THE ADAPTATION AND VALIDITY OF SARC-F SCALE IN INDIVIDUALS OVER THE AGE OF 65

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ABSTRACT
This study aimed to investigate the effects of eating habits on sarcopenia in individuals over 65, to adapt the SARC-F scale which is used for the early diagnosis of sarcopenia into Turkish and to investigate the validity of the scale in individuals over 65. The research was conducted with 91 subjects, including 45 females and 46 males, who presented to Mersin Private Akademi Hospital. A questionnaire that consists of general information, anthropometric measurements, MNA screening test and the SARC-F scale was administered to all participants. Relationship between the MNA screening test, which is used to evaluate nutritional status, and the SARC-F scale, which is used for the early diagnosis of sarcopenia, was found to be statistically significant (p=0.001). Evaluating the MNA test and SARC-F scale according to gender, it was found that there was a statistically significant relationship between the SARC-F score and gender (p=0.004), whereas there was no relationship between the MNA score and the same (p>0.05). According to the sarcopenia risk status, there was a statistically significant difference in terms of body weight, height, fat-free mass, hand grip strength and finger grip strength. Statistical evaluation that was conducted to check the reliability of the SARC-F screening test revealed a Cronbach's Alpha value of 0.60. Evaluation of validity showed that the KMO value was higher than 0.50 and the factor analysis was reliable since the Bartlett's Test provided statistically significant results. In conclusion, eating habits that involve a sufficient and balanced diet have positive effects on the prevention and treatment of sarcopenia and the Turkish version of the SARC-F scale is valid and reliable.
Keywords: Sarcopenia, malnutrition, geriatric, muscle mass, muscle function, SARC-F.

Introductıon

The phenomenon that has emerged and gained global importance with the 21st century is "population ageing" (Kirkwood, 2003). Therefore, the interest in studies concerning senescence and the prevention and treatment of health problems encountered in the elderly has been increasing (Smith, 2005). One of the age-related dramatic and clinical anatomic changes in humans occurs in the skeletal muscle. Sarcopenia, defined as loss of muscle mass and strength, is a syndrome that cannot be ignored due to the fact that all people lose their skeletal muscle mass as they age (Cruz, 2010). Sarcopenia is very common and like most geriatric syndromes, it often goes unnoticed in the early stages and becomes more apparent after a fall or injury (Yu,2016, Fielding,2011). The SARC-F questionnaire, referred to as a rapid screening test, was developed in 2013 to enable health professionals to evaluate the risk of sarcopenia rapidly and easily (Charlotte, 2016).

Further studies are necessary in order to address the lack of widely accepted diagnostic criteria for identifying sarcopenic patients. In this study, it was aimed to investigate the effects of eating habits on sarcopenia and determine whether the Turkish form of 'A Simple Questionnaire to Rapidly Diagnose Sarcopenia (SARC-F)' scale developed by Malmstrom, T.K. and Morley, J.E et al. in 2013 is a valid and reliable tool for the patients in Turkey, considering that it can be a method suitable for use in the diagnosis of sarcopenia in geriatric patients as well as contributing to the limited number of studies in this field.

Factors Affecting Eating Habits in the Elderly

Ensuring and maintaining a good nutritional health is necessary for physical and cognitive functions, prevention or delaying of chronic diseases and disease-related complications and ensuring the general quality of life (Institute, 2001, Report,2003). Malnutrition represents nutritional health, deficiency and imbalances as well as extreme conditions such as obesity, wherein it is affected by a number of factors related to food intake. These factors include food insecurity/food shortages, lack of personal resources, functional impairment (insufficiency of food acquisition, preparation and eating), social isolation, multiple diseases, oral problems, limited knowledge of nutrition and regular use of multiple drugs (Sharkey,2003, White,1991).

Personal and social factors affecting food intake should not be ignored while developing an age-appropriate diet in order to facilitate compliance. Therefore, it is required to define the socioeconomic, demographic and health-related risk factors that may directly or indirectly affect nutrition in the elderly. Age-related loss of vision, tooth loss, difficulty chewing and swallowing, decreased sense of taste and smell would limit the food selection and lead to decreased food consumption as well as reduced liking for meals. However, lifestyle habits or changes, living

alone and cultural differences also play an important role in food selection. Bad eating habits, which are commonly observed in older adults, reveal the need to focus on these factors (Rakıcıoglu,2003, WHO,2002, Pekcan, 2016).

