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SARC-F QUESTIONNAIRE DETECTS FRAILTY IN OLDER ADULTS

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Abstract: *Background/Objectives:* The physical phenotype of frailty, described by Fried et al., shows significant overlap with sarcopenia. EWGSOP2 recommends the SARC-F questionnaire to screen for sarcopenia. Considering common features between both conditions, we aimed to investigate whether the SARC-F questionnaire could also be a valid and reliable tool to screen or evaluate frailty. *Design:* Retrospective, cross-sectional. *Setting:* Istanbul University Istanbul Faculty of Medicine. *Participants:* A total of 447 older adults (70.7% female, mean age: 74.5±6.6 years). *Measurements:* Frailty was assessed by the modified Fried scale. SARC-F questionnaire was performed by all participants. We used a receiver operating characteristics curve to obtain SARC-F cut-off values to detect frailty, and calculated the area under the curve and 95% confidence interval. *Results:* There were 93 (20.8%) older adults with frailty according to the modified Fried scale. SARC-F cut-off ≥1 had 91.4% sensitivity and 44.9% specificity. SARC-F cut-off ≥2 presented the best balance between sensitivity and specificity (sensitivity: 74.1% vs. specificity: 73.7%) to identify frailty (area under curve: 0.807; 95% confidence interval: 0.76-0.84, p<0.001). SARC-F ≥4 had high specificity of 92.6% with a sensitivity of 46.2%. *Conclusion:* We suggest that SARC-F ≥1 point can be used to screen for frailty with high sensitivity, and SARC-F ≥4 can be used to diagnose frailty with high specificity. SARC-F may be used to evaluate frailty in usual geriatric practice.

Key words: Sarcopenia, frailty, screening, diagnosis, geriatric practice.

Introduction

Frailty is a geriatric syndrome characterized by an age-associated decline in physiologic reserve and function across multiple organ systems. It brings increased vulnerability to stressors (1). Frail older adults are less able to tolerate or adapt to illnesses, trauma, or surgical and medical interventions than non-frail ones. Therefore, frailty is associated with increased risk of procedural complications, falls, institutionalization, disability, and death (2). The prevalence of frailty varies with the tool used to detect it.It varies between 9.9%-13.6%, by the analyses of multiple studies (3).

A recent consensus on frailty recommended that older adults over age 70 and adults with chronic disease or weight loss exceeding 5% over a year be screened for frailty using available screening tools (4). Multiple screening tools have been developed and utilized for frailty evaluation, and none of them is regarded as the gold standard. Fried Frailty scale is one of the most utilized ones, and it defines physical frailty phenotype by the presence of three criteria out of five criteria, i.e., low energy, low grip strength, low physical activity, slow walking speed, and/or unintentional weight loss (1).

Frailty is hypothesized to be driven by aging-related molecular changes, chronic environmental exposures, and specific disease states (5). One of the key physiologic components of frailty is sarcopenia: Age-related hormonal changes and changes in inflammatory pathways (such as an increase in inflammatory cytokines) cause a decline in skeletal muscle mass and function. The causal mechanisms underlying sarcopenia have also been hypothesized to contribute to frailty through interactive pathways (6). Therefore, the physical phenotype of frailty shows a significant overlap with sarcopenia (7). Furthermore, sarcopenia is also associated with similar adverse outcomes with frailty (i.e. falls, fractures, physical disabilities, and mortality) (7).

SARC-F questionnaire has been suggested as a first step to identify sarcopenia in older adults by the recent European Working Group on Sarcopenia in Older People 2 (EWGSOP2) consensus (7). SARC-F is a 5 item self-reported questionnaire and does not require any equipment. It has been considered as an easy to apply and a convenient formal method to find sarcopenia cases in clinical practice with high specificity but a lower sensitivity (7).

In this report, we aimed to investigate the efficiency and performance of the SARC-F questionnaire to screen or evaluate frailty in older people.

