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BODY COMPOSITION ORIGINAL ARTICLE

Sarcopenia assessment project in the nursing homes in Turkey

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BACKGROUND/OBJECTIVES: Sarcopenia and sarcopenic obesity (SO) are geriatric syndromes leading to physical disability, poor quality of life and death. The aim of this study was to investigate the prevalence of sarcopenia and SO in nursing homes in Turkey and to define local disparities for diagnosing sarcopenia and SO.

SUBJECTS/METHODS: This cross-sectional multicenter study was performed in 711 patients in 14 nursing homes. Comprehensive geriatric assessment tests, handgrip strength and calf circumference (CC) measurements were carried out. Sarcopenia was both defined by handgrip strength and CC criteria.

RESULTS: According to handgrip strength measurement, 483 (68%) of patients were sarcopenic (male: 72%, female: 63.8%), 228 were non-sarcopenic. The prevalence of SO was 22% (13.7% in men, 30.2% in women). Patients (82.5%) who were diagnosed as sarcopenic by the handgrip strength test were not sarcopenic according to CC sarcopenia criteria. Therefore, we tried to determine the optimal CC value for diagnosing sarcopenia in our population.

CONCLUSIONS: Both sarcopenia and SO were prevalent among Turkish nursing home elderly residents. Most of the patients with sarcopenia were obese or overweight. We showed that diagnosing sarcopenia with CC measurement underestimated the sarcopenia prevalence assessed by handgrip strength. So we concluded that, although different assessment methods are recommended for the diagnosis of sarcopenia local disparities should be considered.

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INTRODUCTION

Sarcopenia is a geriatric syndrome characterized by progressive generalized loss of skeletal muscle mass, strength and function with a risk of adverse outcomes such as physical disability, poor quality of life and death.[1–3] The prevalence of sarcopenia in community-dwelling elderly is 5–13% in 60 to 70-year-olds and 11–50% for the population aged 80 years or older.[1,4,5] The prevalence in nursing homes is rather higher and the rates rise up to 85.4%.[6] The huge discrepancy in prevalence rates depends on the study population, the criteria used to define sarcopenia and the assessment instruments.[7,8] Different methods are used for the evaluation of sarcopenia including walking speed, calf circumference (CC), bioimpedance analysis (BIA), handgrip strength, dual-energy X-ray absorptiometry and imaging methods (computerized tomography and magnetic resonance imaging). Unfortunately, at present there is no gold standard.[8,9]

Sarcopenic obesity (SO), defined as the combination of low lean body mass and high fat mass is associated with higher dependency and metabolic complications.[10] The prevalence of SO varies from 2 to 21.7% in recent studies.[4] However, the prevalence may be underestimated owing to the low awareness of SO.

The aim of this study was to investigate the prevalence of sarcopenia and SO in nursing homes in Turkey and to define local disparities for diagnosing sarcopenia and SO in our population.

MATERIALS AND METHODS

Population and setting

This cross-sectional multicenter study was carried out among 711 patients in 14 nursing homes in three different cities, which are affiliated with the Turkish Social Service and Children Protection Institution. All of the nursing homes were informed about this study and their permission was requested. The list of the institutions that gave permission for the study is given in the Acknowledgment section.

Inclusion criteria were volunteering to participate in the study, being aged 65 years and older, living at that center for at least 1 month and being suitable for the assessment of muscle mass and strength. A total of 711 subjects fulfilling inclusion/exclusion criteria were finally enrolled.

Exclusion criteria were as follows:

- Age <65 years
- Older adults who did not give consent to participate in the study
- Living at that center for less than a month
- An acute illness or problem in the last 1 month such as trauma or infection
- Severe cognitive impairment that disables giving informed consent or performing the tests and scales
- Cooperation problems (inability to have assessment) and immobility that made the residents not suitable for the assessment of muscle mass and strength.

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Measurements

Data was collected and recorded by research nurses who were informed in detail about the study and were educated to perform the tests, scales and anthropometric measurements and record the results.

The performed tests, scales, measurements and the recorded data were as follows:

- Demographic data such as age and gender
- Anthropometric measurements (weight, height, waist, hip, calf and upper mid-arm circumferences)
- Handgrip measurement
- Mini-nutritional assessment (MNA) long form and short form[11–13]
- Basic activities of daily living[14]
- Yesavage geriatric depression scale (short form)[15]
- Standardized mini-mental state examination test[16]
- Get up and go test[17]
- Results of laboratory analyses in the past 6 months (if present)
- History of chronic diseases
- Number of medications

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Less than 18.5 kg/m^2 was defined as underweight, 18.5–24.9 kg/m^2 range was normal, 25.0–29.9 kg/m^2 range was overweight and $\geqslant$30.0 kg/m^2 was defined as obesity in this study.[18]

CC was measured using a standard anthropometric tape with the participant in standing position. The tape was wrapped around the calf of the nondominant leg at the widest part to obtain the maximal circumference. Subcutaneous tissues were not compressed. A cutoff value of 31 cm was used as an indicator for sarcopenia in this study.[19,20]

Handgrip strength was evaluated with the Takei TKK 5401 Digital Handgrip Dynamometer. Three measurements of maximum strength were taken in the dominant hand, in three repetitions with a hand dynamometer, and the highest value was recorded as the maximal grip strength.

