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Measuring Sarcopenia on MRI among Turkish Female Breast Cancer Patients

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ABSTRACT

Background: Since the presence of sarcopenia in breast cancer patients is associated with increased postoperative complications, it is crucial to know its frequency in the prechemoteraphy period. It has been suggested that there are many factors associated with sarcopenia. This study focused on the frequency of sarcopenia over the pectoralis muscle area obtained in routine breast MRI among Turkish females who were newly diagnosed with breast cancer.

Methods: In a prospective study, pectoralis muscle was manually contoured bilaterally, and the cross-sectional area on breast MRI was calculated in newly diagnosed breast cancer patients. The 'Core slices' program was used while calculating SMI. We accepted 7.4 kg/m^2 as the threshold value for sarcopenia.

Results: Overall, 17 patients (17 %) were sarcopenic. The analysis regarding the detection of sarcopenia in the patient groups < 65 and ≥ 65 years of age was not statistically significant (P<0.156). The relationship between the groups with BMI < 25 and ≥ 25 sarcopenia was statistically significant (P<0.001). Sarcopenia was found significantly more frequently in patients with metastasis (P<0,0001).

Conclusion: This study recruited Turkish females who were newly diagnosed breast cancer. It is the first study in the literature to include the same race, gender, and malignancy in which sarcopenia was investigated. It was shown that breast MRI which is radiation-free can be used in the evaluation of sarcopenia in patients with breast cancer. This result is important for being prepared for possible complications before treatment.

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INTRODUCTION

Sarcopenia is an age- and disease-related decease in muscle mass and performance. Cancer is probably the most important pathological condition leading to the loss of muscle mass and is an important cause of sarcopenia.[1-5] According to 2018 data from the World Health Organization, breast cancer is the most common cancer in women worldwide. Sarcopenia is accepted as a strong predictor of poor survival among breast cancer patients.[1-5]

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It has been reported that the prevalence of sarcopenia in cancer patients varies significantly depending on the various types of cancer and disease stages and the tools to measure it. Usually, low muscle mass can be identified by examinations such as dual X-ray absorptiometry (DXA), bioelectrical impedance analysis (BIA), or a computed tomography (CT) scan. Because CT allows the measurement of muscle area and density, it is considered as the gold standard in the evaluation of sarcopenia. Additionally, it is possible to determine low muscle strength by hand grip strength, while the timed get-up and go test and gait speed must measure impaired physical performance.[6-9]

Routine staging evaluations in women with breast cancer with different techniques such as mammography, ultrasound, tomosynthesis, and magnetic resonance imaging (MRI) focus on regional disease. A study was conducted to measure muscle mass in breast cancer patients with breast MRI, which did not involve radiation and was obtained within the general approach to the patient algorithm.[10] In this study, it has been shown that total psoas muscle in CT and pectoral muscle measurement in breast MRI are correlated, and muscle mass can be measured over the pectoral muscle in breast MRI.

Additionally, positron emission tomography (PET-CT) is preferred for staging breast cancer, and the indications for CT alone have decreased. In early-stage breast cancer, both tests may not be obtained. In cases where CT cannot be obtained, having an alternative such as MRI is a significant advantage.

Breast MRI is the most sensitive test for detecting breast cancer.[11] It is used to screen for cases with dense breast parenchyma and in high-risk populations. It is also widely used as a problem solver in addition to conventional examinations. It is frequently preferred in evaluating multifocal-multicentric disease, invasion of surrounding tissues, and nipple involvement.

The European Working Group on Sarcopenia in Older People (EWGSOP) has developed an easy to apply clinical definition and diagnostic criteria for sarcopenia. As far as we know, the only study determining the cut-off value in healthy adult women (18–39 years old) for the Turkish population is that of Bahat *et al.*[12] In this study, the cut-off sarcopenia value for women was 7.4kg/m^2, and we used this value in our study.

In another study by Oflazoğlu *et al.*, in which sarcopenia was determined in newly diagnosed cancers for the Turkish male and female populations, where all cancers were evaluated together.[13] They were used to assess muscle resistance BIA and handgrip dynamometer tools and to obtain the specific cut-off values for women and men. The specific SMI value for female cancer patients in the Turkish population was calculated at 6.76 kg/m^2.

Since the presence of sarcopenia in breast cancer patients is associated with increased postoperative complications, chemotherapy toxicity, and disease-free survival, it is crucial to determine the frequency of sarcopenia in breast cancer patients.[5,14-16] In previous research, we could not find a study in which sarcopenia was evaluated by pectoral muscle measurement on MRI for newly diagnosed breast cancer patients.

In our study, we discussed the determination, frequency, and practical implications of sarcopenia over the pectoral muscle area obtained in routine breast MRI with female newly diagnosed breast cancer patients and its related factors in the Turkish population.