Materials and Methods

This study is a retrospective, cross-sectional study performed in the geriatric outpatient clinic of a university hospital. The participants aged ≥65 years that were admitted to geriatrics outpatient clinic were included in the study. Exclusion criteria were being younger than 65 years old, refusal to participate, moderate to severe dementia, or other cognitive/communicative problems (e.g., severe hearing loss) preventing patients from answering the questions reliably. We informed all the participants about the study details and received consent. The institutional ethical committee approved the study protocol, and we performed the study in line with the guidelines stated in the

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Table 1
Demographic characteristics of the study population

	Male (n=131)	Female (n=316)	Total (n=447)
Age (years)	75.5±6.4	74.1±6.6	74.5±6.6
BMI (kg/m²)	28.2±4.2	31.2±6.0	30.2±5.8
Number of illnesses	3.9±1.8 (4)	4.0±2.0 (4)	3.9±1.9 (4)
Number of regular drugs	6.2±3.6 (6)	6.1±3.4 (6)	6±3.5 (6)
Chronic diseases			
Diabetes mellitus	32.3%	35.6%	34.6%
Hypertension	69.2%	71.4%	70.8%
Coronary heart disease	33.1%	15.6%	20.7%
COPD	11.5%	4.1%	6.3%
Hyperlipidemia	36.9%	34.3%	35.1%
Hypothyroidism	6.2%	21.3%	16.9%
Depression	16.9%	22.2%	20.7%

BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease

Helsinki Declaration.

SARC-F questionnaire is a 5 item self-reported test questioning: Strength (how much difficulty do you have in lifting or carrying ten pounds?), Assistance in walking (how much difficulty do you have walking across a room?), Rise from a chair (How much difficulty do you have transferring from a chair or a bed?), Climb stairs (How much difficulty do you have climbing a flight of 10 stairs?) and Falls (How many times have you fallen in the past year?). Each item is scored as zero if 'none' is the answer; 1, if 'some' is the answer (except for fifth one: item receives 1 point if the patient has fallen 1-3 times) and 2 if a lot or unable is the answer (except for fifth one; item receives 2 points if the patient has experienced 4 or more falls in the past year). The cut-off point for predicting sarcopenia is 4; higher, the result means more risk of sarcopenia. Our group performed the Turkish validity and reliability of the SARC-F questionnaire under the leadership of EuGMS (8). In the Turkish validation, we used 5 kg instead of 10 lbs due to its more convenient use.

We used a modified Fried frailty scale to identify frailty in older adults. The Modified Fried frailty scale has 5 domains: weight loss, exhaustion, weakness, low walking speed, and low physical activity. We assessed weight loss by asking the patient if he/she experienced unintentional weight loss over 4.5 kgs (10 Ibs) in the past year. Exhaustion is assessed by questioning whether he/she feels lack of energy/exhausted. Weakness is assessed by handgrip strength (HGS) measurement: a Jamar hydraulic hand dynamometer is used with a validated protocol (9, 10). HGS is measured in sitting position, with the elbow in 90° flexion, wrist in the neutral position. Participants apply the maximum grip strength with both left and right hands, three times for both sides. The maximum grip strength performed is accepted as the HGS value. We considered the cut-offs for males and females as 27 kg and 16 kg, respectively, as recommended by the EWGSOP2 (9). We measured usual gait speed (UGS) by the participants walking 4 m with their usual speed with a cut off of ≤0.8 m/sec. Finally, we questioned low physical activity by asking whether the subject spent most of his/her time sitting in the previous year or performed physical activities less than once a week (11, 12). If the total score of the modified Fried frailty scale was 0, we defined the older adult as robust, if the score was 1 or 2, as prefrail and ≥ 3 as frail.

We noted the demographics and clinical variables, i.e., age, sex, number of chronic diseases, regular medications, and specific chronic diseases form the patient files. All the participants underwent comprehensive geriatric assessment (CGA); including Geriatric Depression Scale (GDS) (13), Mini-Mental State Examination (MMSE) (14), Mini-Nutritional Assessment (MNA) (15), Katz and Lawton basic and instrumental activities of daily living (ADL and IADL) (16, 17), questioning of chronic pain, constipation, dysphagia, falls in the past year, sleep disorders and urinary and fecal incontinence.

All of the questionnaires were filled and measurements mentioned were performed by a qualified physiotherapist.

Statistical Analysis

We evaluated descriptive statistics as numbers (percentage) for categorical variables and as mean±standard deviation for normally distributed variables, and median for skew distributed ones. We analyzed the nominal variables by the chi-square test. We used an independent sample T-test or Mann-Whitney U test as indicated. We used an analysis of variances test and Kruskal Wallis test to detect differences between more than two groups as appropriate. We calculated the sensitivity and specificity of SARC-F for identifying frailty. We used a receiver operating characteristics (ROC) curve to obtain cut-

