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Prevalence and presence of sarcopenia and sarcopenic obesity in female breast cancer patients

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ABSTRACT

Objective: This study aimed to evaluate prevalence and clinical correlates of sarcopenia and sarcopenic obesity in breast cancer patients

Methods: A total of 50 female patients with histopathological diagnosis of breast cancer were included in this prospective 6-month observational study. Data on patient age, anthropometrics, bioelectrical impedance analysis, physical activity level and blood biochemistry were recorded. Sarcopenia was assessed using preoperative computed tomography (CT) findings, while obesity in sarcopenic patients was identified based on BMI (Body mass index) and fat percentage values.

Results: Obesity, sarcopenia and sarcopenic obesity was evident in 50%, 50% and 20% of patients, respectively. None of the parameters studied, including age, laboratory results, BIA (bioelectrical impedance analysis), or anthropometric findings, showed a significant correlation with the degree of sarcopenia in the overall study population, as well as in patients with sarcopenia and those with sarcopenic obesity.

Conclusion: The findings suggest that sarcopenia is prevalent in half of breast cancer patients before radiotherapy, with concomitant obesity in 40% of sarcopenic patients. Therefore, assessing body composition using CT imaging is essential to recognize sarcopenic obesity earlier and prevent the combined hazards of obesity and depleted muscle mass in breast cancer patients.

Keywords: Breast cancer, nutrition, obesity, sarcopenia, sarcopenic obesity

INTRODUCTION

Weight gain is frequently encountered during antineoplastic treatment among patients with breast cancer and associated with decreased quality of life and increased risk for recurrence and shortened survival.[1-3] In addition, weight gain in patients with breast cancer is considered distinctive in terms of occurrence of gain in weight without concomitant gain or even with loss in lean body mass (LBM), a pattern consistent with sarcopenic obesity.[4-6]

Although obesity has been extensively evaluated based on well-defined body mass index (BMI) criteria in several population studies for obesity, body composition in patients with obesity has been addressed by few studies despite the likelihood of variability in body composition across the BMI spectrum, increasing the likelihood of patients with sarcopenia to be under-reported.[7]

This seems notable given that sarcopenia, a generalized and progressive loss of skeletal muscle mass and muscle function, has emerged as a potential novel marker for risk assessment in the surgical oncology population, given its association with poor clinical outcomes in patients with cancer.[8-10] In fact, sarcopenia is considered to occur in one out of three patients with newly diagnosed breast cancer and to be under-recognized in patients with non-metastatic breast cancer[11], even though it has been

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associated with greater treatment toxicity and a shorter time to tumor progression.[7,12,13]

Hence, early nutritional and body composition assessment is considered to provide valuable prognostic information in patients with breast cancer.[14,15] Given that the shifts in body composition cannot be captured using body weight or BMI measures, use of body composition modalities such as bioelectrical impedance analysis, dual-energy X-ray absorptiometry (DXA) and computed tomography (CT) has been recommended to further elucidate the relationships between body composition and breast cancer outcomes.[4,16,17] Also, CT using a single slice at the level of the third lumbar vertebra (L3) is considered a more sophisticated and precise methodology in assessment of muscle mass.[4,17,18]

Although the maintenance of adequate body weight in relation to body composition is considered amongst the favorable prognostic factors in survivors of any type of cancer[19,20], the concomitant sarcopenia in obese patients with breast cancer may be masked by the excess fat mass despite its association with poorer prognostic outcomes in patients with obesity.[20-22]

Main Points

- Weight gain is a common issue in breast cancer patients, often reducing their quality of life while increasing the risk of recurrence and potentially shortening survival. However, weight gain is typically accompanied by the loss of muscle mass, which may indicate the presence of sarcopenic obesity.
- Sarcopenia has emerged as a new marker for risk assessment in breast cancer patients. This study reveals that more than half of breast cancer patients have sarcopenia, and around 40% of these individuals are obese.
- Traditional measures like body weight or BMI may be insufficient for assessing body composition. More sensitive methods like computerized tomography (CT) scans are crucial for evaluating muscle mass and detecting sarcopenia in overweight and obese patients.
- While this study didn't establish a strong link between physical activity and the presence or degree of sarcopenia, it emphasizes the importance of not disregarding the potential benefits of regular exercise in increasing muscle mass.
- In conclusion, this research lays the groundwork for a better understanding of the complex relationship between obesity, muscle mass, and breast cancer, contributing to the development of treatment strategies for breast cancer patients. It underscores the importance of precise body composition measurements in assessing the combined risks of obesity and muscle loss in breast cancer patients.