Sarcopenia diagnosis was made according to Cardiovascular Health Study criteria (Table 1).[20–22]

Patients who were diagnosed as sarcopenic according to the Cardiovascular Health Study criteria and at the same time had BMI $\geqslant$30 kg/m^2, were diagnosed as SO.

No intervention was carried out and no sample was obtained from the volunteers in this study. The study protocol was approved by the local ethics board and informed consent was obtained from each resident before enrollment. Furthermore, required legal permissions were obtained from the Turkish Social Service and Children Protection Institution.

Statistical analysis

SPSS (statistical package for social sciences) for Windows 15.0 program was used for statistical analysis. All data were entered into a database and were verified by a second independent person. The variables were investigated using visual (histograms and probability plots) and analytical methods to determine whether or not they are normally distributed. Data are presented as mean and $\pm$s.d. for normally distributed variables and as median (minimum-maximum) for skew-distributed continuous variables. Categorical variables are shown as frequencies.

Independent samples *t*-test for normally distributed variables and the Mann–Whitney *U*-test for not normally distributed variables (ADL and ferritin) were used to compare patients with and without sarcopenia. Pearson's χ^2-method was used for categorical variables. Two-sided values of $P<0.05$ were considered as statistically significant.

CC values for predicting sarcopenia were analyzed by using receiver operating characteristics curve analysis. The sensitivity, spesificity, positive predictive values and negative predictive values were presented for differrent CC values.

Table 1. CHS criteria: definition of handgrip strength cutoff values according to BMI[19–21]

BMI (kg/m^2)	*Handgrip strength (kg) value for the diagnosis of sarcopenia*
Men	
$\leqslant$24	$\leqslant$29
24.1–28	$\leqslant$30
$>$28	$\leqslant$32
Women	
$\leqslant$23	$\leqslant$17
23.1–26	$\leqslant$17.3
26.1–29	$\leqslant$18
$>$29	$\leqslant$21

Abbreviations: BMI, body mass index; CHS, Cardiovascular Health Study.

RESULTS

A total of 711 patients were included in this study. According to the handgrip strength assessment, 483 (68%) of patients were sarcopenic (male: 72%, female: 63.8%) and 228 were not sarcopenic. Demographic properties, anthropometric measurements, comprehensive geriatric assessment test scores, laboratory parameters and comorbidities of patients are demonstrated in Table 2. According to MNA-long form 32.6% of sarcopenic patients were undernourished and, according to MNA-short form 41.6% sarcopenic patients were undernourished.

The prevalence of SO was 22% (13.7% in males, 30.2% in females). The distribution of patients according to BMI groups in sarcopenic and non-sarcopenic patients is presented in Table 3.

The prevalence of sarcopenia was 21.2% with the assessment of CC. Patients (82.5%) who were diagnosed as sarcopenic by the handgrip strength test, were not sarcopenic according CC sarcopenia criteria. Therefore, the cutoff CC value was determined for diagnosing sarcopenia in our population. Receiver operating characteristics analysis was performed and the results are presented in Table 4 and Figure 1 for different CC values.

DISCUSSION

In this study, we demonstrated high prevalence of sarcopenia and SO in nursing homes in Turkey. This is the first study demonstrating the prevalence of sarcopenia together with SO in men and women residents in nursing homes in Turkey.

The prevalence of sarcopenia varies according to the study population (community-dwelling and institutionalized elders) and the methods used for the diagnosis of sarcopenia.[1,4] Bahat *et al.*[6] demonstrated that 85.4% of male residents were sarcopenic by measuring muscle mass with BIA in a nursing home in Turkey, but it was not a multicenter study, therefore enough data are lacking for the representation of Turkish population in nursing homes. This multicenter study was conducted in 14 nursing homes in the three biggest cities of Turkey. Most of the nursing homes in Turkey exist in these cities, so this study is representative of the Turkish nursing home population.

