İstanbul Med J 2024; 25(4): 260-4
DOI: 10.4274/imj.galenos.2024.51481

Relationship Between Low Gait Speed and Geriatric Syndromes: Mortality in a University Geriatric Outpatients in Türkiye

Meriş Esra Bozkurt[1], Cihan Kılıç[2], Gülistan Bahat[2], Mehmet Akif Karan[2]

[1]University of Health Sciences Türkiye, Mersin City Hospital, Clinic of Internal Medicine, Unit of Geriatrics, Mersin, Türkiye
[2]İstanbul University, İstanbul Faculty of Medicine, Department of Internal Medicine, Division of Geriatrics, İstanbul, Türkiye

ABSTRACT

Introduction: Usual gait speed is a fundamental component of sarcopenia and frailty. The current study aimed to assess the correlation between low gait speed (LGS), geriatric syndrome, and mortality.

Methods: Of the 2,020 patients who attended the outpatient department of our university hospital between April 2012 and April 2023, a total of 661 participants with accessible gait speed data who were over 60 years of age were included in the study. LGS was defined as a gait speed of 0.8 m/s or less, whereas probable sarcopenia was assessed based on two different measurements: hand grip strength (HGS) and the chair stand test (CST). The cut-off values for HGS were 27 kg for women and 16 kg for men. For the CST, measurements of >15s or an inability to complete the test were considered indicators of probable sarcopenia.

Results: The median age of the participants was 73 (60-96) years, and 455 (68.8%) were women. Among the participants, 56 (27.3%) died during the study period. Univarite analysis revealed no significant association between LGS and mortality, whereas regression analysis suggested that LGS was statistically associated with age, sex, congestive heart failure, frailty, malnutrition, and probable sarcopenia assessed by CST.

Conclusion: In the presence of LGS, screening for malnutrition, frailty, and probable sarcopenia by CST was feasible.

Keywords: Low gait speed, comorbidities, geriatric syndromes, mortality

Introduction

In Türkiye, as in the rest of the world, the proportion of over-65s in the population is steadily increasing (1), and it is projected that by 2043, the number of over-65s in the population will equal those aged 0-14 years (2). The ability of older adults to maintain functional independence with advancing age is crucial both for themselves and for the community (3-5) and for the independent performance of daily and instrumental life activities (6). Declines in functional capacity in older adults can lead to dependency on others for daily and instrumental life activities, increasing also the risk of falls, frailty, sarcopenia, disability, institutionalization, and mortality (5-11).

Usual gait speed (UGS) is frequently used to assess functional capacity in older adults and is a non-invasive, fast, reliable, and practical measurement approach (7). UGS was determined by recording how long it took the patient to walk a 4 meter (m) course, which was recorded on a chronometer (seconds) (7). The European Working Group on Sarcopenia in Older People (EWGSOP2) suggested that a gait speed threshold of less than 0.8 m/s is necessary (7). When considering the presence of sarcopenia and frailty, UGS is clinically recognized as the sixth vital sign (12) and as a crucial parameter that can support clinical care, improve functional independence, and mitigate unfavorable clinical outcomes (3-10). Although several studies have suggested that a low gait speed may be indicative of all-cause mortality, many do not suggest a precise cut-off value for the prediction of mortality (3,6,7,8-13), while other studies report no association between gait speed and mortality, and more claim the relationship is dependent on sex. In some studies, the relationship is assessed without adjusting for confounding factors, while others are based on insufficient information (14-17).

There is an apparent need for regional studies to determine whether the conflicting data regarding UGS stems from chronic comorbid conditions or race-specific variations in gait speed cut-off values. With this in mind, the present study was designed to assess geriatric outpatients in our community with the goal of identifying potential relationships between low UGS and comorbidities, geriatric syndromes, and all-cause mortality.

Address for Correspondence: Meriş Esra Bozkurt MD, University of Health Sciences Türkiye, Mersin City Hospital, Clinic of Internal Medicine, Unit of Geriatrics, Mersin, Türkiye
E-mail: mesragunduz@gmail.com **ORCID ID:** orcid.org/0000-0003-2823-1647

Received: 19.03.2024
Accepted: 21.07.2024

Cite this article as: Bozkurt ME, Kılıç C, Bahat G, Karan MA. Relationship Between Low Gait Speed and Geriatric Syndromes: Mortality in a University Geriatric Outpatients in Türkiye. İstanbul Med J. 2024; 25(4): 260-4

This study was presented as a poster at the 19th EuGMS congress in Helsinki on 22 September 2023.