Table 2
Comprehensive Geriatric Assessment Results

CGA parameters	Total	Male	Female	p
Frailty	20.8%	9.9%	25.3%	<0.001
Urinary incontinence	38.6%	25.2%	44.1%	<0.001
Fecal incontinence	5.1%	5.3%	5.1%	0.90
Falls in the past year	41.3%	32.1%	45.1%	0.01
Dysphagia	8.5%	3.7%	10.4%	0.04
Constipation	5.1%	5.3%	5.1%	0.97
Chronic Pain	62.2%	44.3%	69.6%	<0.001
Sleep Disturbance	38.3%	27.5%	42.7%	0.003
ADL	5.6±0.6	5.7±0.4	5.6±0.7	<0.001
IADL	6.8±1.9	6.7±2.1	6.9±1.9	0.45
MMSE	26.6±3.7	26.8±4	26.5±3.6	0.52
MNA	21.0±4.2	20.9±6	21±3.5	0.95
GDS	10.1±8	6.7±6.7	11.3±8.1	<0.001
UGS	0.89±0.2	0.97±0.2	0.86±0.2	<0.001

*CGA: Comprehensive Geriatric Assessment; ADL: Activities in Daily Living; IADL: Instrumental Activities in Daily Living; MMSE: Mini-Mental State Examination; MNA: Mini-Nutritional Assessment; GDS: Geriatric Depression Scale; UGS: Usual Gait Speed

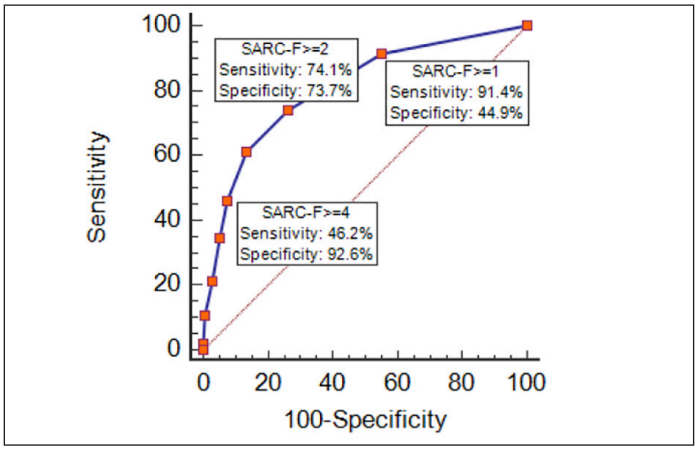
off values, and calculated the area under the curve (AUC) and 95% confidence interval (CI). Sensitivity, specificity, positive (PPVs), and negative predictive values (NPV) were calculated for different cut-off scores of SARC-F to identify frailty. We set a p-value <0.05 as significant. We performed statistical analyses by SPSS v 21.0 (SPSS Statistics; IBM, Armonk, NY) and MedCalc Statistical Software v 15.2 (MedCalc Software, Ostend, Belgium).

Results

We included 447 patients (316 female and 131 male) with the mean age of 74.5±6.6. The patients' demographic and clinical characteristics are outlined in Table 1. Female participants had a higher prevalence of frailty (9.9% vs. 25.3% in males and females, respectively; p<0.001), were more dependent in ADLs (5.7±0.4 in males and 5.6±0.7 in females; p=0.003); had higher GDS score (6.7±6.7 in males and 11.3±8.1 in females; p<0.001), lower UGS values (0.97±0.2 in males and 0.86±0.2 in females; p<0.001) and suffer more from chronic pain, dysphagia, falls, sleep disturbance and urinary incontinence (p <0.001, 0.04, 0.01, 0.003, <0.001, respectively) (Table 2).

There were 20.8% participants with frailty and 45.5% with pre-frailty. Mean age was higher for frailer participants (71.87±5.0, 74.46±6.8, and 79.11±6.0 for robust, prefrail, and frail participants, respectively; p<0.001). Gait speed, ADL, IADL, and MMSE scores were lower, and GDS, SARC-F, and TUG scores were higher in the frail group than pre-frail and robust groups (p values<0.001, for all). Sleep disturbance was more common in the prefrail group, and chronic pain was more common in robust participants (p values were <0.001 and 0.006, respectively). There were 15.4% of the patients with positive sarcopenia screening (point ≥ 4) by SARC-F. Median SARC-F scores were 0 (interquartile range (IQR): 1, 1 (IQR: 2) and 3 (IQR: 4) in robust, pre-frail and frail patients, respectively (p<0.001 for each comparison). All the SARC-F items and total scores were significantly higher in frailty and pre-frailty groups than in the robust group (p<0.001) (Table 3).

