



The Relationship of Sarcopenia with Disease Stage and Activities of Daily Living in Parkinson's Patients

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Abstract

Aim: Parkinson's disease (PD) is the second most common progressive neurodegenerative disease, presenting with motor and nonmotor findings. The relationship between clinical features and sarcopenia in Parkinson's patients is not clear, and the evaluation of this relationship is imperative in terms of preventing falls and disabilities. Our study aimed to describe the demographic and clinical characteristics of patients with PD and to evaluate the relationship between sarcopenia screening test and disease stage, walking speed, hand grip muscle strength, and activities of daily living.

Material and Method: Male and female patients with clinically confirmed PD aged 50 years and older were included in the cross-sectional descriptive study. Disease staging was evaluated using the Hoehn-Yahr scale, walking speed with the Time Up and Go test (TUG), muscle strength with a hand dynamometer, activities of daily living with the Barthel Index, and the SARC-F test for sarcopenia.

Results: Of the 52 patients included in the study, 40.4% were female and 59.6% were male, and the mean age was 69.86±8.14 years. SARC-F score was high in 51.4% of the patients. The disease stage was associated with an increase in SARC-F scores. The increase in SARC-F scores was positively correlated with the increase in the TUG test ($p=0.028$, $r=0.306$), while the SARC-F score was negatively correlated with activities of daily living. ($p=0.000$, $r=-0.684$). Eighty-one-point three percent of the women with low hand muscle strength had high SARC-F scores, and the difference between them was statistically significant.

Conclusion: Our findings indicated that sarcopenia was prevalent among patients with PD, with its prevalence increasing in direct proportion to the progression of the disease. Furthermore, patients exhibiting high sarcopenia levels demonstrated reduced walking speed and impaired daily living abilities. These observations underscore the critical importance of incorporating sarcopenia evaluations into the development of rehabilitation programs for patients.

Keywords: Parkinson's disease, sarcopenia, disease stage, daily living activities

INTRODUCTION

Parkinson's disease (PD) is a chronic and degenerative neurological disease that affects the central nervous system, often leading to progressive deterioration in motor functions. The basic pathophysiology of PD involves the loss of dopaminergic neurons. It causes motor and non-motor symptoms. The primary motor symptoms of PD include bradykinesia, tremor, and postural instability. Cognitive disorders, sleep disorders, autonomic dysfunction, and musculoskeletal changes

have an essential place among non-motor symptoms. Non-motor symptoms such as cognitive impairment, sleep disturbances, autonomic dysfunction, and musculoskeletal changes significantly impact patients (1). These symptoms lead to severe limitations in the activities of daily living of Parkinson's patients (2). Sarcopenia refers to the age-related decline in skeletal muscle mass and function.

Recent studies have reported that sarcopenia and PD share common pathogenetic features. In patients

CITATION

Sertpoyraz FM, Korkmaz T, Ciftci Y, et al. The Relationship of Sarcopenia with Disease Stage and Activities of Daily Living in Parkinson's Patients. Med Records. 2025;7(2):294-8. DOI:1037990/medr.1641540

Received: 17.02.2025 Accepted: 23.03.2025 Published: 26.03.2025

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with PD, disruption of the basal ganglia—a group of subcortical nuclei responsible for movement initiation—and interleukin-6-mediated neuroinflammation lead to motor dysfunction. As a result of motor dysfunction, insufficient muscle use due to bradykinesia, rigidity, and tremors leads to a decrease in muscle mass (3,4). Additionally, factors such as nutritional deficiencies, difficulty swallowing, loss of appetite, and substance use can lead to insufficient protein intake and negatively impact muscle health. Recent research has also revealed mitochondrial dysfunction in sarcopenia and Parkinson's disease. Mitochondrial abnormalities are more common in sarcopenic muscles than in healthy aged muscles (5). This can contribute to muscle degeneration by disrupting energy metabolism. As a result, patients' quality of life decreases, the risk of falls increases, and their functional independence is threatened. In recent years, it has become increasingly imperative to develop new strategies to optimize the health status of individuals with PD. The role of sarcopenia in terms of maintaining muscle health and ensuring the sustainability of functional capacity in PD has been a topic of increasing interest (6).

This study aims to characterize the demographic and clinical features of Parkinson's patients and investigate the relationship between sarcopenia (as assessed by the SARC-F screening test) and key functional parameters, including disease stage, gait speed, handgrip strength, and activities of daily living.

