopenia, but not malnutrition, is associated with fear of falling in older patients with dementia

Saadet Koc Okudur,[1] Lee Smith,[2] Semen Gokce Tan,[3] Veliye Yigitalp,[3] Pinar Soysal[3]

[1]Department of Geriatric Medicine, Manisa State Hospital, Manisa, Turkiye

[2]The Cambridge Centre for Sport and Exercise Science, Anglia Ruskin University, Cambridge, UK

[3]Department of Geriatric Medicine, Bezmialem Vakif University, Faculty of Medicine, Istanbul, Turkiye

ABSTRACT

OBJECTIVE: Fear of falling (FoF) is common in patients with cognitive impairment. However, the role of sarcopenia and malnutrition, which are two important factors that cause falls, on FoF is unknown. The aim of this study was to explore the association between FoF and malnutrition and sarcopenia in older patients with dementia.

METHODS: Two hundred and sixty-six dementia patients underwent comprehensive geriatric assessment. The Falls Efficacy Scale–International (FES-I) was applied to assign and classify FoF. Scores for the FES-I scale were categorized as ≥28, 20–27, or 16–19, representing high concern, moderate, and no or low concern about FoF, respectively. Mini Nutritional Assessment (MNA) scores <17, 17–23.5, or >23.5 were categorized as malnutrition, malnutrition risk, and well-nourished, respectively. Sarcopenia was defined using the SARC-F tool. SARC-F score ≥4 was categorized as sarcopenia. Serum folate, Vitamin B12, and Vitamin D deficiencies were also evaluated. The relationship between FoF groups and nutritional status, presence of sarcopenia, and micronutrient status was evaluated.

RESULTS: The mean age was 80.83±6.61 years. The prevalence of moderate and high FoF in dementia patients was 51%. There was a significant difference in terms of cerebrovascular events, the history of falling, instrumental and basic activities of daily living (IADL and BADL), MNA, and SARC-F scores between the FoF groups ($p<0.05$). The association between sarcopenia and FoF persisted in multivariable analysis adjusted for MNA scores, cerebrovascular events, falls history, BADL, and IADL (OR=2.67, 95% CI: 1.50–4.50), but there was no significant association between malnutrition/micronutrient deficiencies and FoF ($p>0.05$).

CONCLUSION: Sarcopenia is associated with the severity of FoF, but malnutrition or micronutrient deficiencies are not associated with the severity of FoF in older patients with dementia.

Keywords: Dementia; fear of falling; malnutrition; older adults; sarcopenia.

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Dementia is a geriatric syndrome characterized by progressive cognitive decline that prevents the ability to function independently [1]. Dementia patients fall more often than cognitively healthy older adults, but the risk factors are not fully understood [2]. Fear of falling (FoF), a major cause of falls with or without dementia, is a potential consequence of previous falls that can limit the functionality of older individuals [3]. FoF has been found to be associated with multiple poor clinical outcomes in older adults, for example, limitation in physical activity [4], impairment in functionality [5], and cognitive disorder [6]. Literature on the relationship between cognitive impairment and FoF has increased significantly over recent years. This literature suggests that the pres-

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Correspondence: Pinar SOYSAL, MD. Bezmialem Vakif Universitesi, Tip Fakultesi, Geriatri Anabilim Dali, Istanbul, Turkiye.
Tel: +90 212 453 17 00 e-mail: dr.pinarsoysal@hotmail.com

ence of FoF increases the risk of developing dementia, while impairment in cognitive functions may increase the incidence of FoF [7, 8]. It is likely that the association between cognitive disorder and FoF is bidirectional.

Malnutrition and sarcopenia, two prevalent geriatric syndromes, that are also common in dementia patients, are associated with cognitive impairment and increased FoF. A cross-sectional study found that sarcopenia increased FoF in older patients, but this study was conducted in patients >65 years old without cognitive impairment [9]. In another study, conducted in cognitive intact elderly patients, FoF and fear-related activity restriction were found to increase sarcopenia by 8.1 times [10]. A limited number of studies exist examining associations between FoF and nutritional disorders including malnutrition and micronutrient deficiencies. In one study, it was found that the risk of FoF was 1.2 times higher in the elderly with malnutrition risk [11]; however, the study was conducted in patients without cognitive impairment.

Our hypothesis in this study is that malnutrition and sarcopenia, which cause falls, will increase FoF in elderly dementia patients. Therefore, this study aims to explore the association between FoF and malnutrition and sarcopenia in elderly dementia patients.