This study was therefore designed to determine the prevalence and clinical correlates of sarcopenia and sarcopenic obesity in patients with breast cancer by evaluating body composition across the BMI spectrum.

MATERIALS AND METHODS

Study Population

A total of 50 female patients with histopathologic diagnoses of breast cancer who were admitted for radiotherapy were included in this prospective 6-month observational study conducted at a tertiary care center. Fifty consecutive patients with breast cancer aged over 18 years were included in the study. All were given chemotherapy either in an adjuvant or neoadjuvant setting before initiation of radiotherapy, and surgical treatment was performed to all patients. None of patients had metastatic disease. No palliative treatment was given. The intent of treatment was curative in each patient.

Written informed consent was obtained from each subject following a detailed explanation of the objectives and protocol of the study, which was conducted in accordance with the ethical principles stated in the Declaration of Helsinki and approved by the institutional ethics committee (E-18-1868).

Study Parameters

Data on patient age, anthropometrics (body weight (kg), height (m), BMI (kg/m^2)), bioelectrical impedance analysis (BIA; body fat percentage (%), body water percentage (%), visceral fat ratio, bone mass (kg), muscle mass (kg), basal metabolic rate (BMR; kcal), metabolic age), handgrip strength (kg) , physical activity level and blood biochemistry (prealbumin (g/L), albumin (g/dL), vitamin D (ng/mL) and C-reactive protein (CRP, mg/L)) were recorded in each patient. Sarcopenia was assessed using computed tomography (CT) findings, and obesity in patients with sarcopenia was identified based on BMI and fat percentage values.

Patient age and laboratory findings were evaluated according to BMI, sarcopenic obesity, and body fat percentage, and correlations between the degree of sarcopenia and study parameters were assessed in sarcopenia and sarcopenic obesity groups along with the univariate analysis for factors associated with the presence and degree of sarcopenia.

CT-based Sarcopenia Diagnosis

Simulation CT was performed for radiotherapy planning using a CT scanner (GE Bright Speed) without iodine-based contrast material administration. Cross-sectional surface measurements of the psoas muscle, paraspinal

muscles (erector spinae muscles, quadratus lumborum muscle), and abdominal wall muscles (transversus abdominis muscle, external and internal oblique muscles, and rectus abdominis muscle) at the upper end of third lumbar vertebrae (L3) were performed. All CT images were then transferred to a workstation (Eclipse contouring system) for further quantitative computed tomography (QCT) analysis for sarcopenia, which was performed by the same radiation oncology specialist. A single slice at L3 vertebra was selected for sarcopenia assessment. Total skeletal muscles volumes were measured in terms of cm^3. To evaluate sarcopenia, the L3 skeletal muscle index was calculated by dividing the total cross-sectional muscle area by the squared height (cm^2/m^2). Sarcopenia was defined based on previously described cut-off values for women (38.5 cm^2/m^2).[23,24]

Bioelectrical Impedance Analysis (BIA)

Body composition (body fat percentage, body water percentage, visceral fat ratio, bone mass, muscle mass (cm^2)) and physical activity level was measured using a Tanita BC-532 Body Composition Analyzer (Tanita, Tokyo, Japan). For the BIA measurements, the subject stood in an upright position with bare feet on the analyzer footpads. The impedance between the two feet was measured while an alternating current (50 kHz and ~200 μA) passed through the lower body. Body composition parameters were computed with this impedance value.

