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The Overlap of Sarcopenia and Frailty: When Two Major Geriatric Syndromes Coincide

Filiz Demirdağ[1], Esma Nur Kolbaşı[2], Gözde Balkaya Aykut[3], Özlem Pehlivan[4], Sema Uçak Basat[3]

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[1]Department of Palliative Care, University of Health Sciences, Ümraniye Training and Research Hospital, İstanbul, Türkiye
[2]Department of Physiotherapy and Rehabilitation, İstanbul Medeniyet University Faculty of Health Sciences, İstanbul, Türkiye
[3]Department of Internal Medicine, University of Health Sciences, Ümraniye Training and Research Hospital, İstanbul, Türkiye
[4]Department of Rheumatology, University of Health Sciences, Ümraniye Training and Research Hospital, İstanbul, Türkiye

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Correspondence
Esma Nur Kolbaşı,
İstanbul Medeniyet University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye
Phone: +90 216 288 33 33
e-mail: esmanur.kolbasi@medeniyet.edu.tr

ABSTRACT

Objective: The aim of this study was to investigate the prevalence of the co-occurrence of sarcopenia and frailty and to determine any associations between these syndromes and physical activity, nutrition, and psychological well-being in Turkish older adults.

Materials and Methods: All of the participants were aged ≥65 years. Sarcopenia was diagnosed using the SARC-CalF scale with a previously determined national calf diameter cut-off value of 33 cm. Frailty was evaluated with the FRAIL scale. The Rapid Assessment of Physical Activity (RAPA) was administered to measure physical activity, the Mini-Nutritional Assessment (MNA) to evaluate nutritional status, and the Geriatric Depression Scale (GDS) to assess depression.

Results: A total of 566 individuals were included in the study. The prevalence rate of pre-frailty, sarcopenia, frailty, and sarcopenia+frailty was 42.4%, 6.89%, 6.89%, and 2.47%, respectively. A multinomial logistic regression model consisting of the RAPA (p<0.001), MNA (p<0.001), and GDS (p<0.001) revealed that each was associated with all of the subgroups (pseudo R^2=0.322; goodness-of-fit= 0.753; p=0.481). The association became stronger with progression from pre-frailty to sarcopenia+frailty, with the exception of the RAPA score recorded in the sarcopenia subgroup.

Conclusion: The concurrent prevalence rate of sarcopenia and frailty was 2.47% in community-dwelling older adults. The likelihood of being physically inactive, malnourished, and depressed became more pronounced with deterioration in physical condition. This is the first known study to report the prevalence rate of the overlap of frailty and sarcopenia in Türkiye and the association between these syndromes and physical inactivity, malnutrition, and depression. The study has been registered with the US National Institutes of Health (National Clinical Trial number: NCT04146844).

Keywords: Depression, frail elderly, healthy diet, geriatrics, sarcopenia, sedentary behavior

INTRODUCTION

Sarcopenia was defined by the European Working Group on Sarcopenia (EWGSOP) as "a muscle disease (muscle failure) rooted in adverse muscle changes that accrue across a lifetime" in 2019 (1). Frailty is "a state of reduced ability to recover from stress resulting from an age-related decline in reserves" (2). Fried et al. (3) examined criteria such as weight loss, exhaustion, weakness, and physical activity and the progression of the syndrome, and noted that frailty should perhaps be considered separately from comorbidity or disability.

Sarcopenia and frailty may be present concurrently in the same patient; there may be an overlap of the conditions (4). Both syndromes are widespread in older adults and highly associated with serious adverse outcomes, such as falls (5), mobility disorders (6), and mortality (7). However, they are potentially preventable and reversible conditions (8, 9). Therefore, it is important to carefully examine particular aspects of health in order to determine the appropriate treatment.

To our knowledge, no investigation of the prevalence of concurrent existence of sarcopenia and frailty in Türkiye or associations between physical activity, nutrition, and psychological well-being and the overlap of sarcopenia and frailty has been published in the literature. Therefore, this study was designed to a) report the prevalence of the overlap of sarcopenia and frailty in a population of community-dwelling older adults in Türkiye and b) determine associations between physical activity, nutrition, and psychological well-being and these syndromes.