Methods

The study was conducted in full compliance with the principles outlined in the Declaration of Helsinki, and it was conducted after obtaining approval from the Ethics Committee of the İstanbul University, İstanbul Faculty of Medicine (approval number: 15, date: 21.07.2023). The study began with a retrospective review of 2,020 patients aged 60 years who were followed up in the geriatric outpatient clinic of a university hospital from April 2012 to April 2023. Patients aged 60 years or older with a general medical condition appropriate for comprehensive geriatric assessment and performance evaluations were included in the study; those below 60 years of age and those with compromised general medical conditions (such as poor overall health, active cancer, acute illnesses, advanced organ failure, severe dementia, significant osteoarthritis, neuropathy, or stroke sequelae) that rendered them unsuitable for geriatric assessment were excluded. The final study population comprised 661 participants whose age, sex, specific diseases, medication count, probable sarcopenia, falls, frailty, malnutrition, urinary incontinence, sleep disorders, and functional status were recorded. Patient mortality data were accessed from the Ministry of Health's information system. The Katz Index of Independence in activities of daily living (ADL) was used to record activities on a scale of 0-6, while instrumental ADL were evaluated on a scale of 0-8 using the Lawton Instrumental Activities of Daily Living Scale (18,19). Height and weight were measured and recorded, and body mass index (BMI) was calculated by dividing weight by height squared (20). A UGS below 0.8 m/s was considered to indicate reduced gait speed (7). Probable sarcopenia was identified using two distinct measurement approaches: the hand grip strength (HGS) test and the chair stand test (CST). The cut-off value for the HGS test was set at 27 kg for women and 16 kg for men (7), and the cut-off value for the CST was set at 15s or an inability to complete the test. The UGS, HGS, and CST tests were conducted according to the recommendations provided in the EWGSOP2 guidelines (7). Falls data was garnered by asking patients about any falls within the previous year. The FRAIL scale was used to assess frailty, with a score of 3 indicating frailty (21). The Mini Nutritional Assessment-Short Form (MNA-SF) was used to screen for malnutrition, with an MNA-SF score of 7 being considered indicative of malnutrition (22). Urinary incontinence was evaluated by asking patients about any incident of involuntary urinary leakage within the last 3 months. The patients were screened for sleep disorders by asking about experiences of excessive sleepiness or insomnia. Polypharmacy was defined as the consumption of four or more medications (23).

Statistical Analysis

This study's data distribution evaluated with a Kolmogorov-Smirnov test. The association between low UGS and related factors was evaluated using the chi-square, Mann-Whitney U test, and independent samples t-tests in univariate analyses. Before conducting the multivariate analysis, the factors demonstrating significant associations in the univariate analysis were evaluated. For variables included in the multiple logistic regression analysis, the backward elimination method was used. The independent variables in the multiple logistic regression analysis were age, sex, congestive heart failure, probable sarcopenia, (low HGS), probable sarcopenia (CST), frailty, and undernutrition. In the multivariate analyses, the multiple logistic regression method was used to examine the associations between the presence of low UGS and related factors, for which odds ratios (ORs) with 95% confidence intervals (CIs) were calculated.

Results

Among the 661 participants, the median age was 73 years (60-96 years), and 455 of the sample (68.8%) were female. Of the total sample, 56 participants (27.3%) did not survive within the first 73 months. In the univariate analysis, age ($p<0.001$), sex ($p<0.001$), height ($p=0.017$), weight ($p<0.001$), BMI ($p=0.009$), hypertension ($p=0.035$), congestive heart failure ($p=0.011$), chronic renal failure ($p=0.010$), osteoporosis ($p<0.001$), dementia ($p<0.001$), depression ($p<0.001$), probable sarcopenia based on both HGS ($p<0.001$), and CST measurements ($p<0.001$), falls ($p<0.001$), frailty ($p<0.001$), malnutrition ($p<0.001$), urinary incontinence ($p<0.001$), polypharmacy ($p<0.001$), number of chronic diseases ($p<0.001$), ADL ($p<0.001$), and instrumental ADL ($p<0.001$), were identified as factors with a significant association with low UGS, while paired analyses revealed no significant association between low UGS and mortality (Table 1).