Malnutrition in Geriatrics

Malnutrition occurs when individuals are unable to fully use the food they consume as a result of disease or other causes (secondary malnutrition), have too much calorie intake (overnutrition) or insufficient intake of essential nutrients (malnutrition or protein-energy malnutrition). However, despite these definitions, there is no universally accepted definition for malnutrition. Malnutrition in the elderly is a common problem which manifests independently or as a complication of disease (Savaş, 2010).

Older adults are among the highest risk groups in terms of malnutrition in the general population. Therefore, malnutrition is an important issue that should be addressed in this age group. Loss of muscle and adipose tissue due to both aging and malnutrition causes the body composition to change. It is important to know which changes stem from ageing in order to define the changes caused by malnutrition accurately (Verbrugghe, 2013).

Sarcopenia

One of the most dramatic and clinical anatomic changes associated with age in humans occurs in the skeletal muscle. In 1989, Irwin Rosenberg used the term 'sarcopenia' to refer to the age-related process of skeletal muscle loss (Rosenberg, 1989). Sarcopenia derives from the Greek works sarx (flesh) and penia (loss). Sarcopenia, for which the accepted definition is still lacking in research and clinical practice, is accompanied by decreased movement ability, decreased physical endurance, slowed gait speed and physical limitation (Cesari, 2006).

Due to the lack of a globally accepted definition for sarcopenia, which was first defined by Rosenberg, the European Geriatric Medicine Society (EuGMS) encouraged The European Working Group on Sarcopenia in Older People (EWGSOP) to establish consensus diagnostic criteria for sarcopenia in 2009. The EWGSOP divided sarcopenia into three stages: presarcopenia, sarcopenia and severe sarcopenia. In the pre-sarcopenia stage, there is decreased muscle mass while muscle strength and physical performance remain unaffected. In the sarcopenia stage, there is decreased muscle strength or performance along with a decrease in muscle mass. In severe sarcopenia, there is decreased muscle mass, muscle strength and performance, i.e. a decrease in all three criteria (Cruz-Jentoft, 2010).

The development of sarcopenia involves many factors such as aging, genetic characteristics, lifestyle and conditions, malnutrition, immobility/sedentary lifestyle, chronic diseases and drug use. Therefore, sarcopenia can sometimes have a single cause or occur due to the combination of various factors. Therefore, it is beneficial in clinical practice to divide sarcopenia into two: primary sarcopenia that develops only due to aging without any other cause and secondary sarcopenia that develops due to one or more factors. Since the etiology of sarcopenia is multifactorial in many older adults, it may not be possible distinguish between primary and secondary sarcopenia (Cruz-Jentoft, 2010).

There are many techniques to evaluate muscle mass. CT, MRI or DEXA are among the methods that can be used for muscle mass measurement. However, DEXA, BIA and anthropometric measurements are preferred in clinical practice. One of these measurements should be selected by also considering the accessibility, applicability and cost factors (Cruz-Jentoft, 2010).

Muscle strength is best measured using a hand-held dynamometer and requires the best mean value of three measurements (Fried, 2001).

Nutrition Screening Tools

A number of questionnaires have been developed and approved for the assessment of nutritional status. Simplified Nutritional Assessment Questionnaire (SNAQ) is a survey consisting of four questions with high sensitivity and specificity to identify older people who have a risk of weight loss (Wilson, 2005). The SCREEN II (Seniors in the Community: Risk Evaluation for Eating and Nutrition) index was developed by Keller et al. This index determines nutritional status by four factors: food intake, physiological, adaptation and functional condition. Test reliability was confirmed by repeatability and it is widely used in Canada (Keller, 2006; Keller, 2005; Keller, 2001).

"Malnutrition Universal Screening Tool" (MUST) is a simple 5-step screening tool recommended by the European Society of Parenteral and Enteral Nutrition (ESPEN) and the British Association for Parenteral and Enteral Nutrition (BAPEN) for use in both elderly inpatients and outpatients. In cases where BMI cannot be measured in the MUST test, it was suggested to check the arm wrist-elbow (ulna) length to determine the height and estimate BMI from the MUAC (mid-upper arm circumference) measurement. Therefore this test was recommended for

inpatients, since it used an alternative method to estimate height. In addition, while the risk of malnutrition can be mentioned with a BMI below 22 kg/m2 in the elderly, MUST considers a BMI of 20 kg/m2 normal, which is accepted as a disadvantage (Stratton, 2004, Stratton,2006, Visvanathan,2003).