Handgrip strength was used to determine sarcopenia in this study because handgrip strength measurement is simple, easily applicable, quick and noninvasive.[20] Different methods including CC, BIA, handgrip strength, dual-energy X-ray absorptiometry and imaging methods (computerized tomography and magnetic resonance imaging) were used for diagnosing sarcopenia in the studies.[8,9] BIA is also a quick and noninvasive method for measuring body composition via tissue conductivity. However, its reliability has been called into question as measurements can vary depending on an individual's hydration status, ethnicity, physical fitness and age.[20,23] Dual-energy X-ray absorptiometry is the currently preferred attractive method for the assessment of muscle mass. It measures both fat mass and bone mass and is useful for assessing appendicular muscle mass. However, it is not a practical method for the assessment of muscle mass in nursing homes.[24] Magnetic resonance imaging and computerized tomography are considered to be the most accurate measure of muscle mass, but cost, accessibility and the problem of radiation

Table 2. Demographic properties, anthropometric measurements, comprehensive geriatric assessment tests scores, laboratory parameters and comorbidities of the patients

Parameters	*Patients with sarcopenia (n = 483)*	*Patients without sarcopenia (n = 228)*	P
Demographics			
Age (years)	78.5 ± 7.4	76.3 ± 7.7	<0.001[a]
Gender, M/F	257/226	100/128	0.020[a]
Anthropometric measurements			
CC (cm)	36.7 ± 5.8	38.4 ± 6	<0.001[a]
BMI (kg/m^2)	27.6 ± 5.4	26.4 ± 5	0.003[a]
Waist circumference (cm)	98 ± 14	95 ± 14	0.008[a]
Hip circumference (cm)	105.8 ± 13.5	105 ± 13.6	0.456
Upper mid-arm circumference (cm)	28 ± 4	28.7 ± 5.5	0.195
Comprehensive geriatric assessment tests			
ADL	4.5 (0–12)	0 (0–8)	0.085
MNA-SF	11.6 ± 2.3	11.7 ± 2	0.351
MNA-long form	24.5 ± 3.3	25 ± 3	0.034[a]
MMSE	23.5 ± 6.5	24.3 ± 6.7	0.216
Y-GDS	4.4 ± 3.6	3.7 ± 3.5	0.022[a]
GUGT	6.8 ± 1.2	6.8 ± 1	0.145
Laboratory parameters			
HGB (g/dl)	12.8 ± 1.6	13 ± 2.5	0.214
Creatinine (mg/dl)	1 ± 0.3	1 ± 0.4	0.035[a]
TC (mg/dl)	180.4 ± 39.7	179 ± 40.3	0.928
Albumin (g/dl)	3.7 ± 0.5	3.8 ± 0.3	0.418
Comorbidities			
Hypertension	305 (63%)	136 (59.6%)	0.370
Diabetes mellitus	97 (20%)	43 (19%)	0.702
Coronary heart disease	185 (38.3%)	67 (29.4%)	0.020[a]
Cerebrovascular accident	62 (12.8%)	27 (11.8%)	0.708
Parkinsonism	30 (6%)	8 (3.5%)	0.135
Number of medications	4.8 ± 3	3.9 ± 2.3	<0.001[a]
Falls in the last 1 year	44 (9%)	30 (13%)	0.099

Abbreviations: ADL, activities of daily living; BMI, body mass ındex; CC, calf circumference; F, female; GUGT, get up and go test; HGB, hemoglobin; IADL, instrumental activities of daily living; M, male; MNA-SF, mini nutritional test-short form; MMSE, mini-mental state examination; TC, total cholesterol; Y-GDS, yesevage geriatric depression scale. [a]Statistically significant differences ($P<0.05$).

Table 3. The number of patients according to BMI groups in sarcopenic and non-sarcopenic patients

	Patients with sarcopenia (n = 483)	*Patients without sarcopenia (n = 228)*	P
Underweight	9 (2%)	5 (2%)	0.005
Normal	155 (32%)	87 (39%)	
Overweight	163 (34%)	88 (40%)	
Obese	156 (32%)	43 (19%)	

Abbreviation: BMI, body mass index.

Table 4. ROC analysis results of optimal CC for determining sarcopenia in our population

CC (cm)	*Sensitivity (%)*	*Specificity (%)*	*PPV (%)*	*NPV (%)*
31	17.6	90.7	80.6	33.6
35	46.7	64.8	74.1	35.5
37.5	61.3	48.6	72.2	36.6
38	66.2	40.7	70.9	35.6
40	78.8	28.7	70.7	38.3

Abbreviations: CC, calf circumference; NPV, negative predictive value; PPV, positive predictive value; ROC, receiver operating characteristics.