Prior to performing the regression analysis of the factors demonstrating significant associations in the univariate analysis, multicollinearity was evaluated. For variables included in the multiple logistic regression analysis, the backward elimination method was used. The independent variables in the multiple logistic regression analysis were age, sex, congestive heart failure, probable sarcopenia, (low HGS), probable sarcopenia (abnormal CST), falls, frailty, and undernutrition.

In the multivariate analysis, age ($p<0.001$, OR: 1,122, 95% CI: 1.080-1,166), sex ($p<0.001$, OR: 3,444, 95% CI: 1,188-6,283), congestive heart failure ($p=0.045$, OR: 2,543, 95% CI: 1,022-6,325), probable sarcopenia based on CST measurement ($p<0.001$, OR: 5,724, 95% CI: 3,397-9,644), falls ($p<0.001$, OR: 1,705, 95% CI: 1,067-2,725), frailty ($p<0.001$, OR: 2,848, 95% CI: 1,588-5,108), and malnutrition ($p=0.006$, OR: 20,747, 95% CI: 2,412-178,437) were identified as factors associated with low UGS in the multiple logistic regression analysis, while no statistically significant association was observed between low UGS and probable sarcopenia (based on HGS measurement) (Table 2).

Discussion

In the present study, age, sex, congestive heart failure, malnutrition, frailty, and probable sarcopenia diagnosed by the CST method were identified as factors associated with LGS among geriatric outpatients, whereas no significant association was observed between LGS and all-cause mortality within 73 months.

In a study by Taekema et al. (14), 9% of the 599 respondents who were aged 85 years or older recorded a gait speed below 0.8 m/sec, and after adjusting for the relevant confounders using this cut-off value, no significant association was observed between LGS and mortality.

Table 1. Univariate analysis results showing the relationship between low gait speed and factors

	Low UGS, (n=170) (25.7%)	Normal UGS, (n=491) (74.3%)	Total, (n=661) (100%)	p-value
Age*	78 (62-96)	72 (60-93)	73 (60-96)	**<0.001ϴ**
Sex (n, %)				
Male	33 (19.4%)	173 (35.2%)	206 (31.2%)	**<0.001ϴ**
Female	137 (80.6%)	318 (64.8%)	455 (68.8%)	
Height (mt)*	1.52 (1.35-1.73)	1.56 (1.40-1.83)	1.55 (1.35-1.83)	**<0.001ϴ**
Weight (kg)*	70.7 (38.8-117.6)	73.2 (39.0-128.8)	73 (38.8-128.8)	**0.034ϴ**
BMI (kg/m²)*	31.4 (16.7-48.9)	29.3 (16-58.7)	29.8 (16-58.7)	**0.018ϴ**
Chronic disease (n, %)				
Hypertension	134 (78.8%)	340 (69.2%)	474 (71.7%)	**0.017ϴ**
Diabetes mellitus	59 (34.7%)	168 (34.2%)	227 (34.3%)	**0.908**
Congestive heart failure[x]	21 (12.4%)	17 (3.5%)	38 (5.8%)	**<0.001ϴ**
COPD	12 (7.1%)	28 (5.7%)	40 (6.1%)	**0.523**
Chronic liver disease	3 (1.8%)	5 (1%)	8 (1.2%)	**0.443**
Chronic kidney disease	12 (7.1%)	13 (2.6%)	25 (3.8%)	**0.009ϴ**
Osteoporosis	36 (21.2%)	70 (14.3%)	106 (16.1%)	**0.035ϴ**
Dementia	24 (14.1%)	37 (7.7%)	61 (9.2%)	**0.011ϴ**
Depression	42 (24.7%)	78 (15.9%)	120 (18.2)	**0.010ϴ**
Geriatric syndromes (n, %)				
Probable sarcopenia (low HGS)	42 (24.7%)	33 (6.7%)	75 (11.3%)	**<0.001ϴ**
Probable sarcopenia (abnormal CST)	94 (55.3%)	42 (8.6%)	136 (20.6%)	**<0.001ϴ**
Falls	86 (50.6%)	155 (31.6%)	241 (36.5%)	**<0.001ϴ**
Frailty (FRAIL scale ≥3)[⊥]	71 (42%)	40 (8.2%)	111 (16.9%)	**<0.001ϴ**
Malnutrition (MNA-SF)	14 (8.2%)	1 (0.2%)	15 (2.3%)	**<0.001ϴ**
Urinary incontinence	94 (55.3%)	168 (34.2%)	262 (39.6%)	**<0.001ϴ**
Sleep disorders	73 (43%)	174 (35.4%)	247 (37.4%)	**0.219**
Polypharmacy (n, %)	141 (83.4%)	340 (69.7%)	481 (72.8%)	**<0.001ϴ**
Number of chronic drugs*	6 (0-21)	5 (0-17)	5 (0-21)	**<0.001ϴ**
Number of chronic diseases	4 (0-8)	3 (0-10)	3 (0-10)	**<0.001ϴ**
ADL*	6 (1-6)	6 (1-6)	6 (1-6)	**<0.001ϴ**
IADL*	8 (0-8)	8 (0-8)	8 (0-8)	**<0.001ϴ**
Mortality (n, %)	56 (32.9%)	48 (9.8%)	104 (15.8%)	**0.632**