The Appetite Hunger and Sensory Perception (AHSP) questionnaire was developed in nursing homes in the Netherlands. This questionnaire focuses on loss of appetite and changes in the sense of taste and smell. It performed more successfully in healthy older adults than in the underweight elderly (Mathey,2001; Savina,2003).

The Subjective Global Assessment (SGA) is a screening tool that evaluates the level of nutrition in hospitalized patients (McCann, 1999). This screening tool includes a short physical examination that involves weight change, food intake, medical history of gastrointestinal symptoms and functional disorders, subcutaneous fat, muscle loss, edema and acid loss. It was mainly validated for young individuals with gastrointestinal disorders and there are studies suggesting that this tool is not commonly preferred in evaluating healthy older adults (Guigoz, 2006).

The Mini Nutritional Assessment (MNA), proposed by ESPEN for use in the elderly in 2002, consists of global assessment questions, specific dietary questions, self-perception and anthropometric measurements (Vellas, 2006). This screening test has the highest and widely verified reliability and validity. MNA can detect malnutrition long before the pronounced changes in body weight or serum protein levels, since it contains more sophisticated measurements than other tests (Green, 2006).

The SARC-F scale was developed as a rapid screening test for the diagnosis of sarcopenia. This questionnaire enables health professionals to evaluate the risk of sarcopenia rapidly and easily. The questionnaire consists of five components: strength, assistance walking, rise from a chair, climb stairs and falls. These components have been selected so as to reflect health changes associated with the outcomes of sarcopenia. The SARC-F score ranges from 0 to 10, wherein 0-3 points indicates healthy patients, whereas 4 points and above indicates symptomatic patients (Malmstrom, 2016).

Materıals And Methods

Time, place and sample of the study: This study included 120 healthy individuals aged 65 and older who presented to Mersin Private Akademi Hospital between May 2017 and November 2017. However, the study was completed with data from 91 questionnaires, since those with incomplete data were not included in the evaluation.

General study plan: In this study, in order to investigate the effects of eating habits on sarcopenia in healthy patients aged 65 and older and determine whether the Turkish form of 'A Simple Questionnaire to Rapidly Diagnose Sarcopenia (SARC-F)' scale developed by Malmstrom, T.K. and Morley, J.E et al. in 2013 is a valid and reliable tool for the patients in Turkey, the SARC-F scale was used along with the MNA test and a questionnaire that included anthropometric measurements, three-day food consumption log and frequency of food consumption to assess the nutritional status. The questionnaire also investigated the physical activity status. Data from the study: face-to-face interview method was used by the researcher in order to accurately and exactly determine patient information.

Statistical Analysis: Cronbach's alpha coefficient and Kaiser-Meyer-Olkin (KMO) values were studied as well as a factor analysis conducted for the reliability and validity study of the SARC-F scale in Turkish. Statistical analysis of the obtained data was performed with the IBM SPSS 21 software package, MedCalc statistical software package and e-picos software. Parametric tests were used without testing for normality due to compliance with the central limit theorem. Continuous variables were expressed with mean and standard deviation and minimum and maximum values, whereas categorical variables were expressed with frequency and percentage values. Student's T test was used to compare the mean values of two groups and One-Way ANOVA to compare the mean values of more than two groups. Tukey's Post Hoc test was used in case of a difference detected in ANOVA. Chi-Square test was used to evaluate the relationships between categorical variables. 95% confidence interval was used for all tests performed within the scope of this study and $p<0.05$ was considered statistically significant.

Results

Results of the Factor Analysis for the Validity of the SARC-F Scale

A factor analysis was conducted to determine the validity of the SARC-F scale and to obtain the functional dimensioning by identifying factor weights of the items included in the scale. Suitability of data to factor analysis was tested with the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests before conducting the factor analysis. For the evaluated scale that consisted of 5 items, KMO value was found to be 0.70 and the Bartlett's test result was as follows: $\chi 2= 109.568$ ($p \leq 0.05$) (Table 1). A KMO value higher than 0.60 and a significant Bartlett's test result means that the data is suitable for factor analysis (Büyüköztürk, 2011).

