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KEPAN SOCIETY OF CLINICAL ENTERAL PARENTERAL NUTRITION-TURKEY
CLINICAL SCIENCE OF NUTRITION

AIMS AND SCOPE

Clinical Science of Nutrition (Clin Sci Nutr) is a scientific, open Access periodical published in accordance with independent, unbiased, and double-blinded peer-review principles. The journal is the official publication of the Society of Clinical Enteral Parenteral Nutrition – Turkey, and it is published tri-annually in April, August, and December. The publication language of the journal is English.

The journal aims to contribute to the literature by publishing high impact content and become one of the leading publications of the field while functioning as an open discussion forum on significant issues of current interest. Clinical Science of Nutrition also aims to have significant input in emphasizing the increasing importance of clinical nutrition in Turkey and the region, identifying the effects of differences between societies on study results in a clearer way and converting clinical applications into scientific publications as well as forming a bridge between West and East.

The scope of Clinical Science of Nutrition includes original research articles, review articles, case reports, conference reports, and letters to the editor as well as editorials, abstracts from international and national congresses, panel meetings, conferences and symposia. As an online-only publication, in addition to traditional manuscript submissions, Clinical Science of Nutrition is also able to process video, audio and interactive software submissions. Authors are encouraged to submit their content in the most appropriate medium to best convey their findings to the audience of Clinical Science of Nutrition.

The journal covers all aspects of nutrition and dietetics including prevalence of malnutrition and its effects on clinical results; nutritional support and delivery methods and their advantages and disadvantages; nutritional support products and their side effects; immune system and nutritional support; ERAS protocol and nutritional support; home parenteral and enteral nutrition; nutrition support teams and their necessity, challenges and potential solutions of nutritional support.

The journal's target audience includes academicians, practitioners, specialists and students interested in nutrition and dietetics.

Clinical Science of Nutrition currently indexed in EBSCO, Gale, and China National Knowledge Infrastructure (CNKI).

The editorial and publication processes of the journal are shaped in accordance with the guidelines of the International Committee of Medical Journal Editors (ICMJE), World Association of Medical Editors (WAME),Council of Science Editors (CSE), Committee on Publication Ethics (COPE), European Association of Science Editors (EASE), and National Information Standards Organization (NISO). The journal is in conformity with the Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/bestpractice).

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KEPAN SOCIETY OF CLINICAL ENTERAL PARENTERAL NUTRITION-TURKEY
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EDITORDEN

Dear Colleagues,

As we publish the last issue of this year, we would like to share with you that CLINICAL SCIENCE OF NUTRITION has started to be included in the EBSCO, Gale and China National Knowledge Infrastructure (CNKI) directories.

It is great importance for us to reach this point that the journal is supported by your articles. We hope that the journal will be accepted for inclusion in the "Turkish Medical Index" in the near future.

Our sincere thanks to everyone who contributed and supported us, including our distinguished critics and dedicated employees.

Kind Regards,

On behalf of the CSN Editorial Board

Prof. Dr. Sadık Kılıçturgay

CLINICAL SCIENCE OF NUTRITION

Original Article

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The Effect of 16 : 8 Intermittent Fasting Diet on Cognitive Eating Behavior in Individuals with Metabolic Syndrome

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ABSTRACT

Objective: The aim of this study is to determine the effect of intermittent fasting diet on cognitive eating behavior in individuals with metabolic syndrome.
Methods: This intervention-type study was conducted on 70 individuals with metabolic syndrome between the ages of 18 and 65 who were directed by a physician to an obesity counseling center. In the study, energy-restricted diets were planned similarly for all participants. Participants were randomly divided into 2 groups according to age and gender. The control group was followed up for 12 weeks with the frequent intermittent diet plan and the intervention group with the 16 : 8 model intermittent fasting diet plan. The general demographic characteristics of the participants were defined before the research. Three-factor Nutrition Questionnaire was applied before and after the study in order to define the cognitive eating behavior level.
Results: The majority of the participants are in the 54-65 age group. The research group is married (94%), has primary-secondary (52.3%) level of education, whose income is at or above the minimum wage (95.4%), is a housewife (43.1%), retired (24%)), and consists of individuals who are public employees (12.3%). There was no significant difference between the groups in the total score of the 3-Factor Nutrition Questionnaire before the intervention. In terms of the sub-components of the 3-Factor Nutrition Questionnaire, statistically significant differences were found in both groups during the diet in uncontrolled eating, conscious restriction, and emotional eating scores ($P < .05$).
Conclusions: As a result, it has been determined that the application of energy-restricted diet as frequent or 16 : 8 model intermittent fasting diet does not have any superiority over the components of cognitive eating behavior, uncontrolled eating, conscious restraint, and emotional eating. Both energy-restricted diet plans have similarly positive effects on cognitive eating behavior.

Keywords: Eating behavior, fasting, metabolic syndrome, diet

INTRODUCTION

Metabolic syndrome (MetS) has been defined as a series of metabolic dysfunctions that increase the risk of developing diabetes and cardiovascular disease.[1] Although various criteria are used in the definition of MetS, its basis is obesity, hyperglycemia, hypertension, hyperlipidemia, and dyslipidemia components characterized by low high-density cholesterol.[2] Along with the increase in obesity and comorbid diseases in the world, the increase in MetS reaches threatening dimensions in terms of public health[3]. In studies conducted between various countries and groups, the frequency of MetS has been reported to be between 28% and 50% in adults.[4-6] According to the data of the Turkey Metabolic Syndrome Research conducted on the frequency of MetS in our country, 1 out of every 3 adults suffers from MetS.[7] The most basic point in the physiopathology of MetS is insulin resistance and obesity.[8] On the other hand, the sedentary life brought by modern life increases the complications of the disease.[9]

Lifestyle change is the basis of MetS treatment.[10] It is also possible to use pharmacological agents and receive support from surgical treatments for the regulation of insulin resistance, hyperlipidemia, and hypertension.[11,12] The effect of diet therapy in MetS is of major clinical importance. It is known that losing 5%-10% of weight in cases within a 6-month period is very effective in regulating hyperglycemia, hyperlipidemia, and hypertension.[11]

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Energy restriction is the most effective method for weight loss in MetS cases. If a difference is created between the energy spent and the energy taken, it is inevitable that the amount of body fat will decrease.[13] Intermittent fasting diets are also types of diets that allow energy restriction. When examined in terms of terminology, "intermittent fasting" is defined as fasting in a certain period and feeding in a certain period.[14,15] It has been argued that this form of nutrition, which has a very old history, has a healing feature of hunger.[16] As a religious practice, it has been practiced in different forms by many communities for centuries.[17,18]

In vivo and in vitro experiments on the use of intermittent fasting have increased in recent years, with the identification of the molecular mechanisms of long-term fasting.[19] In animal experiments, positive effects have been reported that suppress inflammation, alleviate insulin resistance, and regulate blood pressure.[20] The most common types of intermittent fasting diets are religious fasting such as Ramadan fasting, 5 days of feeding known as the 5 : 2 model, 2 days of fasting or very low-energy nutrition, and 16-hour fasting combined with 8-hour feeding period in a day known as the 16 : 8 model.[21,22] In 16 : 8 model fasting diets, which are also defined as time-limited nutrition, water, unsweetened-cream-free tea and coffee may be consumed during the 8-hour fasting period.[23] In a study examining the effect of dietary intervention on cognitive eating behavior using the 3-Factor Nutrition Questionnaire, cognitive eating behavior scores were compared after 6 and 18 months of standard dietary interventions, and no statistically significant difference was found.[24] There is no study in the literature on the effect of intermittent fasting diet intervention on cognitive eating behavior. This study aimed to investigate the effect of applying an energy-restricted diet and an intermittent fasting diet for 12 weeks on cognitive eating behavior in individuals with MetS.

METHODS

This non-interventional study, which included only dietary intervention, was conducted on patients followed in an obesity counseling center between June 2019 and March 2020. Reference studies were taken into account in the selection of the sample. Based on the assumption that there will be a 5% weight loss during the research, it was assumed that 30 participants in the control and intervention groups would complete the research with the G-power analysis performed with 80% power and $\alpha = 0.05$ margin of error. It was aimed to reach 70 participants, with the assumption that they could discontinue the diet intervention or leave the study for any reason. Participants consist of individuals between the ages of 18 and 65, diagnosed with MetS by a physician and referred to a dietitian, and having a body mass index of 27 kg/m^2 and above. Participants with conditions such as pregnancy, lactation, menopause, type 1 diabetes, the presence of a disease requiring a special diet such as celiac, the use of special nutritional support, heavy physical activity, the presence of problems in liver-kidney functions or immunodeficiency, and the use of insulin or sulfonamide-derived diabetic drugs were excluded. A total of 19 patients were screened in the study, and 128 patients were eliminated due to exclusion criteria. Participants who met the research inclusion criteria were randomized into control and intervention groups according to age and gender. At the end of the study, 33 participants (15 male, 18 female) in the intervention group and 32 participants in the control group (16 male, 16 female) completed the research.

The necessary permissions for the research were obtained. The Data Collection Form prepared by the researcher was used as a data collection tool in the research. The form was filled out by the researcher using face-to-face interview technique. The 3-Factor Nutrition Questionnaire, which is used to determine the level of cognitive eating behavior, was used in the form that included sociodemographic characteristics. The questionnaire was developed by Stunkard and Messick and later revised by the Swedish Obesity Study Group.[25,26] Turkish validity and reliability of the questionnaire were made by Kıraç et al .[27] Necessary permissions for the use of the scale were obtained via e-mail. The 3-Factor Nutrition Questionnaire is a Likert-type scale and measures cognitive eating behavior in the subcomponents of conscious eating, uncontrolled eating, and emotional eating.

Statistical Package for the Social Sciences 20.0 package program was used for statistical analysis. Mean, standard deviation, minimum-maximum, number, and percentage were used to define the variables. Shapiro–Wilk test was used to determine normality. Independent samples *t*-test was used in the analysis of normally distributed data, and Mann–Whitney *U* test was used in the analysis of non-normally distributed data. Chi-square test was used for categorical data. $P < .05$ was accepted as statistical significance level.

Main Points

- Metabolic Syndrome (MetS) threatens public health in terms of obesity, diabetes, and cardiovascular diseases.
- Energy restriction is the most effective method for weight loss in MetS cases.
- Application of energy-restricted diet in the form of frequent intermittent or 16 : 8 model intermittent fasting nutrition plan has similar positive effects on cognitive nutrition behavior, uncontrolled eating, conscious restriction, and emotional eating components, and it was determined that there was no superiority over each other in this study.

Age, gender, body weight, and physical activity levels of the participants were taken into account in the planning of the diets. The Turkish Dietary Guidelines were used to calculate the daily energy expenditure of the participants, and the physical activity factor was added to the basal metabolic rates determined according to age and gender. In the study, 75% of the calculated energy requirement was planned as diet in order to ensure weight loss in all participants. The diets are completely planned according to individual characteristics and macro-micro nutrient needs are taken into consideration. A menu consisting of 5-6 meals was planned at 3-3.5 hour intervals for the participants in the control group and 2 main meals, and 2 snacks between 10:00 and 18:00 or 11:00 and 19:00 in the intervention group. Example menus are shown in Figure 1.

RESULTS

This study was conducted with subjects aged between 18 and 65 years who were referred to an obesity counseling center with the diagnosis of MetS. The male-to-female ratio of the research group is almost equal. There was no significant difference in age distribution between the control and intervention groups. Most of the male participants are retired, and most of the females are housewives. The education level of the participants is generally at the level of primary-secondary education (Table 1). The majority of the group (94%) has a monthly income of minimum wage and above. 83% of the participants use regular medication with the recommendation of a physician. 70% of the participants use antihypertensive, 46% antidiabetic, and 26% hyperlipidemia drugs. It was determined that 86% of the participants had first-degree chronic disease and 69% had second-third-degree chronic disease. There was no statistically significant difference between the groups in terms of income status and presence of disease.

In terms of nutrition and physical activity habits, half of the participants reported that they consumed 2 main meals a day before the study. One out of every 3 participants declared that they do not eat snacks. Most of the participants skipped meals frequently and the most frequently skipped meal was reported as lunch. The main reasons

One-day sample menu of research groups

Control Group Sample Menu	Response Group Sample Menu
Morning (07:30) Light tea (unsweetened) 1 boiled egg 2 walnut kernels 1 slice of semi-skimmed cheese (30 g) 2 slices of whole grain bread (25g) Tomato/cucumber cold cuts 1 medium sized peach	**Morning (10:30)** Light tea (unsweetened) 1 boiled egg 2 walnut kernels 1 slice of semi-skimmed cheese (30g) 2 slices of whole grain bread (25g) Tomato/cucumber cold cuts 1 medium sized peach
Noon (12:30) 1 bowl of lentil soup (200 ml) 4 tablespoons of vegetable food 1 slice of whole grain bread	**Snack (13:30)** 1 glass of kefir (150 ml) 4 apricots
Snack (15:30) 2 wholemeal breadcrumbs (20 g) 1 bowl of yogurt (150 ml)	**Snack (15:30)** 1 bowl of lentil soup (200 ml) 2 wholemeal breadcrumbs (20 g) 1 bowl of yogurt (150 ml)
Evening (18:30) 2 grilled meatballs (60 grams cooked) 3 tablespoons of bulgur pilaf Mixed Season Salad (without oil) 1 glass of buttermilk (200 ml)	**Evening (18:30)** 2 grilled meatballs (60 grams cooked) 3 tablespoons of bulgur pilaf 4 tablespoons of vegetable food 1 slice of whole grain bread (25g) Mixed Season Salad (without oil) 1 glass of buttermilk (200 ml)
Snack (21:30) 1 glass of kefir (150 ml) 4 apricots	

Water/unsweetened tea/unsweetened black coffee/mineral water free every hour
Rest (23:00)

Figure 1. One-day sample menu of research groups.

Table 1. General Characteristics of the Research Group

Characteristics	Control Group (n = 33) n (%)	Intervention Group (n = 32) n (%)	Total (n=65) n (%)	P
Age				
18-29	4(1.1)	3(9.4)	7(10.8	.668
30-41	5(15.2)	9(28.1)	14(21.5)	
42-53	9(27.3)	7(21.9)	16(24.6)	
54-65	15(45.5)	13(40.6)	28(43.1)	
Gender				
Male	15(45.5)	16(50.0)	31(48)	.714
Female	18(54.5)	16(50.0)	34(52)	
Marital status				
Married	30(90.9)	31(96.9)	61(94)	.613
Single	3(9.1)	1(3.1)	4(6)	
Educational status				
Literate	0 (0)	5(15.6)	5(7.7)	.116
Primary education	16(48.5)	12(37.5)	28(43.1)	
Secondary education	2(6.1)	4(12.5)	6(9.2)	
High school and equivalent	11(33.3)	4(12.5)	15(23.1)	
University	4(12,1)	7(21.9)	11(16.9)	
Job				
Housewife	13(39.4)	15(46.9)	28(43.1)	.808
Self-employment	4 (12.1)	1(3.1)	5(7.7)	
Officer	4(12.1)	4(12.5)	8(12.3)	
Paid employee	1 (3.0)	5(15.6)	6(9.2)	
Employee	2 (6.1)	0(0)	2(3.1)	
Retired	9(27.3)	7(21.9)	16(24.6)	

for skipping meals are loss of appetite and lack of time. When classified in terms of physical activity level, it was concluded that 3 out of every 4 people were sedentary (Table 2).