Figure 1
Receiver operating characteristic curve (ROC) analysis of the SARC-F to identify frailty. AUC (95% CI)*=0.807 (0.75-0.85)



*AUC: Area under the curve, CI: Confidence Interval

Table 3
Relationship between SARC-F items and frailty

SARC-F items	Robust (33.6%)	Pre-frail (45.5%)	Frail (20.8%)	p value
Strength (difficulty in lifting and carrying 10 pounds) (%)				
None	87.3	61.6	25.8	<0.001
Some	10.7	24.1	32.3	
A lot or unable	2.0	14.3	41.9	
Assistance (difficulty in walking across a room) (%)				
None	100	90.6	64.5	<0.001
Some	0	8.9	35.5	
A lot or unable	0	0.5	0	
Rise from a chair (difficulty in transferring from a chair or a bed) (%)				
None	98.7	86.7	57.0	<0.001
Some	1.3	12.3	39.8	
A lot or unable	0	1	3.2	
Climb stairs (difficulty in climbing a flight of 10 stairs) (%)				
None	92.0	71.4	34.4	<0.001
Some	7.3	23.6	48.4	
A lot or unable	0.7	4.9	17.2	
Falls in the past year (%)				
None	70	55.7	49.5	<0.001
1-3	29.3	40.4	39.8	
≥4	0.7	3.9	10.8	
Total SARC-F score*	0 (0-1)	1 (0-2)	3 (1-5)	<0.001
High sarcopenia risk	0.7	12.3	46.2	<0.001

* Median (Interquartile range)

Table 4
The sensitivity, specificity, PPVs and NPVs of SARC-F

SARC-F	Se (%) (Interval)	Sp (%) (Interval)	PPV (%) (Interval)	NPV(%) (Interval)
≥1[a]	91.4 (83.8-96.2)	44.9 (39.7-50.3)	30.3 (28.0-32.8)	95.2 (91.0-97.5)
≥2[b]	74.1 (64.1-82.7)	73.7 (68.8-78.2)	42.6 (37.5-47.8)	91.6 (88.4-93.9)
≥4[c]	46.2 (35.8-56.9)	92.6 (89.4-95.1)	62.3 (51.9-71.8)	86.8 (84.5-88.9)

*Se: Sensitivity, Sp: Specificity, PPV: Positive Predictive Value, NPV: Negative Predictive Value; a. Cut-off we suggest for screening of frailty; b. Cut-off ≥2 represents the best balance between sensitivity and specificity; c. Cut-off we suggest for diagnosis of frailty.

Sensitivity and specificity analyses and cut-off determination for the screening and diagnosis of frailty

SARC-F cut-off ≥1 had a sensitivity of 91.4% and specificity of 44.9% to screen frailty. SARC-F cut-off ≥ 2 showed the best balance between sensitivity and specificity (sensitivity: 74.1% vs specificity: 73.7%) (AUC=0.807; 95% Cl: 0.75-0.85) corresponding to the cut-off to identify frailty (Figure 1). On the other hand, a SARC-F cut-off score >=4 performed best to diagnose frailty with considerably high specificity (92.6%) but low-to-moderate sensitivity (46.2%). The sensitivity, specificity, PPV, and NPV are given in Table 4.

Discussion

This study shows that the SARC-F questionnaire could be an appropriate tool screening for not only sarcopenia but also frailty status in older people. The questionnaire demonstrated high sensitivity and specificity for identifying frailty against the modified Fried frailty scale with a cut-off point of 2.

Frailty prevalence increases with age. We identified that

20.8% of our study population was frail by the modified Fried frailty scale. There might be several reasons for the relatively high frailty prevalence in our study. We conducted this study among the older adults admitted to the outpatient clinic. They were not randomized samples form community-dwelling older adults. The majority of participants admitting to our hospital have low socioeconomic status, and this parameter has been suggested to have a significant negative impact on physical health (18) due to, low nutritional status, bad lifestyle behaviors, and more exposures to health risks.

Frailty had significant associations with adverse outcomes like low physical performance and ADL measures in accordance with the literature (1, 19, 20). Also, frailty was significantly associated with higher SARC-F values and hence, increased risk of sarcopenia. This finding brings out the concept that one test may identify both conditions at the same time. There has been increasing recognition of the importance of frailty in recent years, as it is accepted as a pre-disability syndrome associated with a high risk of being hospitalized or disabled (21). Preserving autonomy, health-related quality of life, and aging at home are the goals for healthy aging (22). There exists several questionnaires suggested useful for identifying frailty. One of the most preferred ones is the Fried frailty scale. However, this scale requires some complicated measurements (i.e., handgrip measurement, walking speed); hence requires time and qualification on these measurements. Health care workers have to examine too many patients on a working day in a restricted time. Therefore, a quickly applied, user-friendly questionnaire that can serve for the detection of frailty and sarcopenia simultaneously would be very welcome. According to our results, SARC-F is a suitable tool to screen and diagnose frailty.