METHODS

The local ethics committee approved the prospective study protocol (ID:180 / April 2021). This study included all newly diagnosed breast cancer patients who did not undergo surgery and had received no chemotherapy or radiotherapy between April and December 2021 at our university hospital. We excluded patients with breast cancer who had breast MRIs during or after treatment and those with pectoral muscle invasion and those who had a previous operation that disrupted their pectoral muscle integrity. Those patients' pretreatment height, weight, age, body mass index, and demographic data were recorded.

Images analysis: MRI

All patients were examined with a 1,5 Tesla (T) MRI device (General Electric Signa HDx, Medical Systems, USA). A dedicated 8-channel phased-array breast surface coil was used. The standard MRI images were obtained using the following techniques: Axial fat-suppressed T2 and T1-weighted with a slice thicknesses of 4 mm with a 1,2-mm intersection gap without contrast. The gadolinium-based contrast agent was administered at a dose of 0,1 mmol/kg using an automatic syringe, and this injection was followed by a 15–20 cc of saline flush. Consecutive post-contrast dynamic sequences were taken at 60-second intervals.

The aim was to calculate the PMA cross-sectional area on MRI axial pre-contrast T1-weighted fat-suppressed images. The pectoralis muscle was identified at the level of the sternal angle of Louis at the level of the second costal cartilage in the manubriosternal joint.[10] The pectoral muscle is an easily measurable thoracic muscle, which is assessed on routinely obtained breast MRIs. Pectoralis muscle was manually contoured bilaterally, and the cross-sectional area on axial pre-contrast T1- weighted fat-saturated images was calculated (Figure 1). PMA was calculated by two observers (G.S, more than 15 years of experience in breast imaging, K.A.S, and a 3-year radiology resident) on MRI images by consensus. The 'Core slices' program (a free and open-source web-based interface that allows the measurement of analytic morphomics) was used while calculating SMI. When the muscle area was marked from the appropriate localization, the program automatically calculated the SMI. We accepted 7.4kg/m^2 as the threshold value for sarcopenia.[12] We

grouped the patients with BMI indexes below 25, 25, and above.

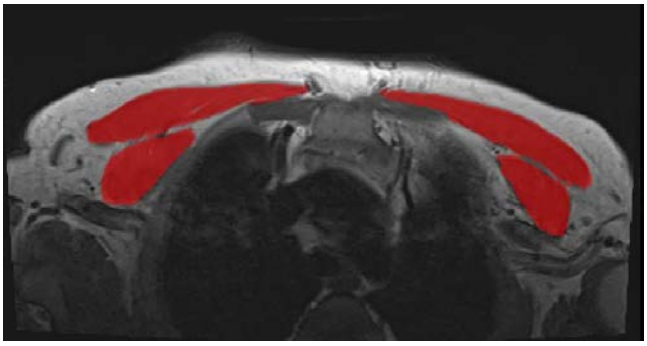

Figure 1. A 48 year- old, newly diagnosed breast cancer Turkish patient. The pectoralis muscle was identified at the level of the sternal angle of Louis used as a bony landmark. The pectoralis muscle (major and minor) area was countered bilaterally (red area) on axial pre-contrast T1-weighted MRI.

Statistical analysis

Statistical analysis was performed using statistical software (SPSS, version 22. 0). We used the Mann–Whitney U test, which is a non-parametric test, to analyze the relationship between the different groups (Table 1). The chi-squared test for categorical variables was used to compare metastatic and non-metastatic groups with or without sarcopenia. P-values<0.05 were considered as the statistical significance.

Table 1. Analysis of the relationship between different groups

	Sarcopenia *n*=17	No sarcopenia *n*=83	P values*
Age	55 (14.5)	50 (20)	< 0.156
Weight	61 (9.5)	73 (17)	< 0.001
BMI	24.8 (4.2)	29.3 (7.6)	< 0.001
SMI	6.4 (1.5)	10.8 (3.8)	< 0.001

Data are presented as median (interquartile range) values, *Mann-Whitney *U* test
SMI, skeletal muscle mass index; BMI, body mass index

RESULTS

Among all patients, 17 patients (17 %) were sarcopenic. The mean age of the patients with sarcopenia was 52± 8.4 (range 37-67), and the mean age of those without sarcopenia was 54.4±11.7 (range 34-84). The number of patients over 65 years was 18% (n=18). Among all patients, 72% were categorized as having BMI ≥ 25 (n=72). The analysis regarding the detection of sarcopenia in the patient groups <65 years of age and ≥65 years of age was not statistically significant (P<0.156). The relationship between the groups with BMI 25 < and 25 ≥ and sarcopenia was statistically significant (P <0.001). In other words, the risk of sarcopenia decreased as the BMI increased.