Hand Grip Strength Measurement

The three measurements were obtained via the digital hand dynamometer (Baseline Smedley Digital Hand Dynamometer Model 12-0286) from the dominant hand and the mean value was recorded as the hand grip strength in kilograms (kg).

Obesity

Patients with sarcopenia with BMI (≥30 kg/m^2) or high/very high body fat percentage were considered to have sarcopenic obesity.

Statistical Analysis

Statistical analysis was made using the IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY). Student's t-test, the Kruskal–Wallis test, and the Mann–Whitney U test with Bonferroni correction and analysis of variance (ANOVA) were used for the analysis of numerical data. Data are expressed as mean± standard deviation (SD), percentage (%) and median (min-max) where appropriate. $p<0.05$ was considered statistically significant.

RESULTS

Overall Characteristics

Overall, obesity was evident in 25 (50%) patients according to BMI assessment, and body fat percentage was very high in 23 (56.0%) patients. Sarcopenia was diagnosed in 25 (50.0%) patients. Sarcopenia alone (without obesity) was detected in 15 (30.0%) patients, obesity alone (without sarcopenia) was seen in 15 (30.0%) patients and sarcopenic obesity was present in 10 (20.0%) patients. Overall, 10 (20%) patients had neither sarcopenia nor obesity (Table 1).

Prealbumin and albumin levels were abnormal in 10 (20.0%) and 2 (4.0%) patients, respectively (Table 1).

Study Parameters According to BMI, Sarcopenic Obesity and Body Fat Percentage

Physical activity level was significantly lower in obese vs. normal weight patients ($p=0.005$) and in patients with very high and high body fat percentages than in those with low or normal body fat percentages ($p<0.001$) (Table 2).

Handgrip strength was similar in patients with sarcopenic obesity and those without sarcopenic obesity (41.3 ± 23.1 kg vs. 36.7 ± 17.2 kg, $p=0.490$). No significant difference was noted in prealbumin, albumin, CRP, and vitamin D levels with respect to BMI, sarcopenia, and body fat percentage (Table 2).

Correlations between Degree of Sarcopenia and Study Parameters

No significant correlation of degree of sarcopenia was noted with age, laboratory, BIA or anthropometric findings in the overall study population, in patients with sarcopenia and in patients with sarcopenic obesity (Table 3).

Univariate Analysis for the Factors Associated with the Presence and Degree of Sarcopenia

None of the parameters studied including age, laboratory, BIA or anthropometric findings was associated with the increased risk for the presence or degree of sarcopenia (Table 4).

Table 1. Overall characteristics			
Anthropometrics			
BMI (kg/m^2) category, n(%)			
Underweight (<18.5)			1 (2.0)
Normal (18.5-24.9)			11 (22.0)
Overweight (25.0-29.9)			13 (26.0)
Obesity (≥30)			25 (50.0)
Bioelectrical impedance analysis			
Body fat percentage, n(%)	Low		1 (2.0)
	Normal		9 (18.0)
	High		12 (24.0)
	Very high		28 (56.0)
Body water percentage (%),mean(SD)			14.8±5.3
Visceral fat ratio, mean(SD)			3.0±0.3
Muscle mass (kg), mean(SD)			43.6±5.2
Bone mass (kg), mean(SD)			2.3±0.3
Basal metabolic rate (kcal), mean(SD)			1398.8±165.0
Metabolic age, mean(SD)			45.7±8.6
Sarcopenia assessment			
Sarcopenia			
Absent			25 (50.0)
Present			25 (50.0)
Sarcopenia and/or obesity			
Sarcopenic obesity, both (+)			10 (20.0)
Only sarcopenia (+)			15 (30.0)
Only obesity (+)			15 (30.0)
None			10 (20.0)
Laboratory findings			
Prealbumin (g/L)	Mean(SD)		0.2±0.0
	n(%)	Normal	40 (80.0)
		Abnormal	10 (20.0)
Albumin (g/L)	Mean(SD)		4.5 ± 0.3
	n(%)	Normal	48 (96.0)
		Abnormal	2 (4.0)
Vitamin D (ng/mL), median(min-max)			14.3(4.7-93.7)
CRP (mg/L), median(min-max)			3(0.9-27.0)