MATERIAL AND METHOD

This study was approved by the Ethics Committee of İzmir Bakırçay University (Ethics approval number: 656). All participants provided written informed consent by the Declaration of Helsinki. An observational cross-sectional study was conducted between January and July 2024 among patients who visited the Physical Medicine and Rehabilitation Outpatient Clinic and were diagnosed with PD by a neurologist.

A total of 60 patients were included in the study, but 8 patients were excluded due to stage 5. The study was completed with 52 patients. Patients aged 50 years or older, of both sexes, who provided written informed consent and were classified as Hoehn-Yahr stage 1-4 were included in the study. Patients with orthopedic and rheumatologic problems that would affect hand grip strength in the upper extremity and walking function in the lower extremity, those who did not sign the informed consent form, those who could not perform commands due to cognitive dysfunction, patients with Hoehn and Yahr scale stage 5, and patients with Parkinson's plus syndrome were excluded from the study. Cognitive functions were evaluated with a mini-mental test, and patients with a score above twenty-five were included

Demographic information and clinical examinations of the patients who signed the informed consent were recorded. A physical therapy and rehabilitation physician made all evaluations.

Disease staging was evaluated using the Hoehn-Yahr scale. Walking speed was assessed with the Timed Up and Go test. Muscle strength was measured using a hand dynamometer. Daily living activities were evaluated with the Barthel test, and sarcopenia was assessed through the SARC-F test.

The Hoehn and Yahr scales evaluate the clinical course of PD. They assess the severity and progression of motor symptoms, which consist of five stages (7).

Stage 1: Symptoms are only unilateral.

Stage 2: Symptoms become bilateral.

Stage 3: Postural instability is evident

Stage 4: Severe motor dysfunctions are seen.

Stage 5: The patient becomes completely dependent.

The SARC-F scale is a simple, rapid and self-reported screening test developed to assess the risk of sarcopenia in elderly individuals. SARC-F evaluates five main parameters on individuals' muscle function and physical performance. These parameters include strength, need for walking assistance, ability to get up from a chair, ability to climb stairs, and risk of falling. The total score on the scale ranged from 0 to 10, with a score of ≥ 4 considered a high risk of sarcopenia. This test provides a critical starting point for planning interventions for managing and preventing sarcopenia. Turkish validity and reliability study was conducted by Bahat et al. (8).

The Time Up and Go test evaluates individuals' balance, gait, and overall mobility levels. The patient is seated in a standard-height chair on a flat, stable surface. It covers the time it takes for the person to get up from the chair, walk 3 meters, turn around, walk back to the starting point, and sit back in the chair. In recent studies, 13.5 seconds or more in Parkinson's patients are considered significant regarding falling and mobility impairment (9).

Hand grip strength is a reliable indicator of upper extremity muscle strength and is a crucial parameter for assessing physical functional capacity. Hand grip muscle strength was evaluated using a Jamar hand dynamometer. The patient was seated in a flat chair with back support, in a wrist position that was either neutral or slightly extended, with the shoulder in a neutral position and the elbow in 90° flexion. For each hand, usually, three measurements were made, and the average value was recorded in kilograms. Hand grip strength of more than 30 kg for men and 20 kg for women is considered normal. Dynopenia is defined as a hand grip strength of less than 30 kg in men and less than 20 kg in women. Decreased hand grip strength, sarcopenia, and fragility have been reported as increased risk symptoms. The test has validity and reliability in Turkish (6,10-12).

The Barthel Index evaluates individuals' performance in ten basic activities of daily living. Each activity is scored based on the individual's level of independence, with a

total score ranging from 0 to 100. The Barthel Index is a reliable scale that objectively evaluates the level of independence of individuals with PD in activities of daily living. The test has a validity reliability in Turkish (13).

Statistical Method

Statistical analysis was performed with SPSS version 21 for Windows. The normality of the data was assessed using the Shapiro-Wilk test. Data with a normal distribution were presented as mean \pm standard deviation. Correlations between variables were evaluated using the Pearson test, as appropriate. The chi-square test was used to assess associations between categorical variables. A p-value of lower than 0.05 was regarded as statistically significant.

RESULTS

The study included 52 patients, comprising 21 females (40%) and 31 males (60%). The mean age of the patients was 69.86 \pm 8.14 years. Demographic data of Parkinson's patients are shown in Table 1, and clinical data are shown in Table 1 and Table 2.