ADL: Activities of daily living, BMI: Body mass index, CST: Chair stand test, COPD: Chronic obstructive pulmonary disease, HGS: Hand grip strength, IADL: Instrumental activities of daily living, MNA-SF: Mini Nutritional Test-Short Form, UGS: Usual gait speed, *Given data as median, ϴSignificant p-values , ⊥Marked data includes 657 participants, XMarked data includes 660 participants

Table 2. Univariate and multivariate regression results for low gait speed

	Univariate analysis				**Multivariate analysis**			
	p	**OR**	**95% Cl Lower upper**		**p**	**OR**	**95% Cl Lower upper**	
Age	<0.001ϴ	1,122	1,080	1,166	<0.001ϴ	1,122	1,080	1,166
Sex	<0.001ϴ	3,490	1,913	6,367	<0.001ϴ	3,444	1,888	6,283
Congestive heart failure	0.044ϴ	2,550	1,024	6,351	0.045ϴ	2,543	1,022	6,325
Probable sarcopenia (low HGS)	0.051	2,056	0.998	4,235	0.052	2,049	0.995	4,219
Probable sarcopenia (abnormal CST)	<0.001ϴ	5,775	3,428	9,729	<0.001ϴ	5,724	3,397	9,644
Falls	0.025ϴ	1,708	1,069	2,729	0.026ϴ	1,705	1,067	2,725
Frailty (FRAIL scale ≥3)	<0.001ϴ	2,874	1,604	5,150	<0.001ϴ	2,848	1,588	5,108
Malnutrition (MNA-SF)	0.006ϴ	20,747	2,412	178,437	0.006ϴ	20,706	2,409	177,956

CI: Confidence Interval, HGS: Hand grip strength, MNA-SF: Mini Nutritional Test-Short Form, OR: Odds ratio, ϴSignificant p-values

In a review of five studies involving a total of 14,692 participants, Cooper et al. (16) identified no significant association between gait speed and all-cause mortality after adjusting for confounding factors, and the results of this study align closely with ours regarding the outcomes associated with mortality.

In a 2009 consensus report, based on a review by the International Academy on Nutrition and Aging Task Force of 27 studies, LGS was identified as a risk factor for disability, cognitive impairment, hospitalization, falls, and mortality (24). In their study of 4,298 respondents aged 65 years or older, Doi et al. (25) reported an association between gait speed, stride length, and mortality, while a contrasting review of nine prospective studies involving a total of 12,901 participants aged 65 years or older by Liu et al. (11) reported an association between LGS and mortality among the male participants, but no significant association among the female participants. Similarly, in a study involving 1,348 older people living in a rural location in South Korea utilizing the 4 m walk test, Jung et al. (8) noted an inverse correlation between gait speed and frailty in both sexes, but when the sex-specific quartiles were considered, different statistical results were observed in the association between gait speed, mortality, institutionalization, and the prevalence of geriatric syndromes. In a study of 2,105 adults aged 65 years or older, Zhao et al. (15) reported an association between LGS and mortality in male participants. The above studies differ in terms of the outcomes related to mortality, which may be attributed to the absence of age, race, and sex-specific cut-off values in their analyses (8-11,24,25). The present findings could be validated by future studies that take into account sex-specific disparities or utilize different cutoff values in an investigation of the association between UGS and mortality (8,11,15).