Table 1: Data on the Suitability of the SARC-F Scale to Factor Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.70
Bartlett's Test of Sphericity	Chi-square	109.568
	P value	<0.001

Results of the Reliability Analysis of the SARC-F Scale

Cronbach's Alpha coefficient was used for the reliability analysis of the scale. A Cronbach's Alpha between 0.80 and 1, 0.60 and 0.79, 0.40 and 0.60, and 0 and 0.39 indicates a highly reliable, reliable, poorly reliable and unreliable scale, respectively (Büyüköztürk, 2011). Cronbach's Alpha was found to be 0.60 for the SARC-F scale (Table 2). In accordance with this value, the scale was considered reliable.

Table 2: Results of the Cronbach Alpha Reliability Analysis for the SARC-F Scale

Factor	Number of items	Cronbach's Alpha
SARC-F Scale	5	0.60

Evaluation of the Sociodemographic Characteristics

Of the 91 subjects who participated in the study, 45 (49.5%) were female and 46 (50.5%) were male. Considering the educational status, 4.4% of the participants were illiterate, 11% were literate, 17.6% were elementary school graduates, 17.6% were middle school graduates, 28.6% were high-school graduates or had received an equivalent education and 20.9% were university graduates. Considering the classification of subjects by age, 40.7% of the participants were 70 and younger, 25.3% were between 71-74, 17.6% were between 75-80 and 16.5% were 81 and older (Table 3).

Table 3: Evaluation of the Sociodemographic Characteristics

N=91		
Variables	Number (n)	Percentage (%)
Gender		
Female	45	49.5
Male	46	50.5
Total	91	100
Educational status		
Illiterate	4	4.4
Literate	10	11
Elementary School	16	17.6
Middle School	16	17.6
High School	26	28.6
University	19	20.9
Total	91	100
Age		
<70	37	40.7
71-74	23	25.3
75-80	16	17.6
>81	15	16.5
Total	91	100

Considering the relationship between sarcopenia risk status and sociodemographic characteristics, there was a statistically significant relationship between age and risk of sarcopenia (p=0.001) (Table 4).

Table 4: Evaluation of the Relationship Between Sociodemographic Characteristics and Sarcopenia Risk Status

N=91	Sarcopenia status				
	Risk		No Risk		
Variables	Number (n)	Percentage (%)	Number (n)	Percentage (%)	P value
Gender					
Female	36	54.5	9	36	0.11
Male	30	45.5	16	64	
Total	66	100	25	100	
Educational status					
Illiterate	4	6.1	-	-	0.07
Literate	8	12.1	2	8	
Elementary School	13	19.7	3	12	
Middle School	13	19.7	3	12	
High School	13	19.7	13	52	
University	15	22.7	4	16	
Total	66	100	25	100	
Age					
<70	17	25.8	20	80	<0.001*
71-74	20	30.3	3	12	
75-80	15	22.7	1	4	
>81	14	21.2	1	4	
Total	66	100	25	100	

Evaluation of the MNA and SARC-F scale administered to the subjects according to gender is provided in Table 5. While there was a statistically significant relationship between the SARC-F scores and gender (p=0.04), there was no relationship between the MNA scores and the same (p>0.05).

Table 5: Evaluation of the SARC-F and MNA Scores According to Gender

	Gender	N	Mean±SD	P
SARC-F Scale	Female	45	4.95±1.60	0.04*
	Male	46	4.22±1.75	
MNA	Female	45	22±3.09	0.82
	Male	46	22.15±3.22	

Relationship Between the Sarcopenia and Malnutrition Status of the Subjects

The subjects were divided into three groups according to the MNA score, i.e. normal, at risk of malnutrition and malnourished. As shown in Table 6, 59.3% of 91 subjects had risk of malnutrition, whereas 7.7% had malnutrition. In addition, 33% of the patients were normal in terms of malnutrition.

According to the SARC-F score, the subjects were divided into two groups: risk of sarcopenia and no risk of sarcopenia. It was found that 72.5% of the subjects had risk of sarcopenia, whereas 27.5% did not have the same.