Table 1. Demographic data of Parkinson's patients	
Demographic data	n (%)
Gender	
Woman	21 (40.4)
Male	31 (59.6)
Age	
50-59 years	6 (11.5)
60-69 years	18 (34.6)
70-79 years	10 (38.5)
80 years and older	8 (15.4)
Education	
Illiterate	4 (7.7)
Secondary	26 (50.7)
Higher education	28 (62.3)
Body mass index	
Weak	1 (1.9)
Normal	15 (28.8)
Weight	25 (48.1)
Overweight	9 (17.3)
Obesity	2 (3.8)
Comorbidity	
Yes	9 (17.3)
No	43 (82.7)

n: number of patients, %: percentage

Table 2. Clinical data of Parkinson's patients	
Clinical data	n (%)
Disease stage	
Stage 1	20 (38.5)
Stage 2	7 (13.5)
Stage 3	14 (26.9)
Stage 4	11 (21.1)
Tremor	
No	12 (23.1)
Yes	40 (76.9)
Rigidity	
No	32 (61.5)
Yes	20 (38.5)
Barthel Index	
Independent	33 (63.5)
Moderately dependent	13 (25.0)
Highly dependent	4 (7.7)
Totally dependent	2 (3.8)
Bradykinesia	
No	11 (21.2)
Yes	41 (78.8)
Dorsal kyphosis	
No	14 (26.9)
Yes	38 (73.1)
Imbalance	
No	25 (48.1)
Yes	27 (59.1)
SARC-F score	
≥ 4	27 (51.9)
< 4	25 (48.1)
Time up to go test (second)	
≥ 13.5	40 (76.9)
< 13.5	12 (23.1)
Dominant hand/muscle strength/female (kilogram)	
≥ 20	5 (24)
< 20	16 (76)
Dominant hand/hand muscle strength/male (kilogram)	
≥ 30	28 (90.3)
< 30	3 (9.7)

n: number of patients, %: percentage

The relationship between the SARC-F score and the stage of the disease was evaluated, and it was positively correlated with the increase in PD stage and the increase in SARC-F score. The relationship between the Disease Stage and SARC-F is shown in Figure 1. When the SARC-F score and the TUG test were evaluated, their relationship was statistically significant ($p=0.028$, $r=0.306$). There was a negative correlation between SARC-F and the Barthel Index ($p=0.000$, $r=0.684$) when dominant hand muscle strength was evaluated with SARC-F. While there was a statistically significant correlation between hand muscle strength and SARC-F scores in women ($p=0.025$), there was no relationship in men ($p=0.71$).

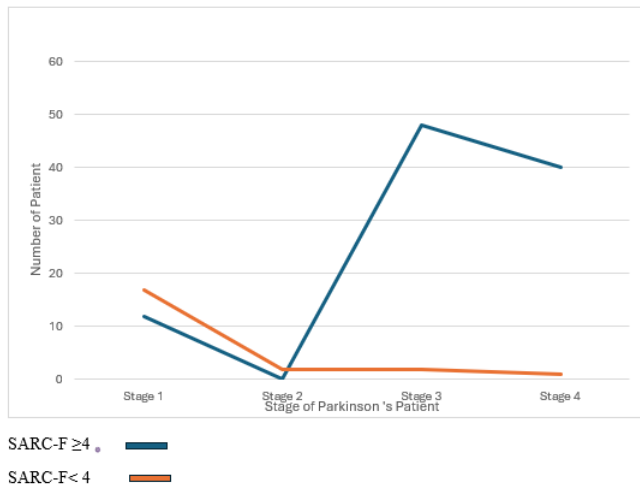


Figure 1. Relationship between disease stage and SARC-F

There was a statistically significant correlation between SARC-F scores and Timed Up and Go test results ($p=0.028$, $r=0.306$), indicating a link between sarcopenia risk and mobility impairment in Parkinson's patients. A significant negative correlation was found between SARC-F scores and Barthel Index scores ($p=0.000$, $r=0.684$), suggesting that sarcopenia negatively impacts daily living activities.

Eighty-one percent of women with low dominant hand muscle strength ($n=16$) had high SARC-F scores, and the difference between them was statistically significant ($p=0.011$). In males, the dominant hand ($n=28$) muscle strength, SARC-F scores were 64.8% ($n=18$) standard, 35.7% ($n=10$) lower, and no significant difference was found between them ($p=0.935$).