The results of the food consumption record obtained during the research are summarized in Table 3. There was no statistically significant difference between the control and intervention groups. As both groups were given similar

Table 2. Nutrition and Physical Activity Habits of the Research Group

Features	Control Group (n = 33) n (%)	Intervention Group (n = 32) n (%)	Total (n=65) n (%)	P
Number of main meals per day				
2	13(39.4)	19(59.4)	32(49.2)	.107
3	17(51.5)	13(40.6)	30(46.2)	
4	3(9.1)	0(0)	3(4.6)	
Number of snacks per day				
none	9(27.3)	16(50)	25(38.5)	.028
1	9(27.3)	11(34.4)	20(30.8)	
2	13(39.4)	3(9.4)	16(24.6)	
3	1(3.0)	2(6.2)	3(4.6)	
4	1(3.0)	0(0)	1(1.5)	
Meal skipping status				
Yes	26(78.8)	25(78.1)	51(78.5)	.948
No	7(21.2)	7(21.9)	14(21.5)	
Skipped meal				
Morning	8(30,8)	9(36.0)	17(33.3)	.768
Noon	16(61,5)	14(56.0)	30(58.8)	
evening	2(7.7)	2(8)	4(7.8)	
Skipping frequency				
Always	3(11,5)	8(32)	11(21.6)	.206
Often	15(57.7)	11(44)	26(51.0)	
Rarely	8(30,8)	6(24.0)	14(27.5)	
Reason for skipping				
Lack of time	6(23.1)	6(24)	12(23.5)	.105
Does not want it-without appetite	12(46,2)	4(16.0)	16(31.4)	
To lose weight	4(15,4)	7(28.0)	11(21.6)	
Non habit	4(15,4)	8(32.0)	12(23.5)	
Physical activity level				
Physically inactive	27(81.8)	23(71.9)	50(76.9)	.381
Low level of physical activity	4(12,1)	6(18.8)	10(15.4)	
Adequate physical activity level	2(6.1)	3(9.4)	5(7.7)	

Table 3. Energy, Macro, and Micronutrient Intakes of the Research Group

	Control Group (n =33)					Intervention Group (n =32)					Total (n=65)	
Food items	Beginning Mean ± SD	4th week Mean ± SD	8th week Mean ± SD	12th week Mean ± SD	*P*	Beginning Mean ± SD	4th week Mean ± SD	8th week Mean ± SD	12th week	*P*	$P_{beginning}$	$P_{week\ 12}$
Energy (kcal)	2043.50 ± 355.16	1556.82 ± 322.61	1578.71 ± 306.83	1519.52 ± 295.71	<.001	2066.14 ± 402.59	1535.88 ± 288.34	1518.4 ± 358.33	1496.54 ± 341.95	<.001	.811	.773
Carbs (g)	216.10 ± 62.57	161.54 ± 46.81	163.47 ± 42.16	158.46 ± 29.28	<.001	201.99 ± 48.42	155.03 ± 44.22	153.6 ± 46.98	151.58 ± 43.39	<.001	.314	.458
Carbs (%)	42.1 ± 8.49	41.68 ± 10.09	41.47 ± 7.3	42.32 ± 6.5	.963	39.23 ± 7.01	40.19 ± 8.58	40.31 ± 7.57	40.66 ± 8.56	.882	.144	.380
Oil amount (g)	92.71 ± 24.72	68.26 ± 23.02	69.44 ± 18.87	63.26 ± 21	<.001	98.89 ± 29.91	66.37 ± 16.25	65.08 ± 18.46	66.16 ± 23.82	<.001	.367	.603
Fat percentage (%)	41.11 ± 9.06	39.4 ± 10.05	39.62 ± 8.77	36.8 ± 8.53	.146	42.82 ± 8.42	39.41 ± 8.8	38.57 ± 6.34	39.43 ± 8.63	.487	.431	.221
Protein amount (g)	80.54 ± 22.08	67.41 ± 22.61	68.73 ± 22.53	72.62 ± 22.62	.001	85.63 ± 22.32	74.27 ± 30.96	73.07 ± 22.53	67.66 ± 19.75	.003	.359	.351
Protein (%)	15.69 ± 3.02	17.19 ± 4.02	17.3 ± 3.84	19.13 ± 4.6	.001	16.66 ± 3.23	19.02 ± 6.13	19.41 ± 4.6	18.25 ± 4.16	.096	.217	.423
Fiber amount (g)	22.77 ± 5.64	28.21 ± 7.74	27.88 ± 8.49	27.92 ± 7.03	<.001	22.68 ± 7.49	25.51 ± 8.16	25.43 ± 9.35	24.86 ± 8.47	.265	.960	.118
Vitamin A (µg)	1714.25 ± 657.02	2615.83 ± 1590.97	2297.01 ± 1340.93	2486.61 ± 1599.57	.005 ¥	2830.12 ± 4899.56	2154.04 ± 1156.48	1746.76 ± 902.71	1985.91 ± 1289.1	.473	.199	.198
Vitamin B9 (µg)	311.22 ± 89.34	380.88 ± 132.25	385 ± 134.77	372.67 ± 127.09	.007 ¥	381.4 ± 186.69	370.67 ± 140.77	358.47 ± 122.37	351.45 ± 110.95	.693	.057	.319
Vitamin B12(µg)	5.49 ± 8.41	4.26 ± 2.98	4.18 ± 1.88	3.58 ± 1.51	.324 ¥	8.7 ± 17.67	3.93 ± 2.42	4.65 ± 1.93	4.73 ± 1.95	.177	.352	.010
Vitamin C (mg)	109.2 ± 68.47	133.5 ± 69.41	138.59 ± 67.14	125.74 ± 64.39	.051 €	80.04 ± 40.3	108.85 ± 60.83	99.31 ± 49.21	110.54 ± 56.5	.037	.083	.316
Sodium (mg)	3740.57 ± 1308.27	2866.54 ± 1224.49	3046.12 ± 1165.18	2702.52 ± 973.81	<.001	3325.97 ± 855.33	2703.07 ± 894.21	2571.16 ± 703.56	2805.94 ± 784.5	<.001	.135	.640
Calcium (mg)	901.83 ± 312.75	840.02 ± 230.24	879.76 ± 287.58	792.66 ± 294.52	.126	921.65 ± 314.05	871.49 ± 298.29	856.19 ± 287.63	852.9 ± 288.52	.514	.800	.408
Phosphorus (mg)	1290.41 ± 286.58	1228.14 ± 319.4	1215.16 ± 324.68	1213.71 ± 292.73	.314	1320.31 ± 287.61	1220.58 ± 365.25	1263.74 ± 354.47	1191.76 ± 320.94	.141	.676	.774
Iron (mg)	10.72 ± 2.82	10.84 ± 3.35	11.64 ± 3.54	11.77 ± 3.03	.272	11.67 ± 3.79	10.75 ± 4.93	11.18 ± 4.02	10.35 ± 3.16	.394	.257	.069
Zinc (mg)	10.21 ± 2.89	9.87 ± 4.86	10.4 ± 3.59	9.93 ± 2.53	.877	11.27 ± 2.95	9.69 ± 3.49	10.76 ± 3.13	9.53 ± 3.26	.020	.150	.583

SD, standard deviation.

Table 4. Mean, standard deviation, and reliability coefficients of the Three Factor Nutrition Questionnaire Scores

Subscores	Three-Factor Nutrition Questionnaire Items (Items in the Scale Are Shown with Numbers)	Pre-test Mean ± SD	Post-test Mean ± SD	Pre-test Confidence Coefficients	Post-test Confidence Coefficients
Uncontrolled Eating Score	**1)** Even if I have just eaten food, when I smell a nice meat being cooked, I can hardly stop myself from eating it.	3.05 ± 0.84	2.71 ± 1.00	0.867	0.820
	4) Sometimes when I start eating, it feels like I can't stop.	3.02 ± 0.84	2.23 ± 0.77		
	5) Being with someone who is eating often makes me feel hungry enough to eat.	2.83 ± 0.78	2.08 ± 0.83		
	7) When I see a delicious food, I get so hungry that I have to eat it right away.	2.95 ± 0.80	2.28 ± 0.78		
	8) I'm so hungry that I can't get enough.	2.88 ± 0.80	2.03 ± 0.68		
	9) I am always so hungry that it is very difficult for me to stop eating before I finish the food on my plate.	2.72 ± 0.80	1.92 ± 0.74		
	13) I'm always hungry enough to eat.	2.54 ± 0.81	1.85 ± 0.75		
	14) How often do you feel hungry?	2.95 ± 0.86	1.98 ± 0.82		
	17) Do you continue to overeat even though you are not hungry?	2.86 ± 0.77	2 ± 0.77		
Emotional Eating Score	**3)** When I am restless or anxious, I find myself eating.	2.65 ± 0.76	2.18 ± 0.68	0.828	0.669
	6) When I am sad, I often eat too much.	2.52 ± 0.89	1.97 ± 0.71		
	10) When I feel lonely, I find myself eating.	2.54 ± 0.85	1.97 ± 0.81		
Conscious restraint	**2)** I try to eat small portions to keep my weight under control.	2.14 ± 0.85	3.06 ± 0.66	0.821	0.796
	11) I consciously stop myself from gaining weight during meals.	2.06 ± 0.73	3.18 ± 0.68		
	12) I do not eat certain foods because they cause me to gain weight.	2.23 ± 0.77	3.26 ± 0.67		
	15) How often can you stop yourself from buying the foods you love to eat?	2.14 ± 0.7	3.05 ± 0.65		
	16) To what extent do you manage to eat less than you would like?	1.95 ± 0.72	3.37 ± 0.8		
	18) When a 1 to 8 rating is made, a 1 indicates no restriction on your eating (eat what you want when you want), and 8 totally restricts eating (strictly limiting your amount of food and not eating again after your portion is gone), giving yourself Indicate which number you will give by ticking the box below which is closest to you.	1.86 ± 0.68	3.25 ± 0.69		

diets as planned, it is expected that macro and micronutrient intakes would be similar.

The mean, standard deviation, and reliability coefficients of the 3-Factor Nutrition Questionnaire scores are given in Table 4. Participants' uncontrolled eating scores were found to be in the range of 0.9-0.8 in the pre-test and post-test, while the reliability coefficients of emotional eating and conscious restraint were found to be between 0.9 and 0.8 in the pre-test and 0.7 and 0.6 in the post-test. Considering the sub-components of the uncontrolled eating score, the highest score of the participants in both the

Table 5. Three Factor Nutrition Questionnaire scores of the research groups

Variables	Control Group (n=33)			Intervention Group (n=32)			Total (n=65)	
	Baseline (Mean ± SD) (Min-Max)	12th week (Mean ± SD) (Min-Max)	*P*	Baseline (Mean ± SD) (Min-Max)	12th week (Mean ± SD) (Min-Max)	*P*	$P^{beginning}$	$P^{12th\ week}$
Uncontrolled eating score	24.48 ± 4.14 (17-33)	19 ± 4.65 (12-29)	<0.001	27.16 ± 5.64 (16-36)	19.16 ± 4.61 (10-29)	<.001 [α]	.033	.892
Emotional eating score	7.73 ± 2.11 (3-12)	6.18 ± 1.74 (3-10)	<0.001	7.69 ± 2.24 (4-12)	6.06 ± 1.7 (3-11)	<.001 [α]	.941	.781
Conscious restraint	12.97 ± 2.57 (7-17)	19.06 ± 2.54 (13-24)	<0.001	11.78 ± 3.75 (6-19)	19.28 ± 3.31 (12-24)	<.001 [α]	.143	.764
Three-Factor Nutrition Questionnaire Total Score	45.18 ± 3.9 (36-56)	44.24 ± 4.83 (36-57)	0.152	46.63 ± 5.22 (39-57)	44.5 ± 4.75 (37-56)	.006	.213	.829
Three-Factor Nutrition Questionnaire scores of male participants	Control Group (n=15 Male)			Intervention Group (n=16 Male)			Total (n=31)	
Uncontrolled eating score	25.93 ± 4.20 (20-33)	21.07 ± 4.11 (17-29)	<0.001	28.88 ± 5.44 (19-36)	20.31 ± 3.94 (14-28)	<.001	.104	.606
Emotional eating score	7.93 ± 1.91 (4-10)	6.27 ± 1.75 (3-10)	0.001	7.56 ± 2.61 (4-12)	5.75 ± 1.48 (4-9)	.001	.656	.382
Conscious restraint	11.93 ± 2.96 (7-17)	19.13 ± 1.73 (16-23)	<0.001	10.44 ± 4.00 (6-18)	17.81 ± 3.51 (12-24)	<.001	.249	.193
Three-Factor Nutrition Questionnaire Total Score of Male Participants	45.80 ± 3.80 (41-56)	46.47 ± 5.10 (40-57)	0.457	46.88 ± 4.80 (39-55)	43.88 ± 4.75 (38-56)	.001	.497	.153
Three-Factor Nutrition Questionnaire scores of female participants	Control Group (n=18 Female)			Intervention Group (n=16 Female)			Total (n=34)	
Uncontrolled eating score	23.28 ± 3.79 (17-31)	17.28 ± 4.46 (12-28)	<0.001	25.44 ± 5.46 (16-34)	18 ± 5.06 (10-29)	<.001	.186	.661
Emotional eating score	7.56 ± 2.31 (3-12)	6.11 ± 1.78 (3-9)	<0.001	7.81 ± 1.87 (6-11)	6.38 ± 1.89 (3-11)	.001	.726	.678
Conscious restraint	13.83 ± 1.86 (9-16)	19.00 ± 3.11 (13-24)	<0.001	13.13 ± 3.03 (9-19)	20.75 ± 2.41 (16-24)	<.001	.426	.078
Three-Factor Nutrition Questionnaire Total Score of Female Participants	44.67 ± 4.01 (36-52)	42.39 ± 3.82 (36-48)	0.012	46.38 ± 5.76 (39-57)	45.13 ± 4.83 (37-56)	.327	.330	.075

pre-test and the post-test was determined "Even if I have just eaten, when I smell a nice cooking meat, I find it hard not to eat it." item, "I'm always hungry enough to eat." substances was detected.

In the sub-components of the emotional eating scores of the participants, the highest score in both the pretest and the posttest was "When I am restless and anxious, I find myself eating." and the lowest score was "When I am sad, I often eat too much." received from the items. Conscious restraint subcomponent also had the highest score in both the pretest and posttest, "Some foods I do not eat because they cause me to gain weight." item, the degree of conscious restraint measured in the last question in the pretest, and "How often can you stop yourself from buying the foods you love to eat" in the posttest? received from the research.

The data of the 3-Factor Nutrition Questionnaire scores and its sub-components are presented in Table 5. In terms of total and sub-scores, it was determined that there was no statistically significant difference in the mean scores of both groups at the end of the diet intervention. In terms of sub-scores, there was no difference between the groups according to gender, while a decrease was observed in the intervention group in males and in the control group in females in terms of total scores, and these decreases were found to be statistically different (Table 5).