Comparison of the MNA and SARC-F screening test results showed that, of the 66 subjects who had risk of sarcopenia according to the SARC-F test, 10.6% had malnutrition, 71.2% had risk of malnutrition and 18.2% had normal nutrition. There was a statistically significant relationship between the SARC-F and MNA screening test results (p=0.001).

Table 6: Evaluation of the Sarcopenia Status According to the Malnutrition Status of the Subjects

	No Risk of Sarcopenia N(%)	Risk of Sarcopenia N(%)	Total N(%)	P value
Normal Nutritional Status	18(72)	12(18.2)	30(33)	<0.001*
At Risk of Malnutrition	7(28)	47(71.2)	54(59.3)	
Malnourished	-	7(10.6)	7(7.7)	
Total	25(27.5)	66(72.5)	91(100)	

Evaluation of the Anthropometric Characteristics and Hand Grip Strength According to Gender

The evaluation of anthropometric measurements and hand grip strength according to gender showed that there was a statistically significant difference in terms of the mean body weight, height, fat-free mass, hand grip strength and finger grip strength, as shown in Table 7 ($p<0.05$).

Table 7: Evaluation of the Anthropometric Measurements and Hand Grip Strength According to Gender

N=91	Gender	N	Mean ±SD	P
Body weight (kg)	Female	44	64.1±12.9	0.04*
	Male	46	69.9±13.1	
Height (cm)	Female	44	16.43±6.38	<0.001*
	Male	46	17.89±8.18	
	Female		Male	
BMI (kg/m2)	n(%)		n(%)	
BMI<19	1(2.3)		2(4.3)	0.51
19<BMI<21	10(22.7)		10(21.7)	
21≤BMI<23	7(15.9)		3(6.5)	
BMI≥23	26(59.1)		31(67.4)	
Total	44(100)		46(100)	
	Gender	N	Mean ± SD	
Fat-free mass (kg)	Female	44	40.04 ±7.59	0.004*
	Male	46	45.58 ±9.80	
Fat mass (kg)	Female	44	24.18 ±9.39	0.7
	Male	46	23.45 ±8.43	
Hand grip strength (kg)	Female	45	18.77±9.48	0.02*
	Male	46	25.55±15.76	
Finger grip strength (kg)	Female	45	5.93±2.98	0.001*
	Male	46	8.91±5.17	
	Female		Male	
Arm circumference (cm)	n(%)		n(%)	
<21	2(4.5)		2(4.3)	0.53
21≤ arm circumference<22	6(13.6)		3(6.5)	
≥22	36(81.8)		41(89.1)	
Total	44(100)		46(100)	
	Female		Male	
Calf circumference (cm)	n(%)		n(%)	
<31	12(27.3)		5(10.9)	0.05*
≥31	32(72.7)		41(89.1)	
Total	44(100)		46(100)	

Evaluation of the relationship between anthropometric measurements and hand grip strength according to sarcopenia risk status showed that there was a statistically significant difference in terms of body weight, height, fat-free mass, hand grip strength and finger grip strength according to the sarcopenia risk status (Table 8) ($p<0.05$).

Table 8: Evaluation of the Relationship Between Anthropometric Measurements and Hand Grip Strength of the Subjects and Sarcopenia Risk Status

N=91	Risk of Sarcopenia n=66	No Risk of Sarcopenia n=25	P value
Variables	Mean±SD	Mean±SD	
Body weight (kg)	64.7±13.2	72.1±12.8	0.02*
Height (cm)	159.878±8.644	164.4±8.456	0.03*
BMI (kg/m2)	n(%)	n(%)	
BMI<19	3(4.5)	-	0.12
19≤BMI<21	15(22.7)	6(24)	
21≤BMI<23	10(15.2)	-	
BMI≥23	38(57.6)	19(76)	
Total	66(100)	25(100)	
	Mean±SD	Mean±SD	
Fat-free mass (kg)	40.969±8.355	47.472±9.77	0.002*
Fat mass (kg)	23.313±9.239	24.636±8.06	0.53
Hand grip strength (kg)	18.242±10.583	32.1±15.294	<0.001*
Finger grip strength (kg)	5.924±3.227	11.28±5.072	<0.001*
Arm circumference (cm)	n(%)	n(%)	
<21	4(6.1)	-	0.17
21≤ arm circumference<22	9(13.6)	1(4)	
≥22	53(80.3)	24(96)	
Total	66(100)	25(100)	
Calf circumference (cm)	n(%)	n(%)	
<31	17(25.8)	1(4)	0.02*
≥31	49(74.2)	24(96)	
Total	66(100)	25(100)	