MATERIALS and METHODS

Ethical Considerations

This research was approved by the İstanbul Health Sciences University Ümraniye Training and Research Hospital Clinical Trials Ethics Committee on December 3, 2020 (no: 390). Written and oral consent was obtained from the patients or their legal guardians when they presented at the hospital. The study has been registered with the US National Institutes of Health (National Clinical Trial number: NCT04146844).

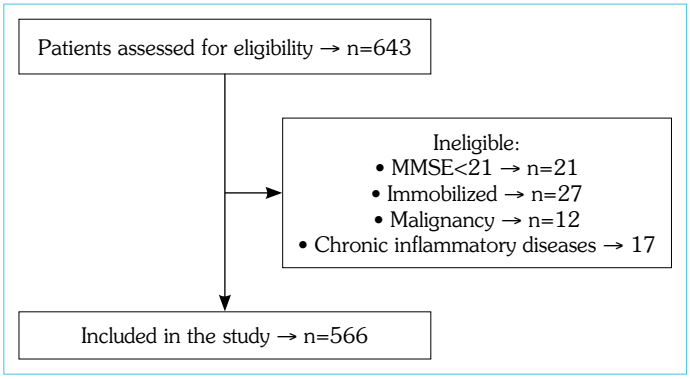

Figure 1. Study diagram
MMSE: Mini mental state examination

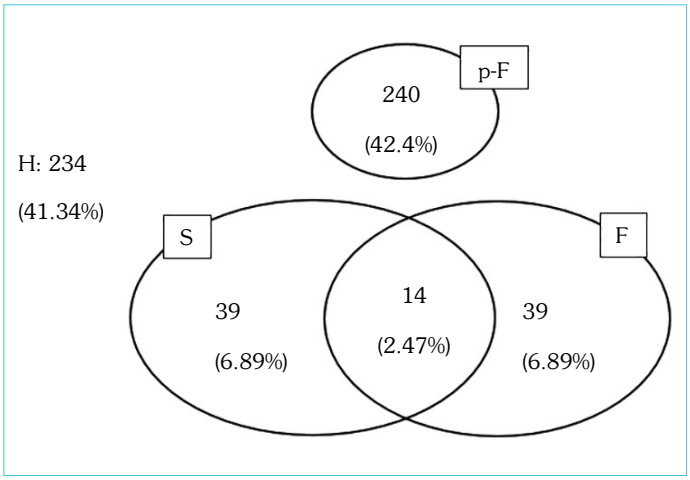

Figure 2. Distribution of frailty and sarcopenia in the study population
F: Frail; H: Healthy (non-sarcopenic, non-frail); p-F: Pre-frail; S: Sarcopenic

Study Design

This was a cross-sectional study conducted at a single center in İstanbul, Türkiye. The records of individuals aged ≥65 years who presented at the internal medicine outpatient clinic of İstanbul Health Sciences University Ümraniye Training and Research Hospital between December 15, 2020 and April 15, 2021 were examined by the researchers for inclusion in the study. The criteria were age ≥65 years and being a native Turkish speaker. Those who a) had cognitive impairment (Mini Mental State Examination <21 points), b) were immobilized, c) had a malignancy, d) had a chronic inflammatory disease, or e) used steroid drugs were excluded.

Outcome Measures

One of the researchers compiled demographic details based on the initial information in the patient and medical files. The outcome measure information was added subsequently for use in the analysis.

The first measurement tool administered was the SARC-CalF, which adds consideration of a calf circumference value to the SARC-F questionnaire (strength, assisting with walking, rising from a chair, climbing stairs, and falling). The SARC-F is used as a means to easily diagnose sarcopenia (10). We adapted the SARC-CalF described by Barbosa-Silva et al. (11) by replacing the original calf circumference cut-off value with the 33-cm reference value defined for the Turkish population (12). In addition to measurement of the calf circumference, anthropometric measurements of the waist, hip, and arms were recorded.