DISCUSSION

As far as is known, this study, in which the effect of applying an energy-restricted diet and an intermittent fasting diet for 12 weeks on cognitive eating behavior in individuals with MetS was investigated, is the first study in the literature. During intermittent fasting diets, only energy intake is limited. Although the results regarding its use in healthy volunteers and individuals without comorbidities are promising, there is still no consensus regarding its long-term use.[28] According to the Australian Dietetic Association and the British Dietetic Association, it has been reported that it is used as an alternative method for its safety, but attention should be paid to the macro and micronutrient requirements of the patients.[29,30]

Macro and micronutrient needs should not be ignored in diets planned for MetS patients, and very low-energy diets should be avoided. In order to ensure the sustainability of diet therapy and to meet individual needs, it is important to provide 45%-55% of the energy from complex carbohydrates, 25%-35% from healthy fats, and meet the protein requirement not exceeding 15%. High-fiber foods; whole grains, legumes, fresh vegetables, and fruits help provide a feeling of fullness.[31] Epidemiological studies have shown that the Mediterranean diet is also suitable for MetS patients due to its cardiovascular effects.[32]

It is known that chronic diseases such as obesity and diabetes have a genetic background.[33] In this study, it was determined that almost all of the participants had chronic diseases such as first- and second-degree diabetes, hypertension, and coronary artery disease, and it is known that it contains findings supporting that chronic diseases may have a familial background. It is known that initiating both a pharmacological and dietary intervention at the same time to understand the effectiveness of the diet may be a confounding factor for research.[34,35]

Based on the hypothesis that an energy-restricted but planned diet with frequent meal intervals will reduce total insulin secretion in individuals and thus keep blood glucose levels under control, it is claimed that it will facilitate the adaptation of individuals to the diet and contribute to the digestion of food and energy expenditure. Although health professionals have different opinions about increasing the number of meals, diets planned with frequent meals by dividing the energy to be taken into parts are widely used.[36] While some epidemiological studies have shown an inverse relationship between increased eating frequency and body mass index, some studies have suggested that there is no such relationship between eating frequency and weight loss and body mass index and that energy intake increases with increasing frequency of eating.[37,38]

In this study, when the results obtained from the patients' food consumption were compared with the reference values of the Turkish Nutrition Guide (TUBER), it was observed that the daily energy intake was within the expected range.[31] In both groups, it was observed that the ratio of energy from carbohydrates in the diet was above 40%, and it was close to the 45%-60% carbohydrate energy ratio given as a reference. Implementation of diets planned with a carbohydrate intake of 50-130 g, under the control of a dietitian, by the British Dietetic Association, where daily carbohydrate intake above 130 g is safer in type 2 diabetes or individuals with cardiovascular risk, lower intakes are considered risky in terms of ketosis and cardiac and it has been reported that returning to safe carbohydrate intake levels in the remission period after a 5% weight loss may be more effective.[39] In this study, it was determined that the daily carbohydrate intake amount was approximately 155 g/day in both groups during the diet.

In terms of protein intake, reference intake values for males and females for TUBER were reported as 63.1 g/day and 55.2 g/day, respectively. In this study, it was observed that the protein intake of the participants varied between 64 and 75 g/day. Although it is thought that the daily protein intake is somewhat high, considering that this study was conducted among individuals with a body mass index of 27 kg/m² and above, it is interpreted that the amount of protein per body weight is consistent with the reference value. According to TUBER, it has been reported that the ratio of daily energy from fat should be between 20% and 35%. In this study, it was determined that the rate of energy from fat of the participants in both groups was between 34% and 40%. This range is considerably higher than the range specified by TUBER as a reference. Although the patients were informed about dietary fat patterns and unsaturated fats were given priority in the menus during diet planning, it is obvious that in practice, individuals eat a little more fat-rich food than expected. In terms of fiber intake, the intake increased during the diet in both study groups and the daily intake amounts were approximately between 23 and 28 g/day, which is consistent with the reference value of 25 g/day reported in TUBER.[31]

The 3-Factor Nutrition Questionnaire, which was developed to measure cognitive eating behavior, allows to measure adults' conscious or uncontrolled eating levels and emotional eating levels. In recent years, intermittent fasting diets, which are based on restriction at certain hours as well as classical energy-restricted eating

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Attitudes, Knowledge, and Evaluations of Nurses Working in Training and Research Hospital Regarding Nutritional Care

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ABSTRACT

Objective: Nurses take an active role in determining the nutritional status of the patient, detecting nutritional changes, and informing the nutritional support team when necessary. This study was conducted to evaluate the attitudes of nurses about nutritional care, to measure their knowledge levels, and to determine their opinions.
Methods: A total of 118 nurses working in inpatient services and intensive care units of Kutahya Health Sciences University Evliya Celebi Training and Research Hospital, who agreed to participate in the study, were included in the study. The participant information form, the scale for evaluating the importance of nutritional assessment, the level of knowledge about nutritional care, and the perceived nutritional quality of care in nurses were filled, and the data were analyzed with the Statistical Program for Social Sciences package program. Descriptive statistics were given as numbers, percentages, and averages. In addition, an independent sample *t*-test and a one-way analysis of variance test were used. A *P* value of <.05 was considered statistically significant in all evaluations.
Results: Of the participants, 60.2% (n=71) were female, 45.8% (n=54) had 6-10 years of professional experience, and 85.6% (n=101) received training on nutritional support. The nurses scored 21.36 ± 4.09 points for the importance of nutritional assessment, 25.33 ± 4.46 points for the level of knowledge about nutritional care, and 33.25 ± 6.33 points for the perceived quality of care related to nutritional care. It was found that there was a significant relationship between the mean scores for the importance of nutritional assessment and gender and education about nutritional support ($P < .05$). A significant correlation was found between the mean score of the perceived quality of care regarding nutritional care and gender ($P < .05$).
Conclusions: Evaluation and monitoring of the patient's nutritional status is a part of nursing care. Although most of the nurses are aware of the importance of nutritional assessment, their knowledge levels and perceived quality of care about nutritional care are not at the desired level.

Keywords: Nursing care, nutrition, nutritional therapy

INTRODUCTION

Malnutrition is a common problem among hospitalized patients. Although it is associated with increased morbidity and mortality, malnutrition is often missed and its treatment is overlooked.[1] Malnutrition screening and appropriate nutritional therapy are essential to ensure a healthy diet, prevent malnutrition, and improve patient outcomes.[2] All healthcare professionals must have basic nutritional knowledge and skills in order to effectively evaluate the patient's nutrition and provide appropriate counseling and treatment to the patient. Thus, patient care will also be positively affected.[3]

Nurses take an active role in meeting the nutritional needs of patients, as they have the most contact with patients and generally perform nutritional screening at the patient's first hospitalization.[2] Nurses should know the symptoms and risk factors of malnutrition and should provide the necessary nursing care to stop the occurrence and progression of malnutrition.[4] In addition, within the scope of nutritional care, nurses are responsible for evaluating the nutritional status of patients, providing the nutritional therapy they need, and monitoring their nutritional status.[5-7] For this reason, nurses should also have sufficient nutritional knowledge.[8] In line with this information, this study aimed to determine the nutritional attitudes, knowledge levels, and opinions of nurses.

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MATERIALS AND METHODS

This is a descriptive study conducted to evaluate nurses' attitudes toward nutritional care, to measure their knowledge levels, and to determine their opinions. Ethics committee approval was received from the Kutahya Health Sciences University Non-Invasive Clinical Research Ethics Committee (Decision No. 2020/17-11; Date: 16.12.2020).

A total of 118 volunteer nurses working at Kutahya Health Sciences University Evliya Celebi Training and Research Hospital were included in the study. Nurses working in units other than inpatient services and intensive care units were not included in the study.

The data were collected through the participant information form and the scale for evaluating the importance of nutritional assessment, the level of knowledge about nutritional care, and the perceived nutritional quality of care in nurses. The participant information form consists of questions about the sociodemographic characteristics of the participants, whether they received training on nutritional support, the follow-up of the nutritional status of the patients, and the nutritional risk scoring-2002 (NRS-2002) form. The scale for evaluating the importance of nutritional assessment, the level of knowledge about nutritional care, and the perceived nutritional quality of care in nurses was developed by Theilla et al[6] in 2016. Gürlek Kısacık et al[9] adapted it to Turkish in 2019 and demonstrated its validity and reliability. It consists of 3 sections and a total of 26 questions on the attitudes toward the importance of nutritional assessment, the level of knowledge about nutritional care, and the perception of nutritional quality. The first part consists of 7 questions about nurses' attitudes toward the importance of nutritional assessment, and the statements are in a 4-point Likert type. The score that can be obtained from the first part is in the range of 7-28. The second part consists of 10 reverse-scored questions that measure the knowledge level of nurses about nutritional care. The answers are in a 4-point Likert type and the score that can be obtained is in the range of 10-40. The last section consists of 9 questions in which nurses evaluate the quality of nutritional care given to patients. The statements are in a 5-point Likert type. The range of points that can be obtained from this section is 9-45. The scale has no cutoff value. As the scores obtained from the sections increase, the attitudes toward the importance of nutritional assessment, the level of knowledge about nutritional care, and the quality of nutritional care increase.[6,9]

Main Points

- Evaluation and improvement of the patient's nutritional status and cooperation with the nutritional support team when necessary are a part of nursing care.
- The quality of patient care can be increased by increasing the knowledge level of nurses about nutritional care.
- Training on nutritional assessment and support should be planned for nurses at regular intervals.

Statistical Analysis

Statistical Program for Social Sciences 22.0 (Armonk, NY, USA: IBM) package program was used in data analysis. Descriptive statistics are given as numbers, percentages, mean, median, standard deviation, and minimum and maximum values. Comparisons between the groups were evaluated using the independent samples *t*-test and one-way analysis of variance test. A $P < .05$ was considered statistically significant in all evaluations.

RESULTS

The data on the general characteristics of the participants are given in Table 1. It was found that the median age of the participants was 30 (21-48) years (min-max), 60.2% (n=71) were female, 44.05% (n=52) were between the ages of 21 and 29 years, 70.3% (n=83) were university graduates, the duration of professional experience of 45.8% (n=54) was 6-10 years, 53.4% (n=63) worked in the clinic, and 58.5% (n=69) were satisfied with the unit they worked in (Table 1). Of the nurses, 85.6% (n=101) stated that they received training on nutritional support, and 64.4% (n=76) stated that they filled the NRS-2002 form effectively. Of the participants, 76.2% (n=32) reported that the most common reason for not completing the NRS-2002 form effectively was lack of time. Of the participants, 78% (n=92) stated that they informed the nutrition support team if their NRS-2002 score was 3 or higher (Table 2).

The nurses' mean attitude score regarding the importance of nutritional assessment was 21.36 ± 4.09, their mean knowledge level score on nutritional care was 25.33 ± 4.46, and their mean perceived quality of care score on nutritional care was 33.25 ± 6.33. When the answers given by the participants to the items in the first part of the scale were examined, it was seen that the highest score belonged to the statement "Monitoring the nutritional status of the patient is a basic element of nursing care" (3.11 ± 0.71), while the lowest attitude score was for the statement "It is important to weigh patients when hospitalized" (2.91 ± 0.68) (Table 3). When the items in the second part of the scale were examined, it was determined that the highest score was for the statement "The main reason why patients do not eat hospital food is the appearance and taste of the food" (3.21 ± 0.78), while

Table 1. General Characteristics of the Participants (n = 118)

General Characteristics of the Participants	Number (n)	Percentage (%)
Gender		
Female	71	60.2
Male	47	39.8
Age (year) median (minimum-maximum)	30 (21-48)	
Age group		
21-29 years	52	44.05
30-39 years	52	44.05
40-48 years	14	11.9
Education status		
High school	31	26.3
Universty	83	70.3
Postgraduate	4	3.4
Professional experience period		
0-5 years	36	30.5
6-10 years	54	45.8
11 years and above	28	23.7
Working department		
Intensive care unit	55	46.6
Clinic	63	53.4
Satisfaction with the unit		
Satisfaction	69	58.5
Dissatisfied	49	41.5

Table 2. Opinions of Participants About Nutritional Support (n = 118)

	Number (n)	Percentage (%)
Get education about nutritional support		
Yes	101	85.6
No	17	14.4
I effectively fill out the NRS-2002 form		
Yes	76	64.4
No	42	35.6
Why can't you effectively fill out the NRS-2002 form?		
I don't know how to fill	6	14.3
I don't have enough time	32	76.2
I don't think it's necessary	4	9.5
What is the score on the NRS-2002 form, which should be reported to the nutritional support team?		
1 and above	1	0.8
2 and above	5	4.2
3 and above	92	78.0
4 and above	10	8.5
5 and above	10	8.5

NRS-2002, nutritional risk scoring-2002.

the lowest score was for "It is inevitable for overweight cancer patients to lose weight and they do not need to be referred to a dietitian" (2.22 ± 0.70) (Table 4). In the last part of the scale, the highest mean score belonged to the statement "Our nursing team monitors the nutritional status of the patients" (3.86 ± 0.83), while the lowest mean score was for "Our doctors also evaluate the nutritional aspect of the patient" (3.23 ± 1.12) (Table 5).

Attitude scores regarding the importance of nutritional assessment and perceived quality of care scores regarding nutritional care were significantly higher in females than in males ($P < .05$). It was observed that the group who received training on nutritional support had higher attitude scores regarding the importance of nutritional assessment than in those who did not ($P < .05$). Attitudes regarding the importance of nutritional assessment, level of knowledge about nutritional care, and perceived quality of care did not show any difference according to age, education level, professional experience, and the unit they worked in (Table 6).

DISCUSSION

Nutritional therapy is an important part of the patient's medical treatment. Planned and patient-appropriate nutritional therapy strengthens the immune system, reduces complications, shortens hospital stay, accelerates recovery, and positively affects morbidity and mortality.[10] The NRS-2002 form is used to evaluate the nutritional status of the patient and the need for nutritional therapy.[11] A

Table 3. Nurses' Evaluation of the Importance of Nutritional Assessment (1 to 4 scale) (n=118)									
	X ± SD 21.36 ± 4.09						Min-Max 7-28		
Nurses' Evaluation of the Importance of Nutritional Assessment	Strongly Agree		Agree		Disagree		Strongly Disagree		X ± SD
	n	%	n	%	n	%	n	%	
1. An initial nutritional assessment is important in patient care	1	0.8	18	15.3	69	58.5	30	25.4	3.08 ± 0.66
2. Monitoring a patient's nutritional status is a basic component of nursing care	2	1.7	24	20.3	61	51.7	31	26.3	3.11 ± 0.71
3. The nurse is responsible for notifying the attending physician if a patient does not eat a served meal	2	1.7	24	20.3	61	51.7	31	26.3	3.02 ± 0.73
4. It is important to weigh patients upon admission	3	2.5	24	20.3	71	60.2	20	16.9	2.91 ± 0.68
5. It is important to repeat the nutritional assessment every week of hospitalization	1	0.8	20	16.9	70	59.3	27	22.9	3.04 ± 0.65
6. Nutritional assessment and monitoring by the nurses improve a patient's recovery	1	0.8	16	13.6	71	60.2	30	25.4	3.10 ± 0.64
7. Nursing care has a significant impact on patients' nutritional status	1	0.8	19	16.1	68	57.6	30	25.4	3.07 ± 0.66

Min-max, minimum-maximum; SD, standard deviation; X, mean.

significant number (35.6%) of the nurses included in this study stated that they could not fill out the NRS-2002 form effectively. In addition, some of the nurses (22%) do not know that the nutrition support team should be informed when the NRS-2002 form is 3 points or more and the appropriate nutrition plan should be created for the patient, and it is thought that all nurses should have this information in order to provide effective nutritional care.