Discussion

The SARC-F scale translated to Spanish was used to evaluate sarcopenia in 487 participants 60 and older living in Mexico. Cronbach's Alpha was found to be 0.64 as a result of the study. This showed that the Spanish version of the SARC-F scale could be used reliably (Sz leif, 2016). In a cross-sectional study that aimed assess the reliability of the SARC-F scale in Japan, kappa coefficient of reliability was found to be 0.66 in 207 diabetic Japanese subjects aged 65 and older. This also showed that the SARC-F scale could be reliably used in Japan (Satoshi, 2016). The present study also provided similar results as other studies in the literature, wherein the Turkish version of the SARC-F scale was found to be valid and reliable.

4000 Chinese subjects aged 65 and older participated in a study that aimed to predict the negative outcomes of the SARC-F scale items. It was reported that the scale could be limited to 3 items by removing the rise from a chair and fall components (Woo, 2018). In the present study, it was found that the scale became more reliable with a Cronbach's Alpha of 0.78, when the falls components was removed. This was thought to stem from the fact that older adults may not accurately remember the answer to the question “how many times did you fall?” or that it was not clear whether sarcopenia was the cause or result of the fall since healthy subjects were included in the study, as seen in the study mentioned above.

In the Canadian National Health Research conducted by Garner et al. with 3,864 males and 4,745 females, it was reported that men included in the slightly overweight category had a higher quality of life since they had more muscle tissue, whereas the same did not apply to women (Graner, 2012). The present study also showed that women had higher risk of sarcopenia. This finding was thought to be associated with the increase in bone density reduction after menopause.

According to the results from the third phase of the EPIC-Norfolk research conducted between 2004 and 2011, grip strength and gait speed exhibited a decrease in parallel to advanced age (Keevil, 2013). Data from the study may suggest the presence of a significant relationship between sarcopenia and decreased gait speed and grip strength with advancing age. The present study also showed that there was a statistically significant relationship between age and sarcopenia ($p<0.05$).

A literature review showed that malnutrition could lead to sarcopenia. The relationship between malnutrition and sarcopenia scales was also significant in this study ($p=0.001$)

Anthropometric measurements of the body are of utmost importance in evaluating the condition of an individual, conducting risk analysis for and diagnosing various diseases and for the success of treatment. This subject is rapidly becoming more popular today, wherein there is a pursuit of highly reliable and valid, repeatable, easily applicable, inexpensive and accessible new methods and scales. Loss in the lower extremity muscles is more rapid as compared to the upper extremities in the elderly. Therefore, there are various studies indicating that calf circumference is an important predictor (Rolland, 2003). In a study by Bahat et al., 274 Turkish men aged 60 and older were evaluated and it was found that 10.5% of the participants had a calf circumference lower than 31 cm. According to the findings of the study, it was reported that older males in the Turkish population had higher rates of functional dependence, sarcopenia and malnutrition as compared to those living in developing and developed Western countries (Bahet, 2013). In another study conducted with 145 subjects aged between 18 and 83, it was found that the mean calf circumference was 37.2 ± 3.4 cm in females and 37.7 ± 5.2 cm in males (Ata, 2016). Kusaka et al. conducted a study with subjects aged between 65 and 86 and reported that it would be more sensible and suitable to define a wide calf circumference with non-sarcopenia (Kusaka, 2017). Results of another study conducted with 526 subjects aged between 40 and 89 indicated that calf circumference has a positive correlation with muscle mass and the optimal calf circumference cut-off value for predicting sarcopenia is <34 cm in men and <33 cm in women (Kawakami, 2015). In Turkey, the first study that aimed to investigate the risk of sarcopenia in the population was conducted by Akın et al. The study included 879 subjects older than 60 living in Kayseri. In the study, the rate of sarcopenia associated with muscle mass was evaluated using a calf circumference criterion of less than 31 cm and a mid-upper arm circumference criterion of less than 21.1 cm and 19.9 cm for males and females, respectively. The rate of sarcopenia according to calf circumference was 6.7% (7.7% in females and 5.6% in males), whereas the same according to mid-upper arm circumference was 7.3% (8.0% in females and 6.6% in males). In accordance with this data, it was concluded that sufficient muscle mass could not provide reliable use of muscles and that muscle function was a more important marker than muscle mass in the diagnosis of sarcopenia (Akın, 2015).