In their study, Jung et al. (8) reported an association between frailty assessed using the K-FRAIL questionnaire and UGS, whereas a meta-analysis of 20 studies involving a total of 13,527 participants aged 60 years, consistent with the present study, reported a relationship between frailty and UGS (26).

Ramsey et al. (27) screened 286 outpatients with malnutrition using the Short Nutritional Assessment Questionnaire and observed a relationship between malnutrition and gait speed. A meta-analysis of 45 studies involving 16,911 adults aged 60 years reported a significant relationship between malnutrition and gait speed (28). In this regard, the results of the present study related to malnutrition are consistent with the literature.

In our study, we reported a significant relationship between CST score and low UGS in a geriatric outpatient sample (29). Similarly, a prospective study by Alcazar et al. (30) involving 1,844 older adults aged 67 years or older reported a significant relationship between CST scores and low UGS, which is consistent with the results of the present study.

The strength of this study lies in its status as the first to explore factors related to low gait speed among older adults in Türkiye, coupled with its inclusion of comprehensive data from a substantial number of patients.

Study Limitations

One limitation of this study is its retrospective design.

Conclusion

The current study identified an association between LGS and factors such as age, sex, malnutrition, frailty, and probable sarcopenia evaluated through CST among older adults in Türkiye.

Ethics Committee Approval: The study was conducted in full compliance with the principles outlined in the Declaration of Helsinki, and it was conducted after obtaining approval from the Ethics Committee of the İstanbul University, İstanbul Faculty of Medicine (approval number: 15, date: 21.07.2023).

Informed Consent: Retrospective study.

Authorship Contributions: Surgical and Medical Practices - M.E.B.; C.K.; Concept - M.E.B., M.A.K.; Design - M.E.B., M.A.K.; Data Collection or Processing - C.K.; Analysis or Interpretation - M.E.B.; Literature Search - M.E.B., C.K., G.B., M.A.K.; Writing - M.E.B., C.K., G.B., M.A.K.

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

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

References

1. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2021-
2. https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Yaslilar-2021-45636&dil=1
3. Cummings SR, Studenski S, Ferrucci L. A diagnosis of dismobility--giving mobility clinical visibility: a Mobility Working Group recommendation. JAMA. 2014; 311: 2061-2.
4. Maggio M, Ceda GP, Ticinesi A, De Vita F, Gelmini G, Costantino C, et al. Instrumental and non-instrumental evaluation of 4-meter walking speed in older individuals. PLoS One. 2016; 11: e0153583.
5. Kuys SS, Peel NM, Klein K, Slater A, Hubbard RE. Gait speed in ambulant older people in long term care: a systematic review and meta-analysis. J Am Med Dir Assoc. 2014; 15: 194-200.
6. Perera S, Patel KV, Rosano C, Rubin SM, Satterfield S, Harris T, et al. Gait speed predicts incident disability: a pooled analysis. J Gerontol A Biol Sci Med Sci. 2016; 71: 63-71.
7. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019; 48: 16-31.
8. Jung HW, Jang IY, Lee CK, Yu SS, Hwang JK, Jeon C, Lee YS, Lee E. Usual gait speed is associated with frailty status, institutionalization, and mortality in community-dwelling rural older adults: a longitudinal analysis of the Aging Study of Pyeongchang Rural Area. Clin Interv Aging. 2018; 13: 1079-89.
9. Weidung B, Boström G, Toots A, Nordström P, Carlberg B, Gustafson Y, et al. Blood pressure, gait speed, and mortality in very old individuals: a population-based cohort study. J Am Med Dir Assoc. 2015; 16: 208-14.
10. Toots A, Rosendahl E, Lundin-Olsson L, Nordström P, Gustafson Y, Littbrand H. Usual gait speed independently predicts mortality in very old people: a population-based study. J Am Med Dir Assoc. 2013; 14: 529.
11. Liu B, Hu X, Zhang Q, Fan Y, Li J, Zou R, et al. Usual walking speed and all-cause mortality risk in older people: A systematic review and meta-analysis. Gait Posture. 2016; 44: 172-7.
12. Middleton A, Fritz SL, Lusardi M. Walking speed: the functional vital sign. J Aging Phys Act. 2015; 23: 314-22.