Nurses play a very important role in ensuring that adequate nutritional care is provided to the patient in an optimal way.[6] Nurses who receive nutrition education can provide more effective nutritional therapy to their patients, and thus the quality of nutritional care can increase.[16] In this study, it was shown that some of the nurses (14.4%) did not receive training on nutritional support. This may cause possible malnutrition to be overlooked. In a study, it was shown that the nutritional education program strengthened the perceptions and knowledge of nurses about nutritional therapy.[16]

In order to provide the patient with proper nutrition, first of all, the patient's nutrition should be evaluated. Nurses play a key role in detecting the patient's malnutrition early, minimizing inequalities in practice, and achieving nutritional goals.[12] In this study, although it is seen that nurses have a positive attitude toward the importance of nutritional assessment, there is a need to develop this attitude. Similar to this study, Theilla et al[6] and Çoşğun et al[7] also reported that nurses had positive attitudes toward the importance of nutritional assessment. Nurses who were female and who received training on nutritional support were found to have higher attitude scores regarding the importance of nutritional assessment. In the study conducted by Theilla et al.[6] it was reported that female nurses exhibited more positive attitudes. In the study of Çoşğun et al.[7] it was shown that the group receiving nutritional education had a more positive attitude. Although nurses considered the nutritional care of the patient as important, they stated that they had to give priority to other nursing activities due to reasons such as lack of time and having multiple tasks.[13]

When the knowledge levels of nurses about nutritional care are examined, it is seen that they are not at the desired level. The scores reported in the studies of Theilla et al[6] and Çoşğun et al[7] also show parallelism with our study. The thought that nutrition therapy is the duty of a dietitian may explain the reason for the low level of knowledge of nurses.[7] On the other hand, meeting the nutritional needs

Table 4. Nurses' Knowledge About Nutrition Care (1 to 4 scale) (n=118)									
	X ± SD 25.33 ± 4.46				Min-Max 15-36				
Nurses' Knowledge About Nutrition Care	Strongly Agree		Agree		Disagree		Strongly Disagree		X ± SD
	n	%	n	%	n	%	n	%	
1. Nurses should focus on the patient's primary diagnosis rather than on nutritional aspects	7	5.9	52	44.1	36	30.5	23	19.5	2.63 ± 0.86
2. A patient who refuses to eat should not be forced to do so	7	5.9	61	51.7	40	33.9	10	8.5	2.44 ± 0.73
3. The main reason patients don't eat hospital food is its appearance and taste	4	3.4	14	11.9	53	44.9	47	39.8	3.21 ± 0.78
4. Nutritional support should commence only once medical treatment has been completed	12	10.2	54	45.8	42	35.6	10	8.5	2.42 ± 0.78
5. Nutritional support is resource-consuming and not a cost-effective investment	14	11.9	61	51.7	39	33.1	4	3.4	2.27 ± 0.71
6. Dieticians, rather than the nursing staff, are responsible for nutritional support	3	2.5	34	28.8	52	44.1	29	24.6	2.90 ± 0.79
7. Parenteral nutrition should be avoided due to its complications	4	3.4	70	59.3	38	32.2	6	5.1	2.38 ± 0.64
8. Obese patients (BMI > 30) are not at risk of malnutrition and should be fed sparingly	7	5.9	65	55.1	39	33.1	7	5.9	2.38 ± 0.69
9. A patient eating a meal should not be disturbed, even for medical treatment	6	5.1	61	51.7	45	38.1	6	5.1	2.43 ± 0.67
10. Overweight patients with cancer will inevitably lose weight and need not be referred to a dietician	15	12.7	66	55.9	33	28.0	4	3.4	2.22 ± 0.70

BMI, body mass index; min-max, minimum-maximum; SD, standard deviation; X, mean.

of the patient and improving the nutritional status is a part of holistic nursing care.[14] Various studies have shown that the awareness of nurses on the importance of nutrition, its evaluation, and nutrition therapy should be increased through training.[13,15] Nutritional education can help nurses and all health professionals to provide evidence-based care that meets the nutritional needs of patients.[2]

Effective and comprehensive nursing care is very important in preventing malnutrition, reducing the length of hospital stay, and reducing the cost.[14] In this study, it is seen that nurses' perceived quality of care scores regarding nutritional care are not at a sufficient level. The mean score of female nurses is significantly higher than that of male nurses. In the study of Çoşğun et al.[7] it was reported that the scores of those working in the intensive care unit and those who received training on nutrition therapy were higher, which might be due to the fact that nutrition therapy is of critical importance for patients treated in the intensive care unit, and therefore, nurses pay more attention to this issue.

Table 5. Nurses' Evaluation of the Quality of Nutritional Care in Nurses' Ward (1 to 5 scale) (n=118)											
	X ± SD 33.25 ± 6.33						Min-Max 18-45				
Nurses' Evaluation of the Quality of Nutritional Care in Nurses' Ward	Strongly Agree		Agree		Disagree		Strongly Disagree		Strongly Agree		X ± SD
	n	%	n	%	n	%	n	%	n	%	
1. Patients receive complete nutritional care	-	-	17	14.4	24	20.3	53	44.9	24	20.3	3.71 ± 0.95
2. Our nursing staff monitors patients' nutritional status	-	-	10	8.5	20	16.9	64	54.2	24	20.3	3.86 ± 0.83
3. The nutritional assessment is performed methodically and professionally	-	-	10	8.5	34	28.8	48	40.7	26	22.0	3.76 ± 0.89
4. Patients requiring a dietician's care receive a consultation with minimal delay	1	0.8	6	5.1	29	24.6	64	54.2	18	15.3	3.77 ± 0.79
5. Physicians address nutritional aspects of patient care	12	10.2	14	11.9	40	33.9	38	32.2	14	11.9	3.23 ± 1.12
6. Patients receive their meals in an appropriate manner as per regulations	8	6.8	6	5.1	20	16.9	64	54.2	20	16.9	3.69 ± 1.03
7. Nurses are aware whether or not a patient has completed his meal	2	1.7	13	11.0	26	22.0	55	46.6	22	18.6	3.69 ± 0.95
8. Information on patients' nutritional state is effectively transmitted among health care staff	1	0.8	10	8.5	25	21.2	61	51.7	21	17.8	3.77 ± 0.87
9. I am satisfied with the level of nutritional care in my ward	1	0.8	13	11.0	25	21.2	56	47.5	23	19.5	3.73 ± 0.92
Min-max, minimum-maximum; SD, standard deviation; X, mean.											

Nutritional assessment of nurses is not sufficient to achieve nutritional goals. It has been reported that the evaluation of body weight, food intake history, disease severity, and gastrointestinal system function is very important. Evidence-based good clinical practice in nutritional assessment and a multidisciplinary nutrition team are the most effective ways to reduce malnutrition.[12] There is a continuing need to raise awareness of the importance of multidisciplinary nutritional care in improving health outcomes for both primary and secondary care.[2] It is necessary to increase the knowledge, skills, and abilities of health personnel about the nutrition problems of patients and the management of these problems.[1,17]

The main limitations are that the study was carried out in a single center and was dependent on the person's statement.

Evaluation of the patient's nutritional status and nutritional care are an important part of nursing practice. In order to increase the knowledge of nurses on nutrition therapy, training should be planned, and nurses should

Table 6. Distribution of Scores for the Importance of Nutritional Assessment, Level of Knowledge About Nutritional Care, and Perceived Quality of Care Regarding Nutritional Care, According to General Characteristics of Nurses

	Importance of Nutritional Assessment			Knowledge of Nutritional Care			Perceived Quality of Care Related to Nutritional Care		
	X ± SD	*t*/F	*P*	X ± SD	*t*/F	*P*	X ± SD	*t*/F	*P*
Gender									
Female	23.08 ± 3.61	**6.541**	**<.001**	24.85 ± 4.70	−1.441	.152	35.76 ± 5.06	**5.778**	**<.001**
Male	18.76 ± 3.35			26.06 ± 4.00			29.46 ± 6.22		
Age									
21-29 years	21.00 ± 4.55			25.88 ± 4.43			33.98 ± 6.43		
30-39 years	21.36 ± 3.63	0.968	.383	24.63 ± 4.44	1.161	.317	31.92 ± 5.53	2.425	.093
40-48 years	22.71 ± 3.85			25.92 ± 4.63			35.50 ± 8.02		
Education status									
High school	21.67 ± 3.54			25.22 ± 4.66			32.90 ± 5.91		
University	21.24 ± 4.21	0.129	.879	25.15 ± 4.29	2.309	.104	33.51 ± 6.31	0.493	.612
Postgraduate	21.50 ± 6.35			30.00 ± 5.09			30.50 ± 10.63		
Professional experience period									
0-5 years	20.94 ± 4.73			25.00 ± 4.59			33.86 ± 6.90		
6-10 years	21.20 ± 3.86	0.834	.437	25.83 ± 4.51	0.619	.540	32.35 ± 5.77	1.034	.359
11 year and above	22.21 ± 3.61			24.82 ± 4.24			34.21 ± 6.61		
Working department									
Intensive care unit	21.36 ± 4.22	−0.002	.998	25.94 ± 4.91	1.384	.169	33.61 ± 6.06	0.581	.562
Clinic	21.36 ± 4.00			24.80 ± 3.99			32.93 ± 6.59		
Get education about nutritional support									
Yes	21.73 ± 3.79	**2.434**	**.016**	25.12 ± 1.67	−1.840	.074	33.29 ± 6.23	0.178	.859
No	19.17 ± 5.12			26.58 ± 2.64			33.00 ± 7.10		

One-way ANOVA and *t*-tests were performed. $P < .05$. SD, standard deviation; X, mean.

be provided with more duties and responsibilities in the nutritional support given to the patient. Thus, the quality of nutritional support given to the patient can be increased.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Kutahya Health Sciences University Non-Invasive Clinical Research Ethics Committee (Date: December 16, 2020, Number: 2020/17-11).

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

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models, have become popular. In this study, the 3-Factor Nutrition Questionnaire was applied before and after the study in order to evaluate the effects of classical energy-restricted diet and intermittent fasting diet applied for 12 weeks on cognitive eating behaviors. It is concluded that doing an intermittent fasting diet does not have a statistically significant effect on the eating behaviors of individuals when compared to only an energy-restricted diet. In terms of sub-scores, there was no difference between the groups according to gender, while a decrease was observed in the intervention group in males and in the control group in females in terms of total scores, and these decreases were found to be statistically different. We think that this is due to the difference in the uncontrolled eating score between the groups at the beginning. There was no significant difference between total scores at baseline in both the control and intervention groups. At the end of the study, statistically significant differences were observed in the scores of conscious eating, uncontrolled eating, and emotional eating in both the classical energy-restricted group and the intermittent fasting group in females. No significant difference was observed between the groups in terms of cognitive eating behaviors.

In the literature, no research has been found that examines the effect of the 16 : 8 model fasting diet on nutritional behaviors using the 3-Factor Nutrition Questionnaire. The findings obtained from this study are a pilot for future studies on this subject. As a result, although intermittent fasting diet is more interesting for individuals, it has similar effects on cognitive eating behavior as classical energy-restricted diets. However, alternatively, intermittent fasting diets are to be compared in different groups in terms of modulating cognitive eating behavior. This study has some limitations, such as the fact that it was conducted in a single obesity counseling center and that psychiatric diseases and conditions that may affect cognitive eating behavior were not taken into account. In order to reach a conclusion at the level of evidence about whether the nutritional behaviors measured by the 3-Factor Nutrition Questionnaire are affected by the intermittent fasting diet, multicenter studies with larger sample size and representativeness are needed.

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Using Proxy-Reported SARC-F on Behalf of Self-Assessment in Older Adults: Examining its Reliability and Agreement with Patient Responses

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ABSTRACT

Objective: SARC-F is a self-reported questionnaire to screen for an increased risk of sarcopenia. Since it requires self-assessment, it is not appropriate for use in patients with impaired judgment or severe communication problems. Whether it can be reliably administered to proxies on behalf of patients is an issue that needs to be clarified. We aimed to study the reliability of SARC-F by proxy and examine the agreement between patient and proxy responses.
Methods: This is a cross-sectional study conducted between September 2019 and October 2021. Patients were recruited from 2 settings: outpatients and nursing home residents. Proxies were relatives/caregivers in community-dwelling setting and nurses in nursing home. We transformed SARC-F to SARC-F by proxy and studied its reliability with interrater and test–retest reliability analyses in the first phase. In the second phase, we examined the concordance between patient and proxy responses in total and item by item.
Results: Total sample size was 279 (172 patients and 107 proxies). Community-dwelling older adults made up 58.1% of the older adult population. Median age of older adults was 72 (60-93), and 44.8% were female. SARC-F by proxy showed an excellent interrater and test–retest reliability, with intraclass correlation coefficients of 0.91 and 0.90, respectively ($P < .001$). It also demonstrated a high level of internal consistency, with a Cronbach's alpha value of 0.82. The total scores of SARC-F by patient and SARC-F by proxy showed a moderate correlation ($r = 0.635$; $P < .001$). The fourth item demonstrated the highest, and the fifth item showed the lowest correlation (r values = 0.591 and 0.443, respectively).
Conclusion: According to our study, SARC-F by proxy can be reliably administered to proxies on behalf of older adults when conditions that prevent reliable judgment or communication exist. Further validity studies of SARC-F by proxy are needed to verify whether it will work well in identifying sarcopenia cases in older adults.

Keywords: Geriatric assessment, older adults, patient-reported outcome measures, proxy, sarcopenia

INTRODUCTION

Sarcopenia has become a hot topic that healthcare professionals have shown more interest in recent years since plenty of reports have been published on its close relationship with adverse outcomes like falls, disabilities, hospitalizations, and mortality in older adults.[1] Recent guides on sarcopenia have recommended the use of SARC-F questionnaire in case finding, with a score of ≥4 meaning that certain individual has an increased risk of sarcopenia.[2,3]

Although SARC-F showed low-to-moderate level of sensitivity, it demonstrated a high level of specificity in identifying sarcopenia, ending up mostly detecting severe cases.[4] Several reports tried to increase its sensitivity by coming up with different thresholds[5] or modifying it by implementing certain measurements [like SARC-CalF (SARC-F and calf circumference)].[6] Whether it can also be used in other conditions (like identifying physical frailty)[7] has been another point to be addressed. Adding to its ease of use and practicality, it has gained an undeniable interest in

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sarcopenia practice in recent years. However, besides the features that favor its common use, it also embodied some limitations coming from its self-reported nature, as it should not be preferred in the presence of dementia or other serious neuropsychiatric problems that may impair judgment or communication problems that make administration of the questionnaire impossible.

In routine practice, healthcare professionals sometimes apply self-reported assessments to caregivers, on behalf of patients. However, the judgments of proxies (relatives, caregivers, or sometimes healthcare staff) may not always be realistic or properly reflect the actual situation, and they can differ depending on several factors like the proximity of the relationship, education level, mood, or caregiver burden of the proxy.[8] On the contrary, sometimes, the perspective of proxies may be more objective and closer to the truth. Hence, the ideal thing is that the reliability and validity of using proxy-reported questionnaires on behalf of patients should be studied before and applied accordingly.

In the literature, there are various reliability studies of proxy-reported questionnaires, mostly assessing the quality of life (QoL) in different patient populations.[9-11] As a self-reported questionnaire, whether it is reliable and valid to apply SARC-F to the proxies on behalf of patients is an issue that needs to be clarified. In order to evaluate how well a test can predict a certain outcome, it is first necessary to study whether the use of that test is reliable. Reliability refers to the degree to which the results obtained by measurement can be replicated. Lack of reliability is expected to affect the validity of certain measurements invariably and can arise from divergence between observers or instruments of measurements.[12] Therefore, this study aims to analyze the reliability of SARC-F questionnaire applied to proxies (namely, *SARC-F by proxy*) on behalf of older patients and study the concordance between SARC-F results obtained from patients and their proxies.

Main Points

- SARC-F is a 5-item screening tool that is recommended for case finding in sarcopenia. As a self-reported questionnaire, it embodies a limitation as it should not be applied to individuals with impaired judgment and communication problems.
- In older adults with dementia or communication difficulties, SARC-F by proxy may be applied to the relatives/caregivers on behalf of the patients, demonstrating excellent reliability.
- SARC-F responses obtained from patients and their proxies showed moderate level of agreement, with the highest agreement on the fourth (climbing stairs) and the lowest agreement on the fifth item (falls in the past year).

METHODS

This study consisted of 2 phases: namely, "adaptation of Turkish SARC-F into *SARC-F by proxy* and reliability analysis" constituted the first and assessment of correlation between "*SARC-F by patient*" and "*SARC-F by proxy*" constituted the second phase. We conducted the study between September 2019 and October 2021, among geriatric outpatients admitted to a tertiary health clinic and residents living in the largest nursing home (NH) in the city that was subordinated to metropolitan municipality. The study was approved by the local ethics committee (reference: 1503/2020, date of approval: October 26, 2020). We received informed consent from all of the participants. We received legal permission from NH administration.