Table 1. Descriptive and clinical features of the participants

Variables and measurements	Female (n=391) Mean±SD	Male (n=175) Mean±SD
Age (years)	73.9±6.41	75.51±6.83
BMI (kg/m^2)	29.25±5.21	27.3±4.97
Anthropometric measurements		
Waist	98.31±12.75	101.5±11.51
Hip	107.56±10.53	104.92±8.78
Arm	29.66±3.94	28.47±3.37
Calf	36.56±4.49	36.48±3.58
SARC-CalF	4.06±4.18	2.33±3.84
FRAIL	1.08±1.06	0.66±0.93
RAPA-aerobic activity	3.68±0.96	4.17±0.88
MNA	24.2±3.78	25.58±2.99
GDS	4.44±3.7	2.79±3.46

BMI: Body-mass index; GDS: Geriatric Depression Scale; MNA: Mini Nutritional Assessment; RAPA: Rapid Assessment of Physical Activity; SARC-CalF: SARC-F with calf circumference; SD: Standard deviation

The second assessment used was the FRAIL scale, which is a simple tool to detect frailty. The scale includes 5 items: fatigue, resistance, ambulation, illness, and loss of weight (13). The FRAIL scale scores range from 0–5 (i.e., 1 point for each component; 0=best to 5=worst) and the scores are used to categorize health status as frail (3–5 points), pre-frail (1–2 points), or robust (0 points).

The Rapid Assessment of Physical Activity (RAPA), a quick and easy tool to assess physical activity levels in adults aged >50 years, was administered to evaluate participation in aerobic and strength+flexibility activities. The total score of the first 7 items is used to rank the level and intensity of aerobic physical activity: 1=sedentary and 5=regularly active. The second part of the RAPA, which measures strength and flexibility, is scored separately: strength training=1, flexibility=2, or both=3 (14).

The Mini Nutritional Assessment (MNA), consisting of 18 items with a maximum score of 30 points, was used to assess the nutritional status of the participants. The sum score is used to grade nutritional status as 1) adequate (≥24 points), 2) at risk of malnutrition (17–23.5 points), or 3) protein-calorie malnutrition (<17 points) (15, 16).

Finally, the Geriatric Depression Scale-15 (GDS) was administered to the participants to gauge their psychological state. The scale consists of 15 questions related to feelings during the previous week and the answers are scored yes/no (0 or 1 point). A score of ≥10 indicates possible depression (17, 18).

Table 2. Univariate multinomial logistic regression analysis¥

Independent variables	Groups							
	Pre-frail (n=240)		Sarcopenia (n=39)		Frail (n=39)		Sarcopenia+Frail (n=14)	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
RAPA	0.577 (0.451–0.739)	<0.001*	0.502 (0.354–0.711)	<0.001*	0.300 (0.200–0.451)	<0.001*	0.215 (0.131–0.354)	<0.001*
MNA	0.855 (0.799–0.914)	<0.001*	0.754 (0.692–0.822)	<0.001*	0.688 (0.622–0.762)	<0.001*	0.640 (0.569–0.721)	<0.001*
GDS	1.192 (1.122–1.266)	<0.001*	1.222 (1.127–1.326)	<0.001*	1.384 (1.254–1.528)	<0.001*	1.416 (1.258–1.594)	<0.001*

¥: Reference group: Not sarcopenic/not frail; *: P<0.05; GDS: Geriatric Depression Scale; MNA: Mini Nutritional Assessment; RAPA: Rapid Assessment of Physical Activity; CI: Confidence interval; OR: Odd ratios

Table 3. Multinomial logistic regression model with the subgroups as dependent variable¥

Model	Groups							
	Pre-frail (n=240)		Sarcopenia (n=39)		Frail (n=39)		Sarcopenia+Frail (n=14)	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
RAPA	0.773 (0.602–0.994)	0.044*	0.789 (0.500–1.245)	0.309	0.466 (0.305–0.714)	<0.001*	0.355 (0.165–0.763)	0.008*
MNA	0.869 (0.800–0.945)	0.001*	0.777 (0.683–0.883)	<0.001*	0.725 (0.641–0.820)	<0.001*	0.653 (0.539–0.791)	<0.001*
GDS	1.168 (1.085–1.258)	<0.001*	1.171 (1.037–1.322)	0.011*	1.303 (1.158–1.467)	<0.001*	1.460 (1.149–1.856)	0.002*