In the present study, 72.7% of females had a calf circumference of 31 cm and higher and 27.3% had a calf circumference less than 31 cm, whereas 89.1% of males had a calf circumference of 31 cm and higher and 10.9% had a calf circumference less than 31 cm. Accordingly, sarcopenia risk status was evaluated in association with calf circumference. It was found that 25.8% of those who had risk of sarcopenia had a calf circumference less than 31 cm, whereas 4% of those who did not have risk of sarcopenia had a calf circumference less than 31 cm. Majority of those who had risk of sarcopenia had a calf circumference higher than 31 cm. Evaluating according to the sarcopenia risk status, it was found that 25.8% of those who had risk of sarcopenia had a calf circumference less than 31 cm. In this study that employed a mid-upper arm circumference less than 21 cm as a criterion, 4.5% of females and 4.3% of males had an arm circumference less than 21 cm. According to the sarcopenia risk status, while 6.1% of the subjects who had risk of sarcopenia had an arm circumference less than 21 cm, none of those who did not have risk of sarcopenia had an arm circumference less than 21 cm. Arm circumference did not have a statistically significant relationship with sarcopenia risk status and gender ($p>0.05$).

Murphy et al. prospectively evaluated the appendicular fat-free mass and grip strength of 3075 individuals aged between 70-79 for seven times within 9 years. Fat-free mass of those included in the study was standardized with respect to height and calculated in kg/m2. The mean fat-free mass was found to be 6.52±1.14 kg/m2 in women and 40.9 ±8.53 kg/m2 in men. The mean BMI value was 27.7±5.50 kg/m2 and 27.0±3.90 kg/m2 in women and men, respectively. In addition, the mean age was 73.5±2.88 and 73.8±2.85 years in women and men, respectively. In the study, it was observed that the increase in age and BMI was a determinant of transition from a normal condition to sarcopenia (Murphy, 2014).

In a study by Akın et al., hand grip strengths were evaluated and it was found that the mean hand grip strength was 17.9 in females and 30.6 kg in males (Akın, 2015). In the Health and Retirement Study conducted with Americans by Haas et al., gait speed and grip strength were evaluated according to gender. The study included data from 14,493 individuals who were born before 1947. It was reported that gait speed and grip strength were higher in males as compared to females, regardless of age (Haas, 2012). In the present study, the mean hand grip strengths were 18.77±9.48 and 25.55±15.76 kg in females and males, respectively. Evaluating hand grip strength according to the sarcopenia risk status, it was found that the subjects who had risk of sarcopenia had a mean hand grip strength of 18.24± 10.58 kg, whereas the same was 32.1±15.29 kg in those who did not have risk of sarcopenia. In the present study, hand and finger grip strength had a significant relationship with gender and risk of sarcopenia ($p<0.05$).

Although there is a large amount of data on the relationship between BMI and sarcopenia in the literature, a significant relationship between the two was not observed in the present study ($p>0.05$). There was a significant relationship between body weight, height, fat-free mass, hand-finger grip strength and sarcopenia risk status ($p<0.05$).

Tanimoto et al. aimed to investigate the effects of sarcopenia on falls in a study that they measured grip strength with a hand dynamometer and muscle mass with BIA in 1110 Japanese subjects 65 and older. Of the subjects who participated in the study, 14.9% of females and 13.4% of males were found to have sarcopenia. The prevalence of falls was 21.3% among females and 16.9% among males. The study showed that history of falls was significantly more prevalent among those who had sarcopenia and those who had reduced grip strength and gait speed than those who did not. However, it could not be clarified whether sarcopenia and reduced gait speed and grip strength were the cause or result of falls, since the study was cross-sectional and included healthy individuals (Tanimoto, 2014). It was thought that the increased reliability coefficient as a result of removing the falls component was also due to the same reason in the present study.

In conclusion, it is thought that the SARC-F scale, which can be used in the early diagnosis of sarcopenia, will be beneficial in maintaining good health and increasing quality of life.

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