DISCUSSION

Our study demonstrated a high prevalence of sarcopenia in Parkinson's patients, with an increasing risk as the disease progresses. It has been determined that sarcopenia has adverse effects on walking speed, activities of daily living, and general functional capacity. Especially in female patients with Parkinson's disease, a 76% decrease in hand muscle strength has been observed. These findings are consistent with the loss of stamina, frailty, and disability caused by motor and non-motor symptoms in PD.

In a meta-analysis conducted by F. Petermann-Rocha et al., the prevalence of sarcopenia in the general population was

reported as 22%, 10%, and 15% according to the EWGSOP, EWGSOP2, and AWGS criteria, respectively (14). However, various studies conducted on Parkinson's patients indicate that the prevalence of sarcopenia ranges from 23.9% to 66.7% (6).

In contrast, Barichello et al. reported that the prevalence of sarcopenia was less than 6% in their study of 235 patients with a clinic for Parkinsonism (12). This difference in prevalence may be due to the diagnostic criteria, sample size, and study methodology used. However, in five studies of Parkinson's patients, Parkinson's patients were reported to have a higher prevalence of sarcopenia compared to control groups (13,14). Studies have reported that the reasons for the increased frequency of sarcopenia in PD are that dopamine deficiency weakens the control of motor functions, mitochondrial dysfunction disrupts cell energy metabolism, and chronic inflammation accelerates muscle protein degradation. It is also emphasized that nutritional problems also contribute (13-15).

Our study found that the risk of developing sarcopenia increases as the disease stage progresses. Previous research has similarly shown that sarcopenia is associated with longer disease duration, more severe motor symptoms (Hoehn and Yahr stage), and loss of functional independence (16).

However, the literature contains conflicting findings regarding the relationship between sarcopenia and motor symptoms (Unified Parkinson's Disease Rating Scale-Motor Examination Scores). This means that the mechanisms of sarcopenia in Parkinson's disease are not fully understood and may differ from person to person (17).

Reduced hand muscle strength is a common issue among older adults and individuals exhibiting symptoms of Parkinsonism. As the disease worsens, patients with Parkinson's face a decline in fine motor skills, a loss of muscle strength, and a decrease in hand dexterity (12-17).

The study shows that low hand grip strength is common among Parkinson's patients, especially women. Gender is an important predictor of muscle strength and SARC-F scores. The tremor, stiffness, and bradykinesia associated with the disease affect hand function and can adversely affect muscle strength by reducing their use (18).

The fact that sarcopenia is more pronounced in women can be attributed to hormonal differences and gender-related variations in muscle mass (17,18). This situation highlights the need for developing individualized treatment approaches based on gender for Parkinson's patients. Weakening hand muscles can restrict patients' independence by complicating daily activities.

The negative correlation between the Barthel Index and SARC-F scores indicates that sarcopenia increases dependence on daily living activities. This highlights the detrimental effects of sarcopenia on functional independence. This finding suggests that sarcopenia is a direct factor affecting the quality of life for patients with PD.

The test duration was high in 76% of the PD and was consistent with the risk of falling. Recent studies have reported that individuals with sarcopenia face a higher risk of falls and fractures, along with a decline in their daily living activities (19). In a systematic review of patients with PD, Ying et al. found that the incidence of falls among those with sarcopenia was more significant than in those without it, recommending early evaluation of sarcopenia in PD to prevent falls and disability (20).

PD, Sen et al. It has been reported that the quality of life of individuals decreases in specific periods, which leads to an increase in the care needs of patients and dependence on caregivers. It is emphasized that this situation increases the burden of care on both the patient and his family (21).

CONCLUSION

Considering the impact of sarcopenia on functional decline in PD, regular screening using the SARC-F test may facilitate early intervention. Furthermore, gender-specific rehabilitation strategies should be developed to address the unique needs of male and female patients. Future research with larger cohorts is needed to establish robust clinical guidelines for managing sarcopenia in Parkinson's patients.

Limitations of the Study

The primary limitation is the small patient sample size and the lack of a control group.

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

Conflict of interest: *The authors have no conflicts of interest to declare.*

Ethical approval: *On 08.07.2022, decision no: 656 ethical approval was obtained from İzmir Bakırçay University Non-Interventional Ethics Committee.*

Acknowledgments: *We would like to thank Prof. Dr. Bedile İrem Tiftikçioğlu for her contributions to this study.*

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