¥: Reference group: Not sarcopenic/not frail; *: P<0.05; GDS: Geriatric Depression Scale; MNA: Mini Nutritional Assessment; RAPA: Rapid Assessment of Physical Activity; CI: Confidence interval; OR: Odd ratios

Statistical Analysis

The statistical analysis was performed using IBM SPSS Statistics for Windows, Version 21.0 software (IBM Corp., Armonk, NY, USA). The normality of the data was analyzed with the Shapiro-Wilk test. Descriptive statistics are reported as the mean±SD for continuous variables and as number and frequency for binary and categorical variables. Frequency analysis was used to determine the prevalence rate of sarcopenia and frailty. The study group was then divided into 5 subgroups based upon the prevalence analysis: not sarcopenic/not frail, pre-frail, sarcopenia, frail, and sarcopenia+frail (overlap). Univariate multinomial regression analysis for each independent variable (RAPA, MNA, and GDS) with the subgroups used as the dependent variable was performed to determine a multinomial regression model. Multinomial regression analysis using the enter method was performed to compare the odds of being physically inactive, malnourished, and depressive between participants who were not sarcopenic and not frail and those with 1 or both conditions (i.e., pre-frailty, sarcopenia, frailty, or sarcopenia+frailty). Pearson chi-squared testing and goodness-of-fit testing were performed and an insignificant p value (p>0.05) was interpreted as a successful model fit. The Nagelkerke R^2 was used for pseudo R^2 statistics. The statistical level of significance was set at p<0.05.

RESULTS

A total of 566 older adults (69.1% women) were included in the study. A flow diagram of the study is provided in Figure 1. Table 1 displays descriptive and clinical characteristics of the participants.

The prevalence rate of both sarcopenia and frailty was 6.89% (each) and the rate of sarcopenia and frailty overlap was 2.47% (Fig. 2). The number of participants in the 5 subgroups based upon the prevalence analysis was not sarcopenic/not frail (n=234), pre-frail (n=240), sarcopenia (n=39), frail (n=39), and sarcopenia+frail (overlap, n=14). Table 2 illustrates the results of univariate multinomial logistic regression analysis with the subgroups used as the dependent variable.

Table 3 shows the multinomial logistic regression model, which included measurements of physical activity (RAPA), malnutrition (MNA), and depression (GDS) (R^2=0.322; goodness-of-fit= 0.753; p=0.481) with the subgroups as the dependent variable. A good model fit was observed and the model was able to predict the dependent variable with a precision of 75.3%. The model consisting of the RAPA, MNA, and the GDS was significantly associated with each subgroup. There was no multicollinearity between the independent variables (MNA variance inflation factor [VIF]=1.284, GDS VIF=1.300, RAPA VIF=1.201).

DISCUSSION

The first objective of this study was to estimate the prevalence of overlap of sarcopenia and frailty in a population of community-dwelling older adults in İstanbul, Türkiye. The results of this study revealed a concurrent prevalence of sarcopenia and frailty of 2.47% and a prevalence rate of 6.89% for sarcopenia and for frailty (each). Another aim was to evaluate possible associations between these geriatric syndromes and physical inactivity, malnutrition, and depression. Both univariate and multiple multinomial logistic regression analysis revealed that these syndromes were associated with physical inactivity, malnutrition, and depression. The odds of being physically inactive, malnourished, and depressed were more pronounced with deteriorating physical condition: from pre-frail to both sarcopenic and frail (except physical activity in sarcopenia).

Sarcopenia and frailty have begun to attract greater attention among researchers worldwide due to the rapid increase in the aging population. There has been some assessment of the prevalence of either sarcopenia or frailty among older adults in Türkiye who lived in different environments (e.g., rural areas or nursing homes) (19–24). Bahat et al. (23) reported a mean sarcopenia prevalence of 8.7% using the SAR-CalF (with 33-cm cut-off point for calf circumference). The difference in the rate findings may be due to the slightly younger population in our study. Also, the strict criteria used for inclusion in the current study likely yielded a group with more robust health.