Each of the SARC-F items was strongly associated with frailty status, and SARC-F had high sensitivity and specificity in detecting frailty with different cut-offs. This finding can be attributed to the common aspects of frailty and sarcopenia. First of all, low muscle strength is the core point of sarcopenia (7) and is an important contributor to physical frailty (1), and both tools consider muscle strength. Walking is evaluated in both as slow gait speed and assistance in walking could be signs of both frailty and sarcopenia (1, 7). The other two items of SARC-F: rising from a chair and climbing stairs are also associated with lower limb muscle strength/power, function, and endurance, which are also hallmarks of frailty (4). The fifth item of SARC-F questions falls during the past year, and both conditions: frailty and sarcopenia, are associated with increased risk of falls (1, 23, 24). Making a consideration from the frailty perspective, malnutrition and weight loss cause loss of not only fat but also muscle and bone (25), and hence, it can cause low muscle strength and function and increase SARC-F scores. Exhaustion and fatigue questioned by FFI may have several reasons (26, 27) and can cause low physical activity and a sedentary lifestyle. These factors have been shown to be associated with higher levels of visceral adiposity that result in a catabolic effect on muscle (28). Therefore, low physical activity can contribute to a decrease in muscle mass and function and, therefore, can increase SARC-F scores. Lastly, frailty itself increases protein catabolism and loss of muscle mass; and hence can cause higher SARC-F scores (29).

Our study suggests that the optimum cut-off value for the detection of frailty is lower than the value suggested for increased risk of sarcopenia. Validation studies of SARC-F with a cut-off ≥4 demonstrated a low to moderate sensitivity and high specificity to detect sarcopenia (8, 30). Our results revealed that the same is valid for identifying frailty if the same cut-off is preferred, which means that SARC-F with a cut-off point of 4 is valuable in terms of diagnosing both conditions; but lower efficacy in screening these pathologies. The cut-off point 2 represents the best balance between sensitivity and specificity. We suggest that these findings may be important in terms of yielding a message that one can be frail without an increased identified risk for sarcopenia according to SARC-F. Therefore, frailty should be screened and assessed even if test results remain negative for sarcopenia.

This study has some limitations. The study population was not randomly selected community-dwelling older adults but among the ones that applied to the outpatient geriatric clinic of a university hospital. Thus, they do not represent the older population. However, this enabled us to study among the participants with a relatively higher prevalence of frailty, making our study a more efficient one. Secondly, this was a retrospective and cross-sectional study. We can not comment on the causal-effect relationship and other potential confounders. However, our aim was not these, and this study was an appropriate one to identify cutoffs. Lastly, we assessed only physical frailty and could not include demented patients; therefore, evaluation of cognitive and social frailty parameters was missing. Demented participants probably would have higher prevalences of both frailty and sarcopenia. Both Fried scale and SARC-F questionnaire are not suitable for use in demented subjects. An alternative approach may be proxy-filled questionnaires but this method needs to be validated and is currently been studied by this group. Our strengths are that, to the best of our knowledge, this is the only report studying the use of the SARC-F tool to screen/identify frailty. Also, the sample size was not limited.

In conclusion, this study suggests that the SARC-F questionnaire with a cut-off value of ≥2 can be used to identify frailty with considerably high sensitivity and specificity. Alternatively, SARC-F cut-off ≥1 can be used for screening, and cut-off ≥4 can be used for diagnosis of frailty in older adults. Assessment of frailty and sarcopenia at the same time would be practical and useful for the community preserving time and effort. However, reports from different populations are needed to study this practical consideration in different regions.

Conflict of Interest: There are no other relationships/conditions/circumstances that present a potential conflict of interest.

Statement of Authorship: Mehmet Akif Karan: Supervision, Reviewing and Editing. Cihan Kilic: Data curation. Gulistan Bahat: Conceptualization, Methodology, Software, Writing- Original draft preparation, Validation, Writing- Reviewing and Editing, Supervision. Serdar Ozkok: Writing- Reviewing and Editing.

Sponsor's role: None.

Ethical standards: The study was conducted according to guidelines in the Declaration of Helsinki. The study was approved from the local ethic committee.

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