Highlight key points

- A limited number of studies exist examining associations between fear of falling (FoF) and sarcopenia or nutritional disorders in dementia.
- One out of two older patients with dementia have a moderate to high fear of falling (FoF).
- Sarcopenia is associated with the severity of FoF in older patients with dementia.
- Malnutrition or micronutrient deficiencies were not associated with FoF in older patients with dementia.

MATERIALS AND METHODS

Two hundred and sixty-six outpatients who were ≥65 years of age and admitted to one geriatric outpatient clinic in Turkey between January 2019 and April 2021 were included. Exclusion criteria were as follows: Acute severe events that may impair the results of geriatric assessment tests (including acute renal failure, acute cerebrovascular events, acute respiratory failure, sepsis, malignancy conditions, and terminal disease), taking medication for sleep disorders, taking nutritional supplements for micronutrient deficiencies or malnutrition, severe dementia, severe vision, and hearing impairment (these situations may prevent communication and understanding commands during the examination). Furthermore, patients with active malignancy, advanced chronic heart failure, stage 4 or 5 chronic kidney diseases, advanced liver disease, uncontrolled diabetes mellitus with complications, heavy alcohol consumption (>60 g/day), and chronic use of steroids were excluded from the study. Patients whose comorbidities were not clearly known were excluded. Mild and moderate dementia patients were included in the study and evaluations were carried out by questioning the patients' caregivers. Comorbid diseases, and medications, were recorded by questioning the patient's close relatives. All patients without exclusion criteria were included in the study. The present study was cross-sectional in nature. The study was designed prospectively. Patients who were suitable for the study design and whose file records were not missing were also included in the study retrospectively. The study was approved by the Bezmialem Vakif University Ethics Committee (Date: August 25, 2020, Number: 14/298). The study was conducted by the Declaration of Helsinki. Comprehensive geriatric assessment (CGA) tests were performed during the outpatient visit [12]. Informed consent was taken from each patient and the patients' relatives/caregivers for participation.

Demographic characteristics (age, gender, years of education, marital, and living status) number of medications, and comorbidities were recorded. Information on patients' chronic diseases and medication use were retrieved from close relatives or caregivers of the patients and previous health records were checked from the hospital and the general health record system. Patients were questioned in terms of recurrent falls (≥1 falls/year) within the past year. Nocturia was recorded and was defined as "the complaint that the person has to wake up at night ≥1 times for voiding" according to the International Continence Society. Patients were questioned for the presence of dizziness symptoms (vertigo, presyncopal lightheadedness, and disequilibrium) [13]. Barthel Index and Lawton-Brody Scale were performed for evaluating the functionality of the patients, respectively.

Dementia Diagnosis

A geriatrician performed neurocognitive assessment tests and evaluated each participant's activities of daily living over the past years. MMSE was applied to all patients

for neurocognitive evaluation. Dementia was diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders (fifth edition) diagnostic criteria. For all patients with dementia, further evaluations, such as brain imaging are also performed.

Anthropometric Measurements

The calf circumference of all patients was measured using a millimeter-graded tape with patients in the supine position, with the left knee raised and the calf at a right angle to the thigh. Body height and weight were measured using a stadiometer and a digital floor scale, respectively. Body mass index (BMI) was calculated using kg/m^2.

The Falls Efficacy Scale–International (FES-I)

FES-I was applied to assign and classify FoF. The scale has 16 questions and 1–4 points are granted to each question. Total FES-I scores range from a minimum of 16 (no concern about falling) to the highest score of 64 (severe concern about falling). Scores for the FES-I scale were categorized as ≥28, 20–27, or 16–19, representing high concern, moderate, and no or low concern about FoF, respectively [14, 15]. Previous studies showed that FES-I was valid and reliable to detect FoF in older patients with and without cognitive impairment [16, 17]. However, patients with severe dementia were excluded from the present study because the FES-I scale has only been validated among patients with mild and moderate dementia [16].

Evaluation of Sarcopenia

The SARC-F is a 5-item simple and rapid screening tool for sarcopenia and potential scores range from 1 to 10. A score ≥4 is predictive of sarcopenia and negative clinical outcomes [18]. We used SARC-F to detect sarcopenia. SARC-F sensitivity and specificity are 33.7% and 93.7%, respectively [19].