Akın et al. (20) reported a prevalence of pre-frailty and frailty of 45.6% and 10%, respectively, in community-dwelling older adults. The rates were around/approximately 3% lower in our study (pre-frailty: 42.4%; frailty: 6.89%). This may also be a result of the difference in the profiles of the study populations. In our study, we excluded participants with cognitive decline, whereas Akın et al. (20) specifically investigated an association between cognitive decline and frailty, among other parameters. A link between frailty and cognitive decline has now been well established (25). Frailty may contribute to cognitive decline through complex physical, psychological, and social mechanisms, which in turn may lead to dementia. Thus, it is not unreasonable that our study resulted in a lower prevalence rate.

A study conducted in Sweden examined the overlap of sarcopenia, frailty, and malnutrition among nursing home residents (26). The overlap rate of sarcopenia and frailty was 9.8%. Another study from Germany recently analyzed the concurrent presence of sarcopenia, frailty, cachexia, and malnutrition in elderly inpatients (4). A meta-analysis noted a sarcopenia and frailty overlap prevalence of 19% (27). There was a large difference in the prevalence of sarcopenia among community-dwelling older adults, nursing home residents, and inpatients (10%, 41%, and 23.5%, respectively). Different prevalence rates in different populations are not unexpected. A team from Bogota, Columbia, reported an overlap rate (2.2%) that was similar to our findings (28). To the best of our knowledge, our study is the first to report the prevalence of the overlap of frailty and sarcopenia in Türkiye.

An important finding of our study is that the odds of being physically inactive, malnourished, or depressive were higher in all of the subgroups than for their healthy peers, with the exception of the physical inactivity parameter in the sarcopenia subgroup (Table 3). In other words, pre-frailty, sarcopenia, frailty, and sarcopenia+frailty were associated with physical inactivity, malnutrition, and depression. Furthermore, these associations became more significant with progression from pre-frailty to the overlap of sarcopenia and frailty.

Numerous other studies have examined an association between sarcopenia or frailty and physical inactivity (9), malnutrition (4, 21, 26), and depression (21). However, as far as we know, our study is the first to define an association between the overlap of sarcopenia and frailty and a model consisting of physical activity, nutritional status, and depressive symptoms in community-dwelling older adults. Our results indicating associations between the model and the physical conditions becoming more pronounced with degradation from robustness to frailty is supported by the hypothesis put forward by Fried et al. (3). Though sarcopenia and frailty may occur concurrently in older adults, adverse outcomes, such as physical inactivity, malnutrition, and depression are more prominent in frail patients than in patients with sarcopenia.

Our study highlights again the importance of the current trend in aging research to design interventions for older adults presenting with multiple coexisting comorbidities (29).

This study had some limitations. First of all, we were not able to diagnose sarcopenia in a more objective manner defined by EWGSOP or any other group, due to several environmental and financial reasons. We, therefore, suggest that future researchers design studies using objective assessment methods, such as grip strength measurement and muscle mass calculations. We used the SARC-CalF, which is a globally acknowledged tool for diagnosing sarcopenia, rather than the SARC-F. The major disadvantage of the SARC-F is its low sensitivity (30). The addition of the calf circumference measurement to the SARC-F (SARC-CalF) can overcome this disadvantage and improve the sensitivity (11). Secondly, we were unable to include more patients due to the coronavirus 2019 pandemic. We recommend the use of larger cohorts in future studies.

CONCLUSION

To conclude, we found a prevalence of an overlap of sarcopenia and frailty in a single center of 2.47% in community-dwelling older adults in İstanbul, Türkiye. Additionally, sarcopenia and/or frailty was associated with malnutrition, physical inactivity, and depression. This association increased as the condition proceeded to a more serious syndrome. Our results highlight the importance of physical activity, adequate nutrition, and psychological well-being to maintain good health and to prevent decline in an older adult's physical condition (i.e., from non-sarcopenic/non-frail to frail).

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Ethics Committee Approval: The Ümraniye Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 03.12.2020, number: 390).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – FD, ENK, GBA, ÖP, SUB; Design – FD, ENK; Supervision – FD, ENK; Resource – FD, ENK, GBA; Materials – FD, ENK, GBA, ÖP, SUB; Data Collection and/or Processing – FD, ENK, GBA; Analysis and/or Interpretation – ENK, FD; Literature Search – ÖP, SUB, FD; Writing – FD, ENK; Critical Reviews – ÖP, SUB, FD.

Conflict of Interest: The authors have no conflict of interest to declare.

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