Table 2. Patient age and laboratory findings according to BMI, sarcopenic obesity and body fat percentage

	BMI (kg/m2)a					Sarcopenic obesity			Body fat percentage					
	Underweight (n=1)	Normal (n=11)	Overweight (n=13)	Obese (n=25)	p[1]	Absent (n=40)	Present (n=10)	p[2]	Low (n=1)	Normal (n=9)	High (n=12)	Very high (n=28)	p[1]
Age (years)	43.0±0.0	57.0 (31.0-89.0)	52.0 (32.0-78.0)	53.0 (37.0-69.0)	0.254	53.3±12.7	57.3±9.9	0.357	43.0 ±0.0	67.0 (34.0-89.0)	47.0 (31.0-67.0)	53.0 (37.0-78.0)	0.110
Prealbumin (g/L)	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.1	0.2 ± 0.0	0.691[3]	0.2±0.0	0.2±0.0	0.396	0.2±0.0	0.2±0.0	0.2±0.0	0.2± 0.0	0.741[3]
Albumin (g/L)	5.4±0.0	4.7±0.3	4.5±0.3	4.5± 0.3	0.131[3]	4.5±0.4	4.4±0.3	0.195	5.4±0.0	4.4±0.4	4.6±0.3	4.5±0.3	0.335[3]
Vit D (ng/mL)	23.8±0.0	15.0±11.7	16.1± 9.5	20.2±18.0	0.566[3]	16.8± 9.2	25.4±26.2	0.567	23.8±0.0	12.7±8.0	17.2±13.5	20.0±16.8	0.310[3]
Physical activity	7.0±0.0	5.0 (2.0-6.0)	2.0 (2.0-6.0)	3.0 (2.0-6.0)	**0.005**	3.5±1.4	2.9 ± 1.2	0.264	7.0±0.0	5.0 (5.0-6.0)	3.0 (2.0-5.0)	3.0 (2.0-3.0)	**<0.001**

Data are expressed as mean± SD or median (min-max)
aunderweight: <18.5 kg/m^2; normal :18.5- 24.9 kg/m^2; ; overweight: 25.0- 29.9 kg/m^2, obese: ≥30 kg/m^2
[1]Kruskal Wallis test and Mann Whitney U test with Bonferroni correction (significance for difference p=0.008), [2]Student's t test, [3]ANOVA test

Table 3. Correlations between degree of sarcopenia and study parameters overall and in sarcopenia and sarcopenic obesity groups

		Degree of sarcopenia		
		Overall (n=50)	Patients with sarcopenia (n=25)	Patients with sarcopenic obesity (n=10)
Physical activity degree	r	0.038	0.250	0.060
	p	0.792	0.228	0.869
	n	50	25	10
Muscle mass (kg)	r	0.031	-0.320	-0.309
	p	0.830	0.119	0.385
	n	50	25	10
Handgrip strength (kg)	r	0.046	-0.192	-0.079
	p	0.750	0.357	0.829
	n	50	25	10
Bone mass (kg)	r	0.024	-0.319	-0.352
	p	0.866	0.120	0.319
	n	50	25	10
Prealbumin (g/L)	r	0.030	-0.204	-0.140
	p	0.838	0.329	0.699
	n	50	25	10
Albumin (g/L)	r	-0.125	-0.186	-0.418
	p	0.386	0.372	0.229
	n	50	25	10
Vitamin D (ng/mL)	r	0.045	0.231	0.758
	p	0.758	0.267	0.011
	n	50	25	10
CRP (mg/L)	r	-0.056	0.021	0.563
	p	0.700	0.921	0.090
	n	50	25	10
Age (years)	r	-0.028	0.012	0.267
	p	0.845	0.955	0.455
	n	50	25	10
BMI (kg/m2)	r	0.207	-0.260	-0.055
	p	0.150	0.210	0.881
	n	50	25	10
Body fat percentage (%)	r	0.207	-0.151	0.006
	p	0.148	0.471	0.987
	n	50	25	10
Body fluid ratio (%)	r	-0.211	0.090	-0.127
	p	0.142	0.668	0.726
	n	50	25	10