First Phase (Adaptation of Turkish SARC-F into SARC-F by Proxy and Reliability Analysis)

This phase included 7 steps based on the guidelines put forward by World Health Organization (WHO).[13] We organized an expert panel including 2 bilingual experts (one having English and the other having Turkish as their mother tongue) and 2 bilingual geriatricians. In the first step, an expert panel composed of 2 geriatricians transformed the Turkish-validated SARC-F into *SARC-F by proxy*: We converted the items originally filled out by patients into the items asked to caregivers/relatives for the assessment on behalf of patients. In this way, proxies would elicit substituted judgment, where they projected themselves into the *body and mind* of the patients when answering the questions (i.e., proxy-patient perspective[14]). In step 2, a bilingual translator having English as her mother tongue and blinded to the original questionnaire back-translated the Turkish *SARC-F by proxy* into the English *SARC-F by proxy*. In step 3, 2 geriatricians and 2 bilingual experts had a meeting and reviewed 2 forms of the test in terms of conceptual and cultural equivalence to reach a satisfactory version. Later at step 4, we e-mailed the 2 agreed-upon versions (Turkish *SARC-F by proxy* and the translated version) to one of the authors of the original English SARC-F, John Morley, and got approval. In step 5 (pre-test phase), we administered *SARC-F by proxy* to 5 female and 5 male participants face-to-face in order to get their opinions, suggestions, and doubts about the comprehension and cultural relevance of the test. World Health Organization guidelines on the process of adaptation and validation of instruments recommended that at least 10 subjects should participate in the pre-test step.[13] At pre-test step, we excluded participants with any cognitive dysfunction or severe hearing impairment that would affect comprehension of the questionnaire. In step 6, 2 geriatricians administered *SARC-F by proxy* to 21 proxies in different rooms on the same day, in order to assess inter-rater reliability. In the final step, we applied *SARC-F*

by proxy face-to-face or by phone to these 21 participants 14 days later in order to evaluate test–retest reliability. We specified a time interval of "14 days," because we considered that this interval would be long enough to prevent recall bias of previous answers and short enough for significant changes in physical capacity to develop.[15]

Second Phase (Assessment of Concordance Between "SARC-F by Patient" and "SARC-F by Proxy")

Since the secondary aim of the study was to find out whether *SARC-F by proxy* would demonstrate a high level of agreement with patient responses, we had to assess the correlation between *SARC-F by patient* and *SARC-F by proxy* results (obtained from their caregivers/relatives). Hence, there were 2 study populations: patients and their proxies. Patient population also included older adults from 2 different settings: community-dwelling (CD) older adults and NH residents. Inclusion criteria for older individuals were being older than 60 years of age and having a concurrent caregiver or a relative who knew and observed the patient well enough to reliably answer the questions. Exclusion criteria for older individuals were having moderate or severe dementia (already diagnosed or recent diagnosis through Clinical Dementia Rating Scale (CDR)), severe hearing or visual impairment, severe depression, admitting to the outpatient clinic alone or with a companion who cannot make a reliable assessment about the patient, and refusal to participate. Inclusion criteria for proxy group were being older than 18 years of age and having frequent contact (contact on a weekly basis, at least via telephone) with the patients or residents that allows the proxy insight into the individual's situation,[8] at least for the last year. Exclusion criteria were having diagnosis of dementia, depression, hearing impairment, having insufficient contact with patient to meet the above-mentioned criteria for proxy assessments, and refusal to participate.

SARC-F is a 5-item self-questionnaire recommended for sarcopenia screening and case finding by the European Working Group on Sarcopenia in Older People 2 guide (EWGSOP2).[2] It evaluates **S**trength, **A**ssistance in walking, **R**ising from a chair/bed, **C**limbing stairs, and Falls. A score of ≥4 means the patient has an increased risk of sarcopenia. *SARC-F by proxy* is the transformed version of SARC-F in which 5 items of SARC-F were converted to the questions directed to the caregivers/relatives of the patients and asked for the answers given on behalf of the patient with a proxy–patient perspective. Proxy assessments can be performed by asking a proxy to assess the patient as they think the patient would respond (i.e., proxy–patient perspective) or to provide their own judgment (i.e., proxy–proxy perspective) on the patients' health status. In proxy–patient perspective, proxy is instructed to "try to view the situation as the patient would" or "think as the patient would."[14] The difference between self-report of the patients' and proxies' perspectives is called "inter-rater gap," and it was hypothesized that this gap was smaller for proxy–patient perspective than proxy–proxy perspective.[8] Therefore, we decided to use this perspective in applying the questionnaire to the proxies.

In the original SARC-F, strength is assessed by asking how much difficulty the patient have in carrying/lifting 10 pounds. However, in Turkish SARC-F validation study, 10 pounds was adapted as 5 kg instead of the precise calculation (4.54 kg) in order to ease the understanding of the question in daily practice, as suggested by EuGMS Sarcopenia Special Interest Group.[15] English and Turkish forms of *SARC-F by proxy* and their scoring system can be found in Supplementary Table 1.

Guidelines for calculation of minimum sample size generally recommend a respondent-to-item ratio ranging from 5 : 1 to 30 : 1.[16] As *SARC-F by proxy* is a 5-item questionnaire, we decided that we would reach an adequate sample size with at least 150 older adults and their proxies. A geriatrician performed face-to-face interviews with older individuals and their proxies in different rooms on the same day.

Comprehensive Geriatric Assessment

We collected the demographic and clinical data of older adults including age, gender, education level, assistance in walking, living alone (yes/no), tobacco and alcohol use, and number of illnesses and regular drugs. We assessed functionality via Katz's basic activities of daily living (ADL) and Lawton's instrumental activities of daily living (IADL) scales. Katz ADL scores range between 0 and 6, and Lawton IADL between 0 and 8 (a score of 0 means complete dependency and full points mean complete independency, for both tests).[17,18] We assessed the cognitive status of the participants via CDR. The clinical Dementia Rating Scale evaluates patients' cognitive and functional performance in 6 areas: memory, orientation, judgment and problem solving, community affairs, home, hobbies, and personal care. Scores from each area are combined to obtain a composite score ranging from 0 to 3. A score of 0 indicates normal cognitive functions; however, a score of 0.5 indicates very mild/questionable dementia; 1 indicates mild, 2: moderate, and 3: severe dementia.[19] We assessed frailty through **F**atigue, **R**esistance, **A**mbulation, **I**llnesses, and **L**oss of weight (FRAIL) index: A subject with a score of ≥3 was considered as frail, 1-2 points as pre-frail, and 0 as robust.[20] We evaluated nutritional status via Mini-Nutritional Assessment-Short Form, with a score of <12 points interpreted as undernutrition, and <8 points as malnutrition.[21] We asked whether older adults experienced any falls during the past year. We defined polypharmacy as using ≥5 medications per day.

Statistical Analysis

We analyzed the normality of the numerical variables with histograms, probability plots, and Kolmogorov–Smirnov tests. We presented numerical variables as mean ± standard deviation or median (minimum-maximum) and categorical variables as numbers and frequencies. We compared 2 groups with an independent sample *t*-test or Mann–Whitney *U* test according to their normality analysis. We compared categorical variables using chi-square test with Yates correction and Fisher's exact test. We assessed the reliability of *SARC-F by proxy* by internal consistency, inter-rater, test–retest reliability, and concordance analyses. We tested inter-rater and test–retest reliability by intra-class correlation coefficient (ICC). We calculated ICC estimates and their 95% CI based on a single measurement, absolute agreement 2-way mixed-effects model. We defined reliability by ICC estimates as: ICC estimate [0.90: excellent reliability, between 0.75 and 0.9: good reliability, 0.5-0.75: moderate reliability, <0.5: poor reliability]. We tested internal consistency by Cronbach's alpha coefficient, with a value of >0.70 indicating a high level of internal consistency. We analyzed the correlation between *SARC-F by patient* and *SARC-F by proxy* in total and item-by-item by Spearman's rho correlation test. Alternatively, we defined *SARC-F by patient* and *SARC-F by proxy* results categorically (≥4 as positive screening) and studied the overall concordance rate. We reported the Cohen kappa coefficient (κ). κ values between 0.81 and 1 were considered as perfect, 0.6-0.8 indicated strong, 0.4-0.6 indicated moderate, 0.20-0.4 indicated low, between 0 and 0.20 indicated very slight agreement, and less than 0 indicated disagreement. We accepted a *P* value of less than .05 as significant. We performed statistical analyses by Statistical Package for Social Sciences (SPSS) v 21.0 (SPSS Statistics; IBM, Armonk, NY, USA) and MedCalc Statistical Software v 15.2 (MedCalc Software, Ostend, Belgium).

RESULTS

First Phase (Adaptation of SARC-F into SARC-F by Proxy and Reliability Analysis)

We assessed whether *SARC-F by proxy* was easy to understand in pretest step and included 5 men and 5 women, with a mean age of 42.3 ± 8.9. For both sexes, 3 of the participants were primary school graduates; 1 male and 2 female participants were high school graduates, and 1 male participant was a college graduate. They did not report any problems in comprehension of the items. Interrater and test–retest reliability steps included 21 proxies with a mean age of 56.2 ± 15.0. Inter-rater reliability analysis showed excellent reliability, with an ICC of 0.91 (0.80-0.97) ($P < .001$). Likewise, test–retest reliability was excellent with an ICC of 0.90 ($P < .001$). Detailed findings of inter-rater and test–retest reliability analyses are given in Tables 1 and 2. Internal consistency analysis of *SARC-F by proxy* showed a high level of consistency, with a Cronbach's alpha value of 0.82.

Table 1. Interrater Reliability Analysis of SARC-F by Proxy

	ICC	95% CI
SARC-F by proxy total	0.919	0.796-0.967
SARC-F by proxy; strength item	0.862	0.666-0.944
SARC-F by proxy; assistance item	0.745	0.364-0.897
SARC-F by proxy; rising item	0.604	0.071-0.836
SARC-F by proxy; climbing item	0.915	0.794-0.965
SARC-F by proxy; falls item	0.750	0.378-0.899

ICC, intraclass correlation coefficient.
We calculated ICC estimates and their 95% CI based on a single measurement, absolute agreement 2-way mixed-effects model.

Second Phase (Assessment of Concordance Between "SARC-F by Patient" and "SARC-F by Proxy")

Demographic and Clinical Characteristics of Older Adults and Their Proxies

Total sample consisted of 279 participants, with 172 older adults (100 for CD group and 72 for NH group) and 107 proxies (98 for CD group and 9 for NH group). Median age of older adults was 72 (min-max: 60-93), and the number of female participants was 77 (44.8%). Median age of the proxies was 52 (min-max: 20-85), with 67 (63.2%) being female. Proxies of CD group were mostly their adult children (54.6%) and proxies of NH group consisted entirely of nurses giving close care to the residents. The cause of the mismatch in patient–proxy numbers is that while 96 proxies in CD group performed *SARC-F by proxy* on behalf of only 1 older individual, 2 proxies administered the test on

Table 2. Test–Retest Reliability Analysis of SARC-F by Proxy

	ICC	95% CI
SARC-F by proxy total	0.952	0.883-0.980
SARC-F by proxy; strength item	0.837	0.596-0.934
SARC-F by proxy; assistance item	0.868	0.682-0.946
SARC-F by proxy; rising item	0.848	0.634-0.938
SARC-F by proxy; climbing item	0.934	0.837-0.973
SARC-F by proxy; falls item	0.800	0.500-0.919

ICC, intraclass correlation coefficient.
*We calculated ICC estimates and their 95% CI based on a single measurement, absolute agreement 2-way mixed-effects model.

Table 3. The Demographical and Clinical Characteristics of the Study Population (N=279)				
	Total	**CD Group**	**NH Group**	*P*
Older individuals				
Number (%)	172 (100)	100 (58.1)	72 (41.9)	
Age (years)*	72 (60-93)	72.5 (60-93)	71 (60-85)	.08
Gender (female)¶	77 (44.8%)	65 (65%)	12(16.7%)	**<.001**
Education level¶				.48
Illiterate	24 (14.3%)	14 (14%)	10 (14.7%)	
Primary school	93 (55.4%)	52 (52%)	41 (60.3%)	
Secondary school	10 (6%)	5 (5%)	5 (7.4%)	
High school	24 (14.3%)	16 (16%)	8 (11.8%)	
University	17 (10.1%)	13 (13%)	4 (5.9%)	
Assistance in walking¶	37 (21.5%)	20 (20%)	17 (23.6%)	.57
Living alone¶	83 (48.2%)	83 (16.2%)	-	N/A
Smoking¶	44 (25.6%)	4 (4%)	40 (55.6%)	**<.001**
Alcohol¶	4 (2.3%)	3 (3%)	1 (1.4%)	.64
Number of illnesses*	4 (0-10)	4 (0-10)	3.5 (0-7)	**.02**
Number of regular drugs*	7 (0-17)	6 (0-15)	7.5 (0-17)	**.03**
Chronic illnesses¶				
Diabetes mellitus	67 (39%)	47 (47%)	20 (27.8%)	**0.01**
Hypertension	112 (65.1%)	81 (81%)	31 (43.1%)	**<.001**
Dyslipidemia	80 (46.5%)	59 (59%)	21 (29.2%)	**<.001**
Ischemic heart disease	63 (36.6%)	50 (50%)	13 (18.1%)	**<.001**
Heart failure	23 (13.4%)	5 (5%)	18 (25.4%)	**<.001**
COPD	33 (19.2%)	5 (5%)	28 (38.9%)	**<.001**
Hypothyroidism	18 (10.5%)	12 (12%)	6 (8.3%)	.43
Proxies				
Number (%)¥	107 (100)	98 (91.6)	9 (8.4)	
Age*	52 (20-85)	55 (20-85)	31(24-47)	<.001
Gender (female)¶	67 (63.2%)	62 (63.9%)	5 (55.6%)	.72
Education level¶				.06
Illiterate	2 (1.9%)	2 (2.1%)	-	
Primary school	24 (22.6%)	24 (24.7%)	-	
Secondary school	6 (5.7%)	6 (6.2%)	-	
High school	29 (27.4%)	23 (23.7%)	6 (66.7%)	
University	45 (42.5%)	42 (43.3%)	3 (33.3%)	
Relationship to the older participant¶				
Spouse		31 (32%)	-	N/A
Child		53 (54.6%)	-	
Daughter-son in law		2 (2.1%)	-	
Sibling		6 (6.2%)	-	
Caregiver		2 (2.1%)	-	
*Nurse^*		-	9 (100%)	
Others#		3 (3.1%)	-	

¶Number (percentage);*Median (minimum-maximum);¥Exceptionally, there were 2 proxies from CD group who answered the questions on behalf of 2 different older individuals. One of them was the daughter of an old couple, and the other was the niece of 2 sisters;^All nurses were responsible for medical treatments of more than 1 resident. The number of residents per nurse ranged between 4 and 17; Niece, nephew, and neighbor.
CD, community-dwelling; COPD, chronic obstructive pulmonary disease; NH, nursing home.

behalf of their 2 different relatives. In NH, 9 nurses from different wards of NH took part in the study. Hence, each of them responded to *SARC-F by proxy* on behalf of the residents from the wards for which they were responsible. The number of residents per nurse ranged between 4 and 17. The demographical characteristics of older individuals and their proxies are given in detail in Table 3.

Median number of chronic diseases was 4 (min-max: 0-10), with hypertension being the most prevalent (65.1%; n=112). When 2 groups of older participants were compared in terms of their clinical characteristics, CD group had significantly more female participants, higher total number of chronic diseases and higher hypertension, dyslipidemia, and ischemic heart disease prevalence. Nursing home group had higher prevalence of tobacco use, chronic obstructive pulmonary disease (COPD), and heart failure and higher number of regular medications. The clinical characteristics of the study population are given in Table 3.