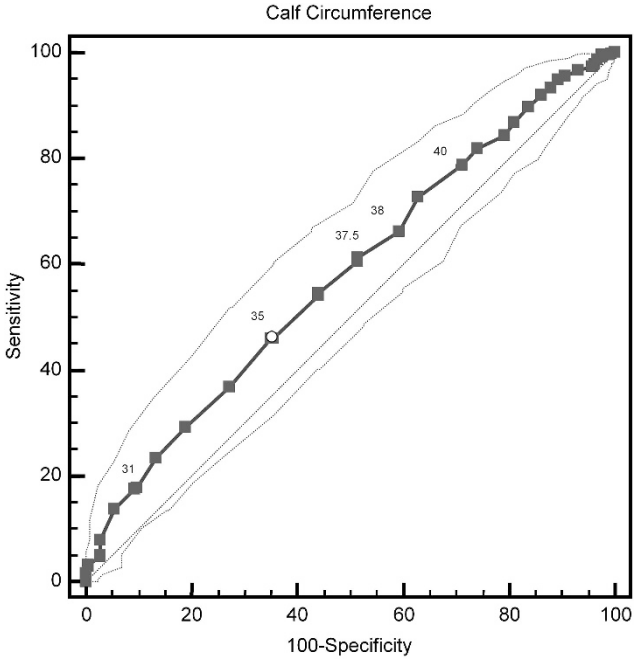

Figure 1. ROC analysis results of different CC for determining sarcopenia.

exposure limit the use of whole-body imaging.[9] Unfortunately, at present there are no standardized diagnostic criteria.

CC has been considered to be the most sensitive anthropometric measure of muscle mass in the elderly by the World Health Organization.[25] It has been shown that a cutoff value of 31 cm may serve as an indicator for sarcopenia.[19,20] However, this cutoff value may show local variation. When we used the CC for the assessment of sarcopenia, prevalence of sarcopenia was lower in the same population. Patients (82.5%) who were diagnosed as sarcopenic by the handgrip strength test, were not sarcopenic when they were evaluated by CC. Mean ± s.d. of CC was 36.7 ± 5.8 in sarcopenic patients and 38.4 ± 6.1 in patients without sarcopenia ($P < 0.001$), so we hypothesized that a cutoff value of 31 cm is not suitable for Turkish population. We investigated the suitable CC value for our population. Receiver operating characteristics analysis suggested that the optimum CC cutoff point for sarcopenia was 35 cm with a 46.7% sensitivity, 64.8% specificity, 74.1% positive predictive values and 35.5% negative predictive values. But optimal sensitivity, specificity, positive predictive values and negative predictive values are not good enough to use for one value. Therefore, the same analysis for different cutoffs were performed and presented in Table 4. Although specifity for the cutoff value 31 cm was high, its sensitivity was extremely low. The value 35 cm seemed to be the best choice for this population.

The prevalence of SO in elderly is increasing and its relationship with physical, metabolic and cardiovascular functions is becoming important for geriatricians.[4,10] However, it is overlooked by many clinicians. Different methods are used for diagnosing SO.[10] Obesity can be assessed by BMI, which is the most widely used measurement, or by measuring fat mass with BIA or dual-energy X-ray absorptiometry.[4,18,26] We used BMI to determine obesity, because it is quick and easily applicable especially in nursing homes. The predicted prevalence of obesity is rising progressively, even among older age groups. In the United States, the prevalence of obesity in elderly was 23.6% in 1990, 32% in 2000 and 37.4% in 2010.[27] In Turkey, the prevalence of obesity increased by 75% in men and by 36% in women from 1990 to 2000 and reached up to 21.1% in men and 43% in women.[28] We have formerly demonstrated that 14.2% of men and 25.5% of women who were admitted to our geriatric outpatient clinic were obese.[29] In our study, the prevalence of SO was 22% and 32% of sarcopenic patients were obese, 34% were overweight.

It has to be kept in mind that SO as a prevalent geriatric syndrome is not only related with problems that is attributed to obesity but also to consequences of sarcopenia. Therefore elderly population including the ones with normal weight or obese should be assessed for sarcopenia. Otherwise, SO may be underestimated.

Interventions including appropriate nutritional support, including sufficient protein and vitamin D supplementation, and exercise can improve the adverse outcomes of sarcopenia and SO. Therefore early diagnosis with practical assessment methods is very important.[2,4]

There is insufficient data about the prevalence of sarcopenia and SO in our population. Therefore, being the first study and large study population in Turkish nursing homes empowers the study. Assessment of the muscle mass only with CC may be a limitation of the study, however, other methods are not practical in nursing homes.

CONCLUSION

Both sarcopenia and SO were prevalent among geriatric residents in Turkish nursing homes. Most of the patients with sarcopenia were obese or overweight. Therefore, physicians should be aware of SO especially in geriatric patients care. We showed that diagnosing sarcopenia with CC measurements underestimated the sarcopenia prevalence assessed by handgrip strength. So we concluded that, although different assessment methods are recommended for the diagnosis of sarcopenia local disparities should be considered.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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