Table 3. Continued

		Degree of sarcopenia		
		Overall (n=50)	Patients with sarcopenia (n=25)	Patients with sarcopenic obesity (n=10)
Visceral fat ratio (%)	r	0.164	-0.190	0.280
	p	0.255	0.362	0.434
	n	50	25	10
Basal metabolic rate	r	0.067	-0.328	-0.309
	p	0.645	0.109	0.385
	n	50	25	10
Sarcopenia rate	r	1	1	1
	p			
	n	50	25	10

Table 4. Univariate analysis for the factors associated with the presence and degree of sarcopenia

	Presence of sarcopenia[a]					Degree of sarcopenia[b]				
	Type III Sum of Squares	[c]df	Mean Square	[d]F	Significance	Type III Sum of Squares	[c]df	Mean Square	[d]F	Significance
Corrected Model	4.137a	17	0.243	0.931	**0.548**	718.739a	17	42.278	0.927	**0.553**
Intercept	0.053	1	0.053	0.204	**0.655**	93.34	1	93.345	2.046	**0.162**
Age (years)	0.222	1	0.222	0.851	**0.363**	17.58	1	17.580	0.385	**0.539**
BMI (kg/m^2)	0.540	1	0.540	2.066	**0.160**	139.49	1	139.493	3.057	**0.090**
Body fat percentage (%)	0.078	1	0.078	0.298	**0.589**	141.42	1	141.417	3.100	**0.088**
Body fluid ratio (%)	0.154	1	0.154	0.590	**0.448**	139.72	1	139.722	3.062	**0.090**
Visceral fat ratio (%)	0.097	1	0.097	0.371	**0.547**	73.16	1	73.158	1.603	**0.215**
Muscle mass (kg)	0.586	1	0.586	2.241	**0.144**	28.71	1	28.708	0.629	**0.433**
Physical activity degree	0.113	1	0.113	0.432	**0.516**	191.66	1	191.664	4.201	**0.049**
Handgrip strength (kg)	0.014	1	0.014	0.054	**0.818**	0.245	1	0.245	.005	**0.942**
Bone mass (kg)	0.093	1	0.093	0.356	**0.555**	23.82	1	23.820	0.522	**0.475**
Basal metabolic rate	0.537	1	0.537	2.055	**0.161**	22.04	1	22.044	0.483	**0.492**
Metabolic age (years)	0.070	1	0.070	0.268	**0.608**	12.60	1	12.597	0.276	**0.603**
Prealbumin (g/L)	0.869	1	0.869	3.325	**0.078**	24.87	1	24.874	0.545	**0.466**
Albumin (g/L)	0.092	1	0.092	0.353	**0.556**	2.30	1	2.305	0.051	**0.824**
Vitamin D (ng/mL)	0.190	1	0.190	0.725	**0.401**	0.05	1	.054	0.001	**0.973**
CRP (mg/L)	0.428	1	0.428	1.639	**0.210**	21.04	1	21.044	0.461	**0.502**
Error	8.363	32	0.261			1459.97	32	45.624		
Total	25.00	50				73443.15	50			
Corrected Total	12.50	49				2178.70	49			

[a]R Squared = 0.331 (Adjusted R Squared = -0.024) [b]R squared = 0.330 (Adjusted R squared = -0.026) [c]df=degree of freedom [d]F=F-distribution

DISCUSSION

Our findings in patients with breast cancer prior to radiotherapy revealed sarcopenic obesity in 20% of the study population, and either sarcopenia or obesity was present alone in 30% of patients. Physical activity levels were significantly lower in obese vs. normal weight patients, and were similar in patients with vs. without sarcopenic obesity. None of the parameters studied including age, laboratory, BIA or anthropometric findings was associated with an increased risk for the presence or degree of sarcopenia in patients with sarcopenia or sarcopenic obesity in the univariate analysis.