The median total *SARC-F by patient* score was 2 (0-10), and 54 (31.4%) of the participants had an increased risk of sarcopenia. Community-dwelling and nursing home groups showed no significant difference in terms of *SARC-F by patient* results. Other CGA findings also showed that CD and NH groups were similar in terms of geriatric syndromes, except for CD group being more frequent fallers and NH group being more dependent in terms of ADL. Findings of CGA are given in Table 4.

Concordance Analysis Between SARC-F by Patient and SARC-F by Proxy

The median total *SARC-F by proxy* score was 2 (0-10), and according to *SARC-F by proxy*, 52 (30.2%) of the participants had positive sarcopenia screening. Although *SARC-F by patient* results did not show significant difference between settings, positive screening for *SARC-F by proxy* was significantly higher in community setting compared to NH (38.0% vs. 19.4%, *P*=.009). Median scores for *SARC-F by proxy* were 3 (0-9) and 1 (0-10) in

Table 4. Comprehensive Geriatric Assessment Findings of the Older Adults

	Total	Community-Dwelling	Nursing Home	*P*
ADL*	6 (1-6)	6 (1-6)	6 (2-6)	**.001**
IADL*	8 (0-8)	8 (0-8)	8 (2-8)	.7
CDR¶				**<.001**
Normal	65 (48.9%)	39 (63.9%)	26 (36.1%)	
MCI	57 (42.9%)	14 (23.0%)	43 (59.7%)	
Early dementia	11 (8.3%)	8 (13.1%)	3 (4.2%)	
Falls in the past year¶	51 (29.7%)	36 (36%)	15 (20.8%)	**.03**
FRAIL*	1 (0-5)	1 (0-5)	1 (0-4)	.05
FRAIL¶				.07
Robust	54 (31.4%)	27 (27%)	27 (37.5%)	
Pre-frail	72 (41.9%)	40 (40%)	32 (44.4%)	
Frail	46 (26.7%)	33 (33%)	13 (18.1%)	
MNA-SF*	13 (5-14)	13 (6-14)	13 (5-14)	.55
Under nutrition¶	40 (23.7%)	24 (24.5%)	16 (22.5%)	.76
Malnutrition¶	7 (4.1%)	5 (5.1%)	2 (2.8%)	.76
Polypharmacy¶	123 (71.9%)	69 (69.7%)	54 (75%)	.45
SARC-F by patient*	2 (2-10)	2 (0-9)	2 (2-10)	.42
SARC-F by patient ≥4¶	54 (31.4%)	35 (35%)	19 (26.4%)	.23

*Median (minimum-maximum);¶Numbers (percentage).
ADL, activities of daily living; CDR, Clinical Dementia Rating Scale; IADL, instrumental activities of daily living; MCI, mild cognitive impairment; MNA-SF, Mini-Nutritional Assessment-Short Form.

CD and NH settings, respectively ($P=.002$). The scores of *SARC-F by patient* and *SARC-F by proxy* showed a moderate correlation, with a correlation coefficient of 0.635 ($P < .001$). The fourth item demonstrated the highest correlation ($r=0.591$) and the lowest was shown for the fifth item ($r=0.443$). We alternatively defined *SARC-F by proxy* and *SARC-F by patient* results categorically (as SARC-F ≥ 4 being positive sarcopenia screening), and studied the agreement between 2 tests. We obtained a κ value of 0.482 (0.341-0.623), which again showed a moderate agreement between patient and proxy results. When we performed a further analysis to study whether the agreement level differed between settings, we found out that results from 2 different settings individually showed moderate agreement, with κ value of community setting being slightly higher than NH setting [0.504 (0.330-0.678) versus 0.414 (0.171-0.657)]. Detailed findings of the results of both tests and their correlation analysis are given in Table 5.

Table 5. Concordance Analyses of SARC-F by Patient and SARC-F by Proxy

	SARC-F by Patient	SARC-F by Proxy	Correlation Coefficient
Total score	2 (0-10)	2 (0-10)	**.635***
1. Strength			
None	54.1%	47.1%	**.454***
Some	25.6%	39.1%	
A lot	20.3%	14.0%	
2. Assistance in walking			
None	72.5%	73.3%	**.446***
Some	15.2%	18.6%	
A lot	12.3%	8.1%	
3. Rise from a chair			
None	64.5%	61%	**.503***
Some	22.7%	33.1%	
A lot	12.8%	5.8%	
4. Climbing stairs			
None	38.4%	46.5%	**.591***
Some	38.4%	32.0%	
A lot	23.3%	21.5%	
5. Falls			
None	70.3%	71.5%	**.443***
Some	23.8%	23.8%	
A lot	5.8%	4.7%	

*P value <.001.

DISCUSSION

In this study, we adapted the Turkish SARC-F to *SARC-F by proxy* with the aim of studying whether it could be applied to their caregivers/relatives on behalf of older individuals who are unable to cooperate or make reliable judgments on their clinical conditions. We found out that *SARC-F by proxy* had an excellent inter-rater and test–retest reliability, and it demonstrated a moderate level of concordance with patient-reported SARC-F.

In routine practice, it is a common method to refer to the statements of the patients' relatives/caregivers on behalf of the patients who cannot make judgments about their own health status or have difficulty establishing reliable communication. However, whether this method is reliable and valid enough should be examined and well-demonstrated in order to use it as a substitute for patients' self-reports. In this context, several proxy-reported questionnaires (mostly QoL assessment tools) have been studied in different patient populations like patients with dementia, stroke, cancer, Parkinson's disease, or other neurological disorders,[9-11,22] with mixed results about their reliability and concordance with patient reports. In the case of sarcopenia, there are insufficient data on how valid or reliable the screening tool SARC-F is when administered to proxies on behalf of patients. Hence, this study serves to fill the gap in the literature on this particular issue.

Screening tools have to be valid enough to predict the conditions or outcomes that they are used for, in order to be recommended for use in routine practice. However, besides validity, another related, equally important concept is the reliability of that certain test since first of all, a test needs to be reliable in order to be valid. It should be able to produce consistent results regardless of the tester and time.[12] In order to check whether *SARC-F by proxy* was a reliable screening tool, we had to adopt the original SARC-F to *SARC-F by proxy*, by transforming the questions directed to the relatives/caregivers rather than patients. We conducted the process as if we were studying the reliability of a questionnaire that was developed for the first time and followed the recommended steps to be taken in reliability studies. We found out that *SARC-F by proxy* demonstrated excellent reliability, with considerably high ICC values for interrater and test–retest reliability analysis (0.91 and 0.90, respectively).

In the second phase of the study, we examined the concordance between patient and proxy reports. Median

values of *SARC-F by patient* and *SARC-F by proxy* were both 2 (0-10), and the patient and proxy scores showed a moderate correlation, like most of the proxy assessments in the literature.[23-25] An important challenge about the proxy-reported questionnaires is that proxy reports are prone to demonstrate systematic differences and hence may not be interchangeable with self-reports all the time. This proxy bias (in other words, inter-rater gap) was associated with different factors. First of all, the nature of the relationship of the proxy, the frequency of the contact, and intimacy are highly important factors that influence the concordance between scores. In order to obtain concordant results, we specified an inclusion criterion of having frequent contact (contact on a weekly basis at least) with the patients or residents that allows the proxy insight into the individual's situation, for at least 1 year. Proxies of CD older adults were mostly their children having at least weekly contact, with spouses coming after, who are expected to give more consistent answers with the patients since they spend more time together. In fact, there is no standard threshold or definition for "frequent contact;" therefore, we adapted this definition from similar proxy-based reliability studies.[8] However, we necessarily elongated the period of contact to at least 1 year since the fifth item questions fall in the previous year, which is very prone to recall bias. In line with this, the item with least concordance between patients and proxies was found to be the fifth item.

Apart from intimate relationship, proxy respondents can also be selected for their professional capacity or skills to make judgments on behalf of patients. However, ratings from different types of proxies may not be interchangeable. In the studies assessing QoL, nurses or clinicians were found to overestimate QoL mostly, unlike family proxies who had a tendency of underestimating.[8] Similarly, although *SARC-F by patient* responses did not differ statistically, nurses scored significantly lower than family members/caregivers in community in our study, suggesting that healthcare professionals may really have a tendency to see the situation more positively than reality. Still, it is vague whether healthcare professionals' point of view is unrealistic or closer to the truth, while judgments of nurses might be more valid as they were probably more objective, they might also be insufficient since they (nurses) are not expected to have closer relationships with proxies than family members. It was also reported that there was a higher patient–proxy concordance for family members compared to healthcare professionals.[10] Supportive of this, the correlation coefficient was higher for the agreement between patients and proxies in community setting, compared to residents and nurses in NH, although responses from the proxies of different settings both demonstrated moderate agreement with patients in our study.

Another important factor influencing the concordance between patient–proxy results is the educational level of the respondents since higher educational level was associated with better agreement.[9] In our study, although proxies were mostly graduate, the education level of most of the patients was primary school, and this may also have prevented a stronger agreement. In addition, although we excluded the patients with moderate to severe dementia, and it is accepted that individuals with mild form of dementia can preserve their reasoning,[26] including patients with cognitive impairment, may have still affected the results since SARC-F also requires respondent to memorize falling episodes in previous year. Furthermore, it was also reported that whether proxy or patient, respondents' mood was also one of the determinants of proxy–patient correlation.[8] Likewise, caregiver burden may have also affected the results. A study analyzing the agreement of 135 dyads of patients and caregivers on QoL of patients with Alzheimer's disease reported that caregivers' burden and depression were 2 of the major factors associated with discrepancy in the results.[27] Unfortunately, we did not perform any assessment on depression, anxiety, or caregiver burden in our study.

Another possible reason for patient–proxy responses showing not strong but moderate agreement may be explained by the theory of "U-shaped relationship between self-proxy agreement and patients' health status." [8] In other words, the self-proxy agreement is estimated to be generally higher for patients in very good or very poor health status. It was reported that the interrater gap was smaller when the patients were more independent in ADL and had fewer neuropsychiatric symptoms, in a study assessing QoL in patients with Alzheimer's disease.[27] The middle part of the curve is estimated to be composed of individuals whose health status is not very bad but who can adapt to bearable adversities and thus ensure their well-being. However, an objective and well-observed proxy may detect and interpret certain findings as signs of poor health condition. In our study, although most of the patients were cognitively intact and independent in ADL and IADL, almost half of the patient population was pre-frail and had considerable rates of chronic diseases and polypharmacy. Therefore, this group of patients seems to fit more somewhere in between rather than at the ends of the above-mentioned curve and hence ending with not strong but moderate agreement between patient–proxy reports.

Another factor that is considered as an important determinant of correlation between patient and proxy reports is the internal consistency of the instrument used. It was reported that a study using an instrument with low internal consistency would not end up with high levels

of concordance between patient and proxy reports.[8] In our study, SARC-F by proxy demonstrated a high level of internal consistency, with a Cronbach's alpha value of 0.82. Hence, this feature of the test seems to be one of the factors that strengthened the agreement between patient and proxy reports.

In the literature, there is only 1 study reporting *SARC-F by proxy*'s reliability in older adults.[28] Maurus et al[28] included older adults from 2 different patient populations: (i) patients undergoing an inpatient geriatric rehabilitation for diverse medical conditions, and (ii) outpatients under surveillance for a rheumatological or hematological disease. Authors explained the reason for recruiting samples from 2 different settings as they intended to create a representative sample of older adults with different levels of functional impairments. They chose the proxies in at least weekly contact with the patient during the last 6 months and also included meeting the patient in person at least twice during the last 6 months. They defined 2 cohorts: proxies in cohort A responded SARC-F by proxy ad hoc (T1) and after 3 months (T2) (by making retrospective judgments about patients' condition at T1) and proxies in cohort B responded to the questions only at T2 (again, retrospective evaluation of patients' status at T1), in order to examine potential recall bias. Patients responded to *SARC-F by patient* only at admission (T1). They stated that they excluded patients with at least moderate cognitive impairment but did not mention whether they performed any examination of cognitive status of the patients. In total, they included 104 patients and 135 proxies and reported the interrater reliability between patient and proxy reports as substantial, with a κ value of 0.79. They also examined the agreement between patient and retrospective proxy reports, and they detected a substantial agreement in cohort A ($\kappa=0.61$) and a moderate agreement in cohort B ($\kappa=0.42$). Although 2 studies had methodological differences, reliability analyses of both studies show that SARC-F by proxy is a reliable tool for use in older adults and mainly shows moderate level of agreement between proxies and patient populations consisting of individuals from different settings (outpatients, hospitalized patients, and NH residents).

This study has certain limitations. Although we recruited participants from both CD and NH to increase the number of study population, the study population is not representative of whole older adult community, and findings cannot be generalized. Since we included older adults without cognitive impairment or at least mild dementia to ensure the reliability of the answers, we may have made a selection bias by creating a healthier population with mostly preserved functionality. Including participants from both settings can be considered as a limitation since the population is not homogenous but also a strength because it included older individuals from different functionality and comorbidity profiles. We tried to implement a proxy–patient perspective and asked the proxies to try to view the situation as the patient would (except for the fifth item of SARC-F by proxy) answer if they were the patients. However, this instruction may not have been fully understood by the proxies, and they may have just simply presented their own judgments (proxy–proxy perspective). In addition, we did not assess the proxies' cognitive status or mood, which could affect the reliability of the responses. One of the major strengths of this study is that it had sufficient number of participants for assessment of the test's reliability. Furthermore, we implemented proxy–patient perspective, which could promise a smaller interrater gap than proxy–proxy perspective.[14] To the best of our knowledge, this is one of the 2 studies in the literature examining the reliability of *SARC-F by proxy* in older adult population.

CONCLUSION

SARC-F is an important tool in sarcopenia case finding but has a limitation in application on patients with dementia or communication problems since it is a self-reported questionnaire. According to this study, SARC-F may be reliably applied to relatives or caregivers on behalf of the patients, in the name of *SARC-F by proxy*. Furthermore, *SARC-F by proxy* results showed a moderate correlation with *SARC-F by patient* scores. How well it can predict sarcopenia and other adverse outcomes will be revealed by future validity studies of *SARC-F by proxy*.

Ethics Committee Approval: The study was approved by the Istanbul University Istanbul Medical School ethical committee (Date: October 26, 2020, Decision No: 1503/2020).

Informed Consent: Written informed consent was obtained from all of the patients, nursing home residents and the proxies who participated in this study.