Evaluation of Nutritional Status

Mini Nutritional Assessment (MNA) was performed on all the patients even if their MNA-short form scores were more than 12 to assess the nutritional status of the participants. The total MNA scores <17, 17–23.5, or >23.5 were categorized as malnutrition, malnutrition risk, and well-nourished, respectively. The MNA test consists of evaluating the following anthropometric measurements (BMI, weight loss, calf circumference, and brachial circumference); global evaluation (6 questions about a number of drugs, mobility, and lifestyle); and dietary and subjective evaluation (8 questions about a number of meals, fluid, and food intake, self-perception of health and nutrition autonomy of eating) [20].

Folate, Vitamin B12 and Vitamin D Assessment

Blood samples were drawn after at least 8 h of fasting to assess the biochemical confirmation of insufficient intake and the metabolic status. Folate and Vitamin B12 levels of the patients were determined in serum with a homogenous chemiluminescent immunoassay using Beckman–Coulter, Woerden, the Netherlands. These biochemical tests were carried out on a Diagnostic Modular Systems autoanalyzer (Beckman Coulter DXD 800). All the blood samples were measured fresh. The inter-assay variation was 5.4% for folate and 4.7% for Vitamin B12. Folate deficiency was defined as <3 ng/mL [21]. Serum Vitamin B12 deficiency was defined as <200 pg/mL [22]. The blood samples were centrifuged within an hour and the sera were stored at −20 °C for analysis of Vitamin D using a radioimmunoassay method. Serum Vitamin D deficiency was defined as <30 ng/mL [23].

Statistical Analyses

All patients were evaluated according to the FES-I scale and divided into three groups: High, moderate, and low concern about FoF. These three groups were compared through statistical analyses. The Kolmogorov–Smirnov test was used for the continuous variables with a normal distribution. Paired sample t-test was used for the continuous variables with a normal distribution. Groups were compared for means using the Mann–Whitney U test for the continuous variables with a non-normal distribution. For comparisons between proportions, Chi-squared tests or Fisher's exact test were used, as appropriate. Univariate, adjusted for age, and multivariable-adjusted regressions were performed to evaluate the association using logistic regression (OR and 95% CI) for other outcomes. A p=0.05 was considered to be statistically significant. All statistical analyses were performed using Statistical Package for the Social Sciences 22.0 version (IBM Corp., Armonk, NY, USA). The required number of samples was calculated to be at least 207 patients with an acceptable error of 5% and 95% confidence level.

RESULTS

Of the 266 patients, the mean age was 80.83±6.61 years and 66.2% were female. A total of 266 participants were included in the study, 49%, 22%, and 29% were in the low FoF, moderate FoF, and high FoF groups, respectively. We presented the demographic and clinical characteristics of the study population as shown in Table 1. Among these groups, significant differences were found for cerebrovascular events, falling history in the last year, basic activities of daily living (BADL), ınstrumental activities of daily living (IADL), MNA, weight loss, and SARC-F scores ($p<0.05$). However, there was no significant difference in terms of age, gender, education, living or marital status, comorbidities except cerebrovascular events, the presence of nocturia and dizziness, number of drugs used, MMSE, and BMI ($p>0.05$). Since there was no statistically significant difference between the age distributions of the FoF groups, statistical analysis was not required according to a certain age range. In addition, there was no significant difference between the groups in terms of serum folate, Vitamin B12, and Vitamin D deficiencies ($p>0.05$).

Sarcopenia prevalence was 68.8%, malnutrition prevalence was 22.9%, and risk of malnutrition prevalence was 51.9%. While the prevalence of sarcopenia increased from the low FoF group to the high FoF group, the number of those with normal nutritional status decreased ($p<0.05$).

Logistic regression analysis was carried out. The association of FoF with sarcopenia and malnutrition is shown in Table 2. In the univariate analysis, FoF was associated with both malnutrition and sarcopenia. The association with sarcopenia remained significant after adjustment for MNA scores. In a multivariable analysis adjusted for MNA scores, cerebrovascular events, BADL, and IADL, the association with sarcopenia and FoF held (OR=2.67, 95% CI: 1.50–4.50) ($p<0.05$). There was no significant relationship between malnutrition and FoF after adjustment for sarcopenia, cerebrovascular events, BADL, and IADL ($p>0.05$).

DISCUSSION

In this study, we aimed to evaluate the association between FoF and malnutrition and sarcopenia in dementia patients. There are limited studies on this topic and they have been conducted only in older adults with dementia. More than half of dementia patients in the present sample reported a moderate-to-high FoF. Independent of MNA score, cerebrovascular disease, history of falling, BADL, and IADL, sarcopenia increases the FoF risk 2.67 times, whereas there is no significant association between malnutrition or micronutrient deficiencies and FoF.