In a systematic review of 35 studies in 6894 patients with cancer, the prevalence of pre-therapeutic sarcopenia was reported as 38.6% in the overall study population and 25.5% in patients with breast cancer, being significantly and independently associated with postoperative complications, chemotherapy-induced toxicity and poor survival in patients.[25] Also, when compared with other studies that reported the prevalence of sarcopenia in women with stage IV breast cancer (25%)[12], and in patients with operable breast cancer (14%)[7], our findings seem to indicate much higher rates for sarcopenia (50%) in patients with breast cancer prior to radiotherapy.

The prevalence of sarcopenic obesity in our patients (20%) seems closer to previously reported rates in patients with operable breast cancer (14%)[7], and in patients with solid tumors of the respiratory and gastrointestinal tract (15%)[24]. Sarcopenic obesity was also reported to be evident in 25% of postmenopausal women without a history of cancer[26] along with much higher rates (95%) reported in survivors of breast cancer.[27]

Nonetheless, obesity was not present in 60% of patients with sarcopenia in the current study, supporting data from a past study among patients with operable breast cancer that indicated a significant association between sarcopenia and BMI category, with a higher percentage of patients with sarcopenia having a normal BMI.[7] However, the presence of concomitant obesity in 40% of our patients with sarcopenia is important given that sarcopenic obesity is considered an independent predictor of cancer survival[24], along with poorer prognosis in patients with sarcopenia with elevated vs. normal BMI.[7,24,28] This may be due to adverse factors associated with excessive adipose tissue such as insulin resistance and chronic inflammation.[7]

However, it should also be noted that in patients with operable breast cancer with normal BMI, an unexpectedly better prognosis and better toleration of chemotherapy toxicity was reported in patients with vs. without sarcopenia[7], in contrast to studies that indicated shorter survival times and greater treatment toxicity associated with sarcopenia in other cancer populations[24,28,29] and patients with metastatic breast cancer.[12] Thus, authors suggested the inclusion of patients with early-stage breast cancer (and thus recognition of sarcopenia through a CT scan early in the course of disease) to be a potential reason for the remarkable benefit associated with sarcopenia in their study[7], decreasing the likelihood of diminished muscle mass as a result of the cancer cachexia syndrome.[30]

Notably, our findings indicated the presence of sarcopenia in half of the patients with breast cancer, among which obesity accompanied in 40%. This seems to emphasize the role of the assessment of body composition and the use of CT-based sarcopenia diagnosis as a sensitive test for identifying occult sarcopenia in overweight and obese patients who might otherwise remain unrecognized and devoid of necessary treatment in the clinical setting[31], Hence, body weight assessment per se seems to be insufficient in this regard.[7,24]

Similarly, in a population-based study of patients with solid tumors of the respiratory and gastrointestinal tract, a large proportion of obese patients with cancer (15%) were reported to be affected by sarcopenia, and obesity was indicated likely to mask sarcopenia.[24] This seems notable given that sarcopenic obesity represents a worst-case scenario because it involves the hazards of both obesity and depleted muscle mass simultaneously, and is associated with an increase in the number and severity of complications in patients with breast cancer.[4,24,32]

Indeed, in a past study with 166 patients with metastatic breast cancer receiving first-line palliative chemotherapy, low muscle mass (LMM) and low muscle attenuation (LMA), which reflect low muscle quantity and low muscle quality, respectively, were reported in 66.9% and 59.6% of patients, and sarcopenic obesity was evident in 7.2% of the study population.[33] The authors also noted a significant association of LMA but not LMM or sarcopenic obesity with overall survival.[33]