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Supplementary Table 1. SARC-F by proxy		
Component	**Question**	**Score**
1-Strength	Does your patient have difficulty in lifting and carrying a 5 kg weight?	No=0 Some=1 A lot or not able=2
2-Assistance in walking	Does your patient have difficulty in walking in a room?	No=0 Some=1 A lot/ with assistance/not able=2
3-Stand up from a chair	Does your patient have difficulty while standing up from a chair or a bed?	No=0 Some=1 A lot or not able without help=2
4-Climbing up the stairs	Does your patient have difficulty while climbing up a 10 stairs?	No=0 Some=1 A lot or not able=2
5-Falls	How many times has your patient fallen in the last year?	None=0 1-3 times=1 4 times or more=2
Screening score	Score ≥4 suggests sarcopenia	

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Review of the Cut-off Thresholds for Muscle Masses in Diagnosis of Sarcopenia and Creation of a New Appendicular Muscle Mass Estimation Equation Suitable for the Turkish Population

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ABSTRACT

Objective: The aim of our study is to compile the muscle mass index and cut-off levels of the height squared-, weight-, and body mass index-adjusted models, used in the literature for the diagnosis of sarcopenia. The study also aims to create a new appendicular skeletal muscle mass estimation equation for non-segmental bio-impedance analyzer and to determine the relationship between all these muscle mass *indices* and muscle strength.
Methods: Body composition was assessed with bio-impedance analyzer, and muscle strength was assessed by hand grip strength with hand dynamometer. Absolute muscle mass, fat free mass, skeletal muscle mass, and appendicular skeletal muscle mass levels measured by bio-impedance-analyzer were calculated with the estimation equations defined in the literature; separately, height-, weight-, and body mass-indexed models were created. The averages of these *indices*, 2 standard deviation low, as well as correlation analysis with hand grip strength were performed. Multiple linear regression analyses were performed to construct the appendicular skeletal muscle mass estimation equation.
Results: A total of 200 young healthy individuals aged 18-40 years (50% male) were included in the study. The cut-off thresholds were 28/16 for hand grip strength; 20.1/13.3 kg for appendicular skeletal muscle mass; 7.0/5.4 kg/m^2 for appendicular skeletal muscle mass/height squared; 29.7/22.8% for appendicular skeletal muscle mass/weight; 0.81/0.56 for appendicular skeletal muscle mass/body mass index based on 2 standard deviation lower in men and women, respectively. The linear regression analysis, which has a high correlation with hand grip strength (r: 0.719; $P < .001$), the appendicular skeletal muscle mass estimation, quite strong (adjusted R^2: 0.959), was presented as a new equation: ASMM = 3.567 + (0.119 × h^2/Z) + (4.323 × gender) + (0.164 × weight). The height squared in cm^2; for gender men = 1 and women = 0; weight in kg; Z is bio-impedance-analyzer impedance in 50 Ω frequency.
Conclusion: This study showed us that body mass index-adjusted models were more strongly correlated with muscle strength than both height- and weight-indexed models, which differ from those commonly used in the literature.

Keywords: Appendicular muscle mass estimation equation, cut-off thresholds, malnutrition, muscle masses, sarcopenia

INTRODUCTION

The definition of sarcopenia, which is characterized by a decrease in age-related muscle function and mass, has been updated with some changes in the last decade. According to the 2010 report of the European Working Group on Sarcopenia in Older People (EWGSOP), muscle mass loss was predominant than the loss of muscle strength, and muscle mass loss without loss of muscle strength was defined as "presarcopenia." If loss of muscle strength was added to muscle mass loss, it was defined as "sarcopenia," and if loss of performance was added to sarcopenia, it was defined as "severe sarcopenia".[1] In the EWGSOP 2018 update, sarcopenia was defined as "muscle failure" and primarily focused on low muscle strength as a key characteristic of sarcopenia, uses detection of low muscle quantity and quality to confirm the sarcopenia diagnosis, and identifies poor physical performance as indicative of severe sarcopenia.[2]

There is a consensus in the literature on gender-specific cut-off levels for muscle strength loss, which is now the

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first step in the definition of sarcopenia. However, many estimation formulas have been developed especially with bio-impedance method for the detection of muscle mass loss, which is necessary for the diagnosis of sarcopenia, and thus many cut-off points have emerged in the diagnosis. In the literature, based on absolute muscle mass (MM), fat free mass (FFM), skeletal muscle mass (SMM), appendicular skeletal muscle mass (ASMM), different *indices* have been formed by correcting according to height squared or weight or body mass index (BMI), and in general, 2 standard deviation (SD) lower and sometimes 1 SD lower of the young healthy population have been determined as the cut-off point. However, global or regional standardized cut-off levels are not yet available. Therefore, a researcher who wants to do research about sarcopenia has serious confusion as to which index s/he should use during the diagnosis stage.

Due to this complexity in the literature, we planned this study. The aim of this study is to create a reference group of healthy young adults between the ages of 18 and 40 and to compile the muscle mass *indices* that have been defined in diagnosis of sarcopenia for bio-impedance method and to compare the muscle mass estimation equations developed in different countries. Starting from this, our second goal is to develop a new estimation equation suitable for body composition analyzer (BIA) unable to perform segmental analysis. Third, as the EWGSOP final report emphasizes, the aim of this study is to find the most powerful muscle mass prediction equation and index by prioritizing muscle strength.

METHODS

The study was conducted in cross-sectional fashion and complied with the Helsinki Declaration. The permission of the Ethics Committee was received prior to the commencement of the study (date: 28/11/2017 and no: 2017/514/118/12).

Participants

The sample size was calculated using the prevalence of 13%, margin error of 5%, confidence level of 95%, and missing data of 15%. The target sample size was determined as 200 participants by using $[(Z1 - \alpha)^2\ p(1 - p)]/d^2$ formula.

A total of 200 healthy individuals (100 females, 100 males) of young adults aged 18-40 years without any disease were included in the study. Participants were randomly selected from the relatives of the patients who came to the hospital and medical staff. Those with the following conditions were excluded from the study: any unstable diseases, known inflammatory disease, an acute illness, pregnancy.

Body Composition Analysis by Bioelectrical Impedance

On arrival for clinical testing, participants were asked to empty their bladders, following which their height and weight were measured. The heights and waist circumferences (WC) of the healthy adults were measured in standing position. The hand grip strength (HGS) was measured 3 times from the dominant hand with hand dynamometer to determine the muscle strength (Takei physical fitness test) and the highest values were recorded. The instructions of the manufacturer were considered in analyzing the body composition according to BIA in light clothes and bare feet without eating and drinking for at least 4 hours before the analyses.

Muscle mass was estimated using an 8-polar segmental BIA (Tanita BC 418®). Appendicular skeletal muscle mass was obtained by adding muscle masses of upper and lower extremities. This device produces an 800 μA constant sinusoidal current at a single frequency of 50 kHz. The actual parameter measured with BIA is the voltage (V) that is produced between 2 electrodes located most often at sites near to, but different from, the sites where current is introduced. The measurement normally is expressed as a ratio, V/I, which is also called impedance (Z). The measuring instrument is therefore called a bioelectrical impedance analyzer. Impedance has 2 components, resistance (R) and reactance (X). In BIA, the resistance is nominally about 250 Ω, and reactance is about 10% of that amount, so the magnitude of Z is similar to that of R.[3] Our machine reported only the impedance values. Although in many BIA reports, Z and R are used as if they are interchangeable, we calculated R and X according to this formula: $Z = \sqrt{(R^2 + X^2)}$. These values were then entered into the prediction equations, and these BIA equations were used to predict SMM and ASMM (kg).

Prediction Equations

The mean HGS was calculated for the gender-specific muscle strength of the participants from young healthy individuals, and the 2 SDs lower of the mean were determined as the cut-off point for the loss of muscle strength (dynapenia).[4] For sex-specific muscle mass assessment, in addition to MM, FFM, and ASMM which were calculated automatically by machine, the SMM formula developed by Janssen and 5 different ASMM formulas validated with Dual Energy X Ray Absorptiometry (DEXA) were developed in different countries so far for estimation. These estimation equations are as follows:

SMM (Janssen) = (h^2/R × 0.401) + (gender × 3.825) – (age × 0.071) + 5.102. (Canada/2002)[5]

ASMM (Kyle) = (h^2/R × 0.267) + (gender×1.909) + (weight × 0.095) – (age × 0.012) + (Xc × 0.058) –4.211. (Switzerland/2003)[6]

ASM (Kim) = (h^2/R × 0.104) + (gender × 2.954) – (age × 0.050) + (weight × 0.055) +5.663. (Korea/2014)[7]

ALM (Yoshida) = (h^2/Z50 × 0.197) + (weight × 0.179) – 0.019 for men,

= (h^2/Z50 × 0.221) + (weight × 0.117) + 0.881 for women. (Japan/2014)[8]

ASMM (Peniche) = (h^2/R × 0.2394) + (gender × 2.708) +(weight × 0.065) – 0.05376(Mexico/2015)[9]

ASMM (Sergi) = (RI × 0.227) + (gender × 1.384) + (weight × 0.095) + (Xc × 0.064) – 3.964. (Italy/2015)[10]

The h^2 is height square in cm^2; for gender, men = 1 and women = 0; age is in years; weight in kg; R is BIA-resistance in ohms (Ω); Xc is BIA-reactance in Ω; Z is BIA-impedance in Ω; RI is resistance normalized for stature. While Janssen, Kyle, and Peniche used 50 Ω single-frequency BIA in their studies, Kim used 250 Ω multi-frequency BIA and Yoshida used 50 Ω multi-frequency BIA.

Formation of New Appendicular Skeletal Muscle Mass Estimation Equation Suitable for Non-segmental Bio-impedance Analyzers

The currently recommended parameter for the diagnosis of sarcopenia is ASMM. With the hand-to-*foot* segmental BIA devices, individual muscle masses of the extremities can be calculated and ASMM can be obtained from the sum of these. However, ASMM cannot be calculated with *foot-to-foot* non-segmental BIA devices. Because of this need, we aimed to create a predictive equation suitable for the estimation of ASMM based on the equations developed in various countries. For this purpose, we tried to form the most appropriate equation with multiple linear regression instruments by adding the physical properties of our reference group as well as the BIA impedance level.

Creating Indices

There is consensus all over the world in the definition of BMI, which is the ratio of weight to height squares (kg/m^2). However, a large range of *indices* has been created by compiling the *indices* defined so far. Absolute muscle mass was adjusted for body size in different ways, namely using height squared (MM/h^2), weight (MM/w), and BMI (MM/BMI). Fat-free muscle mass, SMM, and ASMM (separately for all equations) were adjusted in the same ways, respectively, FFM/h^2, FFM/w, FFM/BMI; SMM/h^2, SMM/w, SMM/BMI, and ASMM/ h^2, ASMM/w, ASMM/BMI.

Statistical Analyses

The SPSS (IBM Statistical Package for Social Sciences-version 22 for Windows) and Microsoft Excel 2010 were used to analyze the data and any score was deemed significant if it was $\alpha < 0.05$. Initially, a descriptive data analysis was done to compare the population that participated in the study according to the gender. For biochemical and muscle parameters, the descriptive statistics were given with arithmetic means, SDs and 2 SD below of means. Multiple linear regression analyses were performed to create the ideal ASMM equation for our society and the most ideal equation was used. Linear correlation analysis was performed and correlation coefficients (r^2) were determined by scatter dot graphs in order to determine the correlation between the results of different methods and HGS.

RESULTS

New Appendicular Skeletal Muscle Mass Estimation Equation Suitable for Non-segmental Bio-impedance Analyzers

We created a predictive equation for ASMM estimation by BIA method. In addition to the impedance value of the BIA, the variables of height, weight, and sex were used in the estimation equation. The age variable did not have a significant effect on the formula and therefore was not used. The selected model had an adjusted $R^{2\prime}$ of 0.965 and performed each regression assumption. The equation is as follows:

ASMM = (h^2/Z × 0.119) + (4.323 × gender) + (0.164 × weight)+3.567

(The h^2 is height square in cm^2; for gender, men = 1 and women = 0; weight in kg; Z is BIA-impedance in 50 Ω frequency.)

As shown in the Figure 1, the correlation between this new estimation equation and the BIA data (r^2: 0.965) was found to be very strong.

Differences Among Muscle Mass/Indices and Cut-off Thresholds in Assessing Sarcopenia

In Table 1, means of the MM, FFM, SMM, and ASMM of young healthy adult participants according to gender;

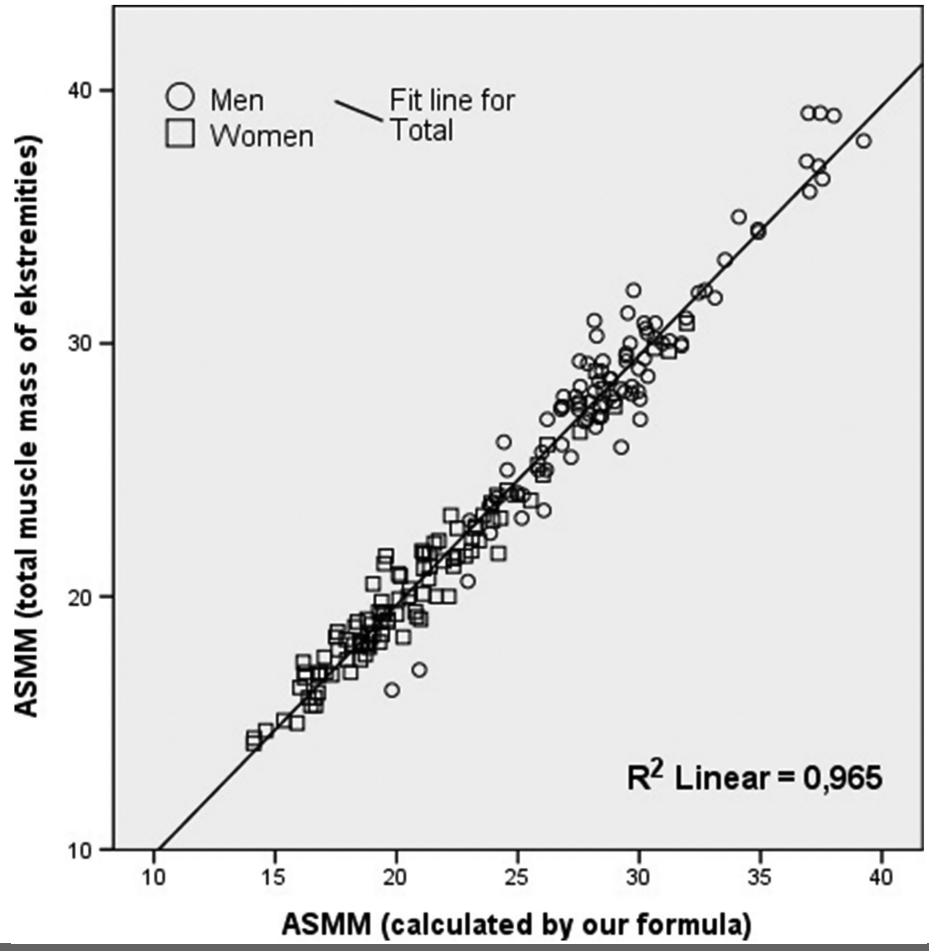

Figure 1. The correlation between ASSM of our new estimation equation and the BIA data

muscle mass index averages, *indices* corrected according to height, weight, and BMI; 2-SD below averages which were generally accepted cut-off points for sarcopenia.

The cut-off levels of HGS in men and women are respectively 28/16.

While the mean sum of extremities of the ASMM measured by BIA was 28.6 ± 4.3 kg/20.3 ± 3.5 kg in men and women, the mean ASMM calculated with our formula was 29.1 ± 3.8 kg/20.8 ± 3.7 kg. Therefore, the cut-off levels were 20.1/13.3 in men and women, respectively, according to the sum of extremities; 21.47/13.45 according to the equation that we created. The means of SMM were found to be 34.5 kg/24.9 kg, and 2-SD lower of the means were determined 22.7 kg/16.8 kg as cut-off points in males and females, respectively. The averages of other muscle mass estimates and 2-SD low levels are shown in Table 1 comparatively.

Estimation equation which gives the closest result to ASMM (except for the equation created by us) was calculated with ASMM (Yoshida); the lowest ASMM estimate was obtained by Kim equation. Peniche predicts a higher ASMM in men than Sergi, while it is the opposite in women. This is probably due to the difference in sex multiplier, the same for the h^2-, w-, and BMI-adjusted muscle mass *indices*. The cut-off levels of ASMM/h^2, which is one of the most commonly used *indices* in the diagnosis of sarcopenia, are 6.97/5.41 in males and females, respectively. In addition, the cut-off levels of SMM/w, which is another most frequently used *indices* in the diagnosis of sarcopenia, are 27.5%/23.3% in men and women, respectively, in our study. All other *indices* and adjusted models proposed or not proposed yet in the literature are summarized in Table 1.