In the present study, the prevalence of moderate and high FoF in dementia patients was 51%. In population-based samples, the prevalence of FoF varies between 15.1% and 69.2% [10, 14, 24]. Although it has been observed in many studies that there is a mutual association between cognitive impairment and FoF and that FoF is more frequent in dementia patients than in non-dementia patients, there are limited studies on the prevalence of FoF in older adults with dementia. For example, in one study, FoF was found in 31% of elderly patients with Alzheimer's disease (AD) [25]. In another study comparing the prevalence of geriatric syndromes in AD and dementia with Lewy body (DLB), it was found that the prevalence of medium and high FoF was 93.4% and 46.5% in DLB and AD, respectively [7, 26]. Although there are few studies, these differences in the prevalence of FoF may be due to differences between studied populations and FoF assessment methods; however, the high incidence and importance of FoF in dementia patients is obvious.

According to one study, elderly patients with FoF had a high probability of having a history of cerebrovascular disease, which is consistent with other data and it has been reported that FoF is associated with lower extremity muscle weakness in stroke patients [27]. Another important finding from this study was the high frequency of falls in the last 1 year in dementia patients with FoF. In a recent study, it was reported that the history of falling was a significant risk factor for FoF [28], and community-dwelling older adults with multiple histories of falls had a 3.70 times higher FoF risk [28]. Falls in elderly dementia patients may cause further decrease in functional capacity and death after fractures and this indicates that the risk factors leading to the development of FoF should be further investigated [29].

In the present study examining the association between sarcopenia and nutritional factors and FoF in older adults, especially in dementia patients, a significant association between sarcopenia and FoF was found, and sarcopenia increased FoF by 2.67 times. In a study conducted among healthy elderly patients, sarcopenia was found to be an independent risk factor for FoF, similar to the present study [30]. Another study evaluating community-dwelling patients showed that FoF and fear-related activity restriction increased the risk of sarcopenia [10]. The relationship between sarcopenia and FoF may

Table 1. Demographic and clinical characteristics of the participants (n=266)

Characteristic	Low concern about FoF (n=130)	Moderate concern about FoF (n=58)	High concern about FoF (n=78)	p
Age (year)	80.26	81.86	81.02	0.374
Gender, female, %	67.4	63.8	68.4	0.840
Education	5.30±4.53	4.69±4.76	3.72±4.32	0.066
Marital status				
Single	12.8	13.8	19.7	0.394
Married	42.3	46.6	36.8	
Spouse ex	43.1	36.2	43.4	
Living status, %				
Alone	10.0	5.2	6.6	0.722
With spouse	38.5	46.6	36.8	
With children	41.5	43.1	47.4	
With caregiver	9.2	5.2	7.9	
Comorbidities, %				
Hypertension	63.1	70.7	61.0	0.480
Diabetus mellitus	32.3	43.1	37.7	0.346
Coronary artery disease	20.0	22.4	23.4	0.834
COPD	6.9	6.9	6.6	0.995
Cerebrovascular events	6.9	20.7	16.9	0.015
Congestive heart failure	12.3	6.9	13	0.480
Peripheral artery disease	1.6	1.7	5.2	0.256
Osteoarthritis	54.8	9.7	35.5	0.209
Geriatric assessment				
Falls in a year, %	39.7	65.5	64.1	0.002
Number of drugs used	6.38±1.31	6.38±2.89	7.13±3.20	0.122
Dizziness, %	39.7	53.7	47.9	0.194
Nocturia, %	46.4	22.3	31.4	0.186
SARC-F score	3.72±2.99	6.64±2.67	7.85±2.40	0.000
Sarcopenia %	23.8	22.4	32.1	0.335
Decreased muscle strength %	71.9	78.6	87.2	0.037
Low muscle mass %	34.1	32.8	34.6	0.974
Calf circumference in cm	35.06±4.47	34.87±3.70	34.85±4.92	0.938
MNA scores	21.05±4.52	20.43±3.79	18.10±5.58	0.000
Nutritional status, %				
Well-nourished	35.4	19.0	12.8	0.000
Risk of malnutrition	45.4	67.2	51.3	
Malnutrition	19.2	13.8	35.9	
Weight loss >3 kg (6.6 lbs)	19.4	29.1	36.8	0.032
BMI, %				
23 or greater	95.0	86.8	82.4	0.185
BADL score	80.34±19.15	66.16±20.63	52.32±24.53	0.000
IADL score	8.47±6.28	5.84±6.03	4.67±4.85	0.000
MMSE	18.03±6.24	16.44±6.92	15.06±9.12	0.122
Vitamin B12 level	58.96±49.62	43.28±25.93	53.72±45.65	0.422
Vitamin folate level	7.52±4.17	6.89±4.31	7.56±4.83	0.405
Vitamin D level	22.13±15.51	21.47±11.75	22.60±12.52	0.829