In a systematic review of body composition changes in women treated for breast cancer, the authors reported no changes in LBM in five of nine trials on LBM within 3-4 years of diagnosis and treatment, despite losing body weight and fat mass in one study.[4] Notably, in a 24-week dietary intervention trial among patients with breast cancer, an average of 6.1 kg loss of body weight was reported to be accompanied by a simultaneous loss of LBM, but an increase in the prevalence of sarcopenic obesity from 10% at baseline to 18% at trial completion.[34]

Although BMI and body weight are easily obtained prognostic endpoints, they fail to accurately estimate potentially important changes in lean or adipose tissues.[4] Hence, given the recent imaging studies in other cancer populations highlighting the variability in LBM across the BMI spectrum[12,24,28], the prognostic significance of the interaction between body weight and adiposity in patients with breast cancer merits further investigation.[4] Moreover, given the identification of highest rates of LBM depletion in the earliest postmenopausal years[35], the likelihood of menopausal status to be a moderator of body composition is considered, along with a need for further investigation, to separately address the natural increases in adiposity and decreases in lean tissue in premenopausal and post-menopausal patients with breast cancer.[4]

Although certain cancer types (i.e. colorectal cancer) and patient age over 65 years were reported to be associated with increased susceptibility to sarcopenia in a past study among patients with respiratory and gastrointestinal cancer[24], our findings revealed that none of the parameters studied including age, laboratory, BIA or anthropometric findings was associated with an increased risk for the presence or degree of sarcopenia in patients with sarcopenia or sarcopenic obesity in the univariate analysis.

In elderly populations, sarcopenic obesity is considered to be an independent predictor of disability, and obese patients with vs. without sarcopenia were reported to have poorer self-assessed functional status and restricted activities of daily living.[36] Resistance exercise is considered likely to offer improved lean mass in the breast cancer population.[27,37,38] However, physical activity level was not associated with presence of either sarcopenic obesity or sarcopenia and also the degree of sarcopenia in our patients. Strikingly, our findings revealed no significant difference in CRP, prealbumin, albumin, and vitamin D levels with respect to the presence of obesity, sarcopenia or sarcopenic obesity in patients with breast cancer. Nonetheless, the interaction between obesity and sarcopenia in patients with breast cancer needs further investigation considering confounding factors such as disease stage, menopausal status, and previous treatments in the assessment of combined hazards of obesity and depleted muscle mass in patients with breast cancer.

Certain limitations of this study should be considered. First, due to its observational nature and the non-randomized group allocation, the likelihood of main selection bias and confounding is possible. Second, although the current study provides data on real-life clinical practice, the potential lack of generalizability seems another important limitation due to the relatively small sample size. Third, the lack of data on menopausal status is another limitation because of the likelihood of menopausal status acting as a moderator in body composition changes, which otherwise would extend the knowledge achieved in the current study.

CONCLUSION

In conclusion, our findings revealed sarcopenia in half of patients with breast cancer prior to radiotherapy and concomitant obesity in 40% of patients with sarcopenia. This emphasizes the crucial role of the assessment of body composition using CT imaging rather than body weight and BMI-based assessments alone in the earlier recognition of sarcopenic obesity to prevent combined hazards of obesity and depleted muscle mass in patients with breast cancer. None of the potential risk factors studied in our population, including patient age, BIA or anthropometric findings was associated with an increased risk for either the presence or degree of sarcopenia in patients with sarcopenia or sarcopenic obesity. However, the body composition changes in patients with breast cancer and the prevalence and prognostic role of sarcopenic obesity needs to be further investigated, particularly in terms of subgroups stratified by ongoing treatment, variability in muscle mass across the BMI spectrum, and menopausal status.

Ethical approval: The study was approved by the Ethics Committee of Ankara Numune Training and Research Hospital (E-18-1868, date: 26.06.2018).

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

Author contributions: Conception İ.K.; Design – İ.K., R.H; Supervision – İ.K., R.H.; Resources – None; Materials – İ.K.; Data Collection and/or Processing – İ.K., R.H.; Analysis and/or Interpretation - İ.K; Literature Search – İ.K.; Writing Manuscript - İ.K., R.H; Critical Review – İ.K, R.H.

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