13. Westbury LD, Beaudart C, Bruyère O, Cauley JA, Cawthon P, Cruz-Jentoft AJ, et al. Recent sarcopenia definitions-prevalence, agreement and mortality associations among men: Findings from population-based cohorts. J Cachexia Sarcopenia Muscle. 2023; 14: 565-75.

14. Taekema DG, Gussekloo J, Westendorp RG, de Craen AJ, Maier AB. Predicting survival in oldest old people. Am J Med. 2012; 125: 1188-94.

15. Zhao W, Ukawa S, Tsushita K, Kawamura T, Wakai K, Ando M, et al. Association of gait speed with mortality among the Japanese elderly in the New Integrated Suburban Seniority Investigation Project: a prospective cohort study. Age Ageing. 2015; 44: 153-7.

16. Cooper R, Kuh D, Hardy R; Mortality Review Group; FALCon and HALCyon Study Teams. Objectively measured physical capability levels and mortality: systematic review and meta-analysis. BMJ. 2010; 341: c4467.

17. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, et al. Gait speed and survival in older adults. JAMA. 2011; 305: 50-8.

18. Obesity: Preventing and managing the global epidemic. Geneva 2000; Available from: http://apps.who.int/iris/ bitstream/10665/42330/1/WHO_TRS_894.pdf ?ua1⁄41&ua1⁄41

19. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of adl: a standardized measure of biological and psychosocial function. JAMA. 1963; 185: 914-9.

20. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. Gerontologist. 1969; 9: 179-86.

21. Isautier JMJ, Bosnić M, Yeung SSY, Trappenburg MC, Meskers CGM, Whittaker AC, et al. Validity of nutritional screening tools for community-dwelling older adults: a systematic review and meta-analysis. J Am Med Dir Assoc. 2019; 20: 1351.e13-1351.e25.

22. Thompson MQ, Theou O, Tucker GR, Adams RJ, Visvanathan R. FRAIL scale: Predictive validity and diagnostic test accuracy. Australas J Ageing. 2020; 39: e529-e536.

23. Pazan F, Wehling M. Polypharmacy in older adults: a narrative review of definitions, epidemiology and consequences. Eur Geriatr Med. 2021; 12: 443-52.

24. Abellan van Kan G, Rolland Y, Andrieu S, Bauer J, Beauchet O, Bonnefoy M, et al. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an International Academy on Nutrition and Aging (IANA) Task Force. J Nutr Health Aging. 2009; 13: 881-9.

25. Doi T, Nakakubo S, Tsutsumimoto K, Kurita S, Ishii H, Shimada H. Spatiotemporal gait characteristics and risk of mortality in community-dwelling older adults. Maturitas. 2021; 151: 31-5.

26. Navarrete-Villanueva D, Gómez-Cabello A, Marín-Puyalto J, Moreno LA, Vicente-Rodríguez G, Casajús JA. Frailty and physical fitness in elderly people: a systematic review and meta-analysis. Sports Med. 2021; 51: 143-60.

27. Ramsey KA, Meskers CGM, Trappenburg MC, Verlaan S, Reijnierse EM, Whittaker AC, et al. Malnutrition is associated with dynamic physical performance. Aging Clin Exp Res. 2020; 32: 1085-92.

28. Kramer CS, Groenendijk I, Beers S, Wijnen HH, van de Rest O, de Groot LCPGM. The association between malnutrition and physical performance in older adults: A systematic review and meta-analysis of observational studies. Curr Dev Nutr. 2022; 6: nzac007.

29. Bahat G, Kilic C, Eris S, Karan MA. Power versus sarcopenia: associations with functionality and physical performance measures. J Nutr Health Aging. 2021; 25: 13-7.

30. Alcazar J, Losa-Reyna J, Rodriguez-Lopez C, Alfaro-Acha A, Rodriguez-Mañas L, Ara I, et al. The sit-to-stand muscle power test: An easy, inexpensive and portable procedure to assess muscle power in older people. Exp Gerontol. 2018; 112: 38-43.