Correlations Between Muscle Strength and Muscle Mass Indices

The correlation between these measured and calculated *indices* with muscle strength was demonstrated in Table 2. The strongest correlation between muscle mass and muscle strength was determined by ASMM calculated according to the equation developed by Kim

Table 1. Differences Among Muscle Mass and Muscle Strength *Indices* Derived from Height-, Weight-, and Body Mass Index-Adjusted Models and Cut-Off Points of the Young Healthy Adult Reference Group in Assessing Sarcopenia

		Male			Female		
		Mean	**SD**	**2 SD**	**Mean**	**SD**	**2 SD**
	Age (years)	28.9	5.8		27.9	5.8	
	Height (cm)	176.1	7.4		161.5	6.7	
	Weight (kg)	80.1	16.6		68.0	18.3	
	Body mass index (kg/	25.7	4.6		26.0	6.6	
	Hand grip strength	43.5	7.7	28.1	24.8	4.3	16.1
Muscle mass	Muscle mass (kg)	59.76	8.90	41.95	43.03	6.54	29.96
	Fat free mass (kg)	63.37	9.37	44.63	46.40	7.37	31.65
	ASMM (kg)	28.59	4.27	20.1	20.28	3.48	13.3
	SMM (Janssen)	34.50	5.92	22.66	24.93	4.04	16.84
	ASMM (Kyle)	26.07	4.53	17.00	19.30	3.72	11.85
	ASMM (Peniche)	24.35	4.22	15.91	17.38	3.38	10.62
	ASMM (Sergi)	23.66	3.95	15.77	18.00	3.32	11.35
	ASMM (Kim)	19.50	2.27	14.95	14.26	1.94	10.38
	ASMM (Yoshida)	27.82	5.12	17.58	20.79	4.04	12.72
	ASMM (Ours)	29.06	3.80	21.47	20.76	3.65	13.45
h^2 adjusted (kg/m^2)	Muscle mass (kg)	19.22	2.17	14.88	16.47	2.08	12.31
	Fat free mass (kg)	20.37	2.25	15.88	17.76	2.45	12.87
	ASMM (kg)	9.27	1.15	6.97	7.93	1.26	5.41
	SMM (Janssen)	11.09	1.60	7.90	9.55	1.43	6.70
	ASMM (Kyle)	8.37	1.15	6.07	7.38	1.30	4.79
	ASMM (Peniche)	7.82	1.10	5.62	6.66	1.21	4.23
	ASMM (Sergi)	7.60	0.99	5.63	6.89	1.16	4.58
	ASMM (Kim)	6.28	0.59	5.11	5.47	0.70	4.07
	ASMM (Yoshida)	8.93	1.33	6.28	7.96	1.45	5.06
	ASMM (Ours)	9.40	.98	7.43	7.92	1.29	5.33
w adjusted (%)	Muscle mass (kg)	75.62	6.45	62.72	65.36	8.84	47.67
	Fat free mass (kg)	80.18	6.70	66.78	70.28	8.63	53.03
	ASMM (kg)	36.13	3.24	29.65	30.00	3.61	22.79
	SMM (Janssen)	44.10	8.29	27.53	38.14	7.44	23.26
	ASMM (Kyle)	33.03	4.49	24.06	29.07	3.75	21.57
	ASMM (Peniche)	30.92	4.68	21.56	26.22	3.74	18.73
	ASMM (Sergi)	29.98	3.77	22.43	27.14	3.34	20.47
	ASMM (Kim)	24.92	3.46	18.00	21.76	3.42	14.92
	ASMM (Yoshida)	35.05	3.56	27.92	31.27	3.68	23.91
	ASMM (Ours)	36.78	3.55	29.68	31.12	2.84	25.44

Table 1. Differences Among Muscle Mass and Muscle Strength Indices Derived from Height-, Weight-, and Body Mass Index-Adjusted Models and Cut-Off Points of the Young Healthy Adult Reference Group in Assessing Sarcopenia (*Continued*)

		Male			Female		
		Mean	SD	2 SD	Mean	SD	2 SD
BMI adjusted	Muscle mass (kg)	2.35	0.28	1.80	1.71	0.26	1.18
	Fat free mass (kg)	2.49	0.29	1.91	1.84	0.26	1.32
	ASMM (kg)	1.12	0.15	0.81	0.77	0.10	0.56
	SMM (Janssen)	1.37	0.28	0.82	1.00	0.21	0.58
	ASMM (Kyle)	1.03	0.17	0.69	0.76	0.12	0.52
	ASMM (Peniche)	0.96	0.17	0.63	0.68	0.12	0.45
	ASMM (Sergi)	0.93	0.14	0.65	0.71	0.11	0.50
	ASMM (Kim)	0.77	0.11	0.55	0.57	0.09	0.38
	ASMM (Yoshida)	1.09	0.15	0.79	0.82	0.12	0.58
	ASMM (Ours)	1.14	0.13	0.88	0.81	0.09	0.63

ASMM, appendicular skeletal muscle mass; BMI, body mass index; h^2, height square; HGS, hand grip strength, FFM, fat free mass; MM, total muscle mass; SMM, skeletal muscle mass; SD, standard deviation; w, weight.

et al[7] (*r*: 0.762, *P*: < .001). The highest correlation coefficient was determined between ASMM (Kim) and HGS (r^2: 0.57).

The strongest correlation between muscle mass *indices* and HGS was seen in BMI-adjusted models as shown in Table 2. Among the BMI-indexed models, the strongest correlation with HGS was observed with our equation (*r*: 0.757; *P* <.001). Between HGS, the strongest correlation was with MM/h^2 in height-indexed models; and with ASMM/w (ours) in weight-indexed models.

DISCUSSION

In the meta-analyses, although it was detected more common in Asian individuals (around 20%), the prevalence of

Table 2. Spearman Rho Correlation Coefficient Between Hand Grip Strength and Muscle Mass *Indices*

Hand Grip Strength	Muscle Masses	Height Square-Adjusted Models	Weight-Adjusted Models	Body Mass Index-Adjusted Models
Muscle mass	0.750	0.582	0.467	0.754
Fat free mass	0.747	0.529	0.451	0.753
Appendicular skeletal muscle mass	0.725	0.421	0.466	0.735
Skeletal muscle mass (Janssen)	0.708	0.442	0.298	0.593
Appendicular skeletal muscle mass (Kyle)	0.684	0.429	0.386	0.680
Appendicular skeletal muscle mass (Peniche)	0.703	0.473	0.426	0.691
Appendicular skeletal muscle mass (Sergi)	0.669	0.382	0.319	0.670
Appendicular skeletal muscle mass (Kim)	0.762	0.493	0.316	0.662
Appendicular skeletal muscle mass (Yoshida)	0.656	0.385	0.421	0.711
Appendicular skeletal muscle mass*	0.719	0.461	0.539	0.757

All correlations are significant at the 0.01 level.
*Calculated by the formula in this study.

sarcopenia in the world was 10% on average.[11] This is very valuable in terms of recognizing sarcopenia and taking the necessary precautions early, predicting the aging generation and the problems to be encountered.

These *indices*, which were used in the definition of sarcopenia, were originally published in the study by Baumgartner et al[12] developed for the estimation of ASMM in magnetic resonance imaging (MRI)/computed tomography-verified DEXA measurement.[12] This study has been the reference for many future studies. However, because this index is positively correlated with BMI, it has the limitation that subjects with a greater BMI due to a larger amount of fat are less likely to be classified as having sarcopenia. Since it was developed for DEXA, we could not include the formula that he developed.

Then in 2000, Janssen et al[5,13] developed the SMM equation for MRI-validated BIA measurement. The difference between this formula and other formulas was that they did not include weight variable but suggested the weight-adjusted SMM/w index. Another difference was that the mean of young healthy adult population was defined as 1 SD low in class 1 sarcopenia and 2 SD low in class 2 sarcopenia. The recommended cut-off levels in men and women, respectively, were 37%/28% for class 1 sarcopenia; the same order as 31%/22% in class 2 sarcopenia. Accordingly, in our study, cut-off levels were 3% lower in men; 1% higher in women. The reason for this can be explained by the fact that the body weights of men in our population are in a wider range and the SD values are high and the cut-off point is 2 SD lower.

In 2010, according to EWGSOP consensus, muscle mass cut-off points on diagnosis of sarcopenia were recommended as 8.87/6.42 kg/m^2 for SMM/h^2; severe sarcopenia <8.5/5.75 kg/m^2; moderate sarcopenia 8.51-10.75/5.76-6.75; normal muscle >10.76/6.76 kg/m^2 for absolute muscle mass/height^2 in men and women, respectively, by using BIA. While there was a natural difference of 2 kg/m^2 between skeletal muscle loss and absolute muscle mass loss for men at these recommended threshold levels, this difference of 0.3 kg/m^2 in women caused some confusion. In our study, *EWGSOP* first reported that SMM/h^2 was 1 kg/m^2 lower in men and 0.3 kg/m^2 higher in women (7.9/6.7 kg/m^2 for men and women). For MM/h^2, the difference was 4 kg/m^2 for men and 5.6 kg/m^2 for women. This consensus led to serious confusion in the diagnosis of sarcopenia.

Fortunately, the cut-off levels proposed in the EWGSOP 2018 revision were further simplified and only ASMM terminology was used. Cut-off levels were clearly defined as 20/15 kg for ASMM; as 7/6 kg/m^2 for ASMM/h^2. Prior to that, in 2014, the Asian Working Group for Sarcopenia (AWGS) was much closer to these levels, have recommended cut-off values for ASMM/h^2 measurements 7.0 kg/m^2/5.7 kg/m^2 for men and women, respectively. In our study, the values of 20.1/13.3 kg for ASMM and 7.0/5.4 kg/m^2 for ASMM/h^2 in men and women, respectively, were determined and this difference between the sexes and between each other was minimized according to both the 2nd revision of the EWGSOP and the AWGS report. Even with the prediction equation we have created, we have reached much closer levels, especially in men (21.47/13.45 for ASMM; 7.43/5.33 for ASMM/h^2 in men and women, respectively). The reason for this difference in women can be explained by the fact that the weight of women in our study is higher than in the current studies.

By the way, another muscle mass index, the ASM/BMI index, was introduced by the Foundation for the National Institutes of Health (FNIH) Sarcopenia Project in 2014.[14] According to this study, ALM/BMI cut-off levels were recommended as 0.789 for males and 0.512 for females which were very close to our accounts (0.81 and 0.56, respectively, in men and women). A slight difference of 0.06 was found in our cut-off levels calculated by the estimation equation.

In our country, a recent study by Bahat et al.[15] involving 301 healthy young and 992 elderly, is perhaps the only study to determine BIA-based cut-off levels in the Turkish population. According to this study, the cut-off points of SMI/h^2 were 9.2/7.4 kg/m^2 in males and females, respectively. In another study by the same authors, the reference cut-off thresholds for SMMI/w were proposed as 37.4% and 33.6% for men and women, respectively, using the Janssen formula. In the same study, SMMI (BMI) cut-off points that best predict the low grip strength for 26 kg/16 kg thresholds were detected as 1.036 kg/BMI and 0.770 kg/BMI for males and females, respectively.[15] In our study, calculated cut-off cutting levels were approximately 1 kg/m^2 low in the length index model; 10% lower in the weight index model; 0.2 units low in the BMI-indexed model. The reason for excess difference in the weight-indexed model was that the weight of the individuals participating in our study was higher than the individuals in Bahat et al's study.[15] We have not included obesity as an exclusion criterion in our study.

In 2010, the EWGSOP consensus recommends the cut-off levels for HGS as 30/20 kg and recommends modification according to BMI; in the 2018 revision, it was determined to be 27/16, very similar to the FNIH study. As a matter of fact, while the AWGS group recommends 26 kg/18 kg respectively in men and women, in the FNIH study, 26/16 was recommended. In our study, the cut-off levels of HGS

were found to be 28/16 similar to the recommendations of the European group.

According to all these studies, even if a consensus was obtained in the ASMM and ASMM *indices* measured by BIA method and our study supported these, most of the BIA machines currently used could not perform segmental measurements and could not detect skeletal muscle mass or appendicular muscle mass. Therefore, data that could be diagnosed as sarcopenia could not be obtained with BIA devices that use *foot-to-foot* measurement. The second objective of this study was to compare the estimation equations developed in these countries and to develop a new equation suitable for our society.

Among all, BMI-indexed models were the best and among BMI-indexed models, ASMM/BMI index, developed by us was superior in correlation with HGS (*r*: 0.757).

This study showed us the superiority of the ASMM equation developed by Kim et al[7] (*r*: 0.762) in correlation with HGS for our society. However, the muscle mass volumes predicted in the Kim equation were lower than that of both the other equations and other studies in the literature because of the difference between impedances of the BIAs, suggesting that this formula should be modified slightly more in our society. The Yoshida equation gave the closest result to the ASMM calculated by the sum of the limbs separately.

The reason for this difference was the frequency characteristic of the instrument used. In other words, Yoshida and Kim used a multi-frequency BIA device while the other 4 used a single-frequency BIA device. The machine used in Kim's study was 250 kHz resistance BİA device but the one in Yoshida's study was 50 kHz. Probably for this reason, ASMM (Kim) results remained below the estimates of other equations despite the HGS prediction being the strongest, ASMM (Kim) equation (figure). Perhaps the most powerful estimates could be obtained in our society with a modified equation obtained by increasing the constant coefficient or a new cohort with DEXA/BT/MRI and BIA measurements could be composed to create a new equation specific to our society. But we chose to create a new estimation equation by targeting ASMM. We found that this equation corresponds with the data obtained from segmental BIA device with 96% accuracy and its correlation with HGS is very strong (*r*: 0.719).

Estimation equations developed for BIA measurements were then validated with DEXA for ease of use and cost. In 2003, Kyle developed a new equation by including the "weight" factor in addition to the Janssen equation.[6] In 2014, in 2 separate Yoshida[8] equations specifically for gender and in the Peniche's[9] and Sergi's[10] equations developed in 2015, there is no age factor unlike the others.

Another difference between studies is that there were only young participants in the Janssen and Kyle studies, while others were only elderly individuals. For this reason, the mean muscle mass obtained by the Kyle equation was higher in our study (except Yoshida) than in the others. Similar to our study, Solomon et al[16] from Australia adapted ASMM equations to their populations in individuals aged 18-83 years and showed that the Sergi equation performs best, but the Kyle equation was one step ahead for men and individuals with lower than 25 kg/m^2 of BMI.[16]

In our study, the muscle mass parameter calculated by BIA method in the diagnosis of sarcopenia was examined in various aspects, especially in relation to HGS and in comparison with each other. And with the reference group we established, the suitability of cut-off levels recommended in the literature to our society was tested and very concordant results were obtained. As a result, a new estimation equation that can be used in the estimation of ASMM, which has a strong correlation with HGS, and which can be used for the diagnosis of sarcopenia with non-segmental BIAs, has been created. In addition, there were several limitations of our study. In terms of sample size, it remained well below the literature. And even though the center where the study was conducted encompassed a large and diverse variety of individuals, it was a single-centered study. As a result, it can be thought that the power to represent society may be limited. The other limitation of our study was that the BIA device was a single-frequency machine. Therefore, the adaptation of the equations obtained from the studies performed with the multi-frequency measurement device caused some drawbacks. Since the machine gives only impedance level and does not give R and Xc levels separately, it is calculated manually according to $Z=\sqrt{(R^2+X^2}$ formula (R/Xc≈10).[3]

Ethics Committee Approval: This stud was approved by the University of Health Sciences, Kartal Dr. Lutfi Kirdar City Hospital Ethics committee (Date: April 24, 2018, Decision No: 2018/514/128/12).

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