BMI: Body mass index; BADL: Basic activities of daily living; COPD: Chronic obstructive pulmonary disease; FoF: Fear of falling; IADL: Instrumental activities of daily living; MMSE: Mini-mental state examination; MNA: Mini nutritional assessment.

Table 2. Association of FoF with sarcopenia and malnutrition

	Univariate	MNA adjustment	MV-adjusted[a]
Sarcopenia	1.21 (0.89–1.66) p=0.226	1.09 (0.78–1.51) p=0.61	0.99 (0.69–1.48) p=0.94
	Univariate	Sarcopenia adjustment	MV-adjusted[a]
Malnutrition	1.52 (1.10–2.11) p=0.013	1.48 (1.05–2.08) p=0.025	1.12 (0.75–1.66) p=0.566

a: Adjusted for MNA scores, cerebrovascular events; BADL, and IADL, BADL: Basic activities of daily living; FoF: Fear of falling; IADL: Instrumental activities of daily living; MNA: Mini nutritional assessment; MV: Multivariable.

be explained by several mechanisms. First, in elderly patients, sarcopenia has been demonstrated to be closely related to orthostatic hypotension (OH) [31] and OH is also known to be significantly associated with a high risk of FoF [32]. Therefore, sarcopenia may cause symptoms such as dizziness, weakness, and balance disorder through OH resulting in FoF. However, OH was not investigated in the present study. Second, sarcopenia may cause the development of FoF in patients by creating standing, walking, and balance problems [33]. Finally, there may be a bidirectional relationship between FoF and sarcopenia. Since patients with FoF are afraid of falling, they may avoid further mobilization, and live a more sedentary life, leading to the development of sarcopenia [34].

According to the results of our study, there is no relationship between malnutrition and FoF. This result was similar to other data in the literature [11, 24]. For example, in one study evaluating patients aged 75 years and over, it was found that malnutrition risk in men did not have a predictive role in terms of FoF [11]. On the other hand, micronutrient levels were not found to be a risk factor for FoF. To the best of our knowledge, there are limited studies in the literature evaluating the association between these vitamins and FoF in dementia patients. Two studies were detected in which the association between Vitamin D supplementation and FoF was evaluated in older adults without cognitive impairment. In an uncontrolled prospective study, D-hormone analog alfacalcidol treatment was reported to reduce FoF in elderly patients with osteoporosis [35]. In a previous study with older female adults in which the effect of exercise and Vitamin D supplementation on FoF was assessed, it was revealed that Vitamin D supplementation temporarily reduced FoF (1 year) [36].

The strengths of the present study are as follows: An adequate sample size, CGA tests were performed in all participants, comorbidities were evaluated, and FoF was evaluated with FES-I scale. However, findings from the present study should be interpreted in light of its limitations. First, the design of the study is cross-sectional. Second, we diagnosed sarcopenia with SARC-F. Although SARC-F is recommended to be used as a screening test for sarcopenia, it has been found to distinguish elderly patients with and without probable sarcopenia [37, 38]. However, we have added that we used SARC-F to diagnose sarcopenia as a limitation of our study after your valuable comments. Third, OH was not assessed as well as other potential correlates of FoF, such as gait and balance status, hearing and vision problems, and anxiety.

Conclusions

The risk of FoF, which is common in elderly dementia patients, is increased by sarcopenia. FoF should be examined in dementia patients during medical examinations. Those with FoF should also be evaluated in terms of the presence of sarcopenia. The combination of FoF and sarcopenia preventive approaches may allow FoF to be managed more effectively in these patients and thus, possible negative consequences in dementia patients can be prevented more successfully. However, future longitudinal data can shed light on this issue.

Ethics Committee Approval: The Bezmialem Vakif University Clinical Research Ethics Committee granted approval for this study (date: 25.08.2020, number: 14/298).

Authorship Contributions: Concept – PS; Design – PS; Supervision – LS; Data collection and/or processing – SKO, PS; Analysis and/or interpretation – SGT, VY; Literature review – PS; Writing – SKO, PS; Critical review – PS, LS.

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