$T_{1-4}N_{1-3}M_0$ was detected in 73% of the patients, and $T_{1-4}N_{1-3}M_1$ in 23%. All patients with distant metastases also had axillary metastases. Also, 4 % of the patients ($T_1N_0M_0$) had no nodal or distant metastases. A statistically significant correlation was found between sarcopenia and metastasis (P<0.0001).

DISCUSSION

Our study is the first to investigate sarcopenia by pectoral muscle measurement on MRI in Turkish female patients with newly diagnosed breast cancer. In this study, we found that radiation-free breast MRI can be a good alternative in the evaluation of sarcopenia in patients with breast cancer. CT and DXA are generally preferred among imaging methods to evaluate sarcopenia. However, both methods involve radiation. Breast MRI is a radiation-free method that is frequently used in patients with breast cancer for indications such as determining the spread of the disease and planning treatment. Particularly in breast cancer patients, the use of conventional CT for staging purposes may not be possible with the wide spread use of PET-CT. The fact that breast MRI, which is already obtained in daily practice as part of the diagnostic algorithm, can healthily predict sarcopenia and provide data that will help the clinician in treatment planning. Among the factors affecting sarcopenia, race and gender are important variables. Our study included a relatively homogeneous series as it involved only the female Turkish population with breast cancer patients, and therefore its results are valuable.

The latest studies present a highly variable prevalence of sarcopenia among cancer patients. In the HEAL study, the prevalence of sarcopenia in breast cancer patients was 16% and sarcopenia was associated with an increased risk of overall mortality.[5] In a meta-analysis, the prevalence of sarcopenia in all stages of the disease before cancer treatment was found to range from 15% to 74%.[17] In this meta-analysis, the prevalence of sarcopenia before both chemotherapy and surgery was 39%, while the prevalence of sarcopenia before chemotherapy was 29%. In another meta-analysis, the prevalence of body composition measurement and sarcopenia was reported to be 11-74% using abdominal CT, while the prevalence of sarcopenia calculated using body composition measurement and functional assessment tools remained at 12-51%.[15,17-20] In Pamukdjian *et al.*'s review of 26 studies, sarcopenia was noted in 25% of men and 13.1% of women.[21] Although our study consisted only

of female patients with breast cancer, the prevalence of sarcopenia was 17% in line with the literature.

Sarcopenia is defined by the European Society of Parenteral and Enteral Nutrition (ESPEN) and the European Working Group on Sarcopenia in Older People (EWGSOP) as a progressive disease involving loss of muscle mass, muscle strength, and/or physical performance.[6] There is a study showing that muscle mass loss is the most important of the three factors in terms of postoperative complications.[19] In our study, we evaluated sarcopenia based on loss of muscle mass before treatment, which is important in determining the patients that may experience complications after treatment.

Sarcopenia is particularly common among cancer patients, as the incidence of cancer increases with age.[22] In addition, the sedentary lifestyle brought about by old age, chronic diseases, and some related drug treatments may exacerbate muscle wasting in elderly individuals diagnosed with cancer.[23,24] In our study, unlike some other studies, no correlation was found between age and sarcopenia.[25] However, as in most studies, low BMI appeared to be a factor negatively affecting sarcopenia.[13,26] Prevalence rates in patients with advanced disease in the literature have been reported to be higher than in patients with early-stage disease.[13,17] However, it was not found to be statistically significant. Also, Zang *et al.* have shown that sarcopenia is a risk factor for mortality among female early breast cancer patients.[27] In our study, sarcopenia was found significantly more frequently in patients with metastasis.

Our hospital is located in a predominantly Turkish region. We had Turkish females who were newly diagnosed with breast cancer as a relatively homogeneous patient group. The most important limitation of our study is the small size of our sample group and a single-center study. Since the measurements were made by consensus, intraobserver difference analyses were not needed. Another limitation is that the cancerous group was not compared to a normal control group and the absence of a clinical test for sarcopenia. In addition, evaluating sarcopenia with only the pectoral muscle measurement is an important limitation. There is only one study in the literature that found a correlation between the psoas muscle and the pectoral muscle areas.[10] More studies are needed for this generalization.

CONCLUSION

It has been shown that breast MRI with radiation-free examination can be used in the evaluation of sarcopenia in patients with breast cancer. This result is important for physicians to be able to predict and be prepared for possible complications before treatment.

ETHICAL CONSIDERATIONS

The study was conducted in accordance with the principles of the Helsinki Declaration. As a routine procedure, written informed consent was obtained from each patient for all procedures and publication. Ethics committee approval was received for this study from the Clinical Trials Ethics Committee (ID:180 / April 2021).

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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REFERENCES

1. Del Fabbro E, Parsons H, Warneke CL, Pulivarthi K, Litton JK, Dev R, et al. The relationship between body composition and response to neoadjuvant chemotherapy in women with operable breast cancer. Oncologist. 2012;17(10):1240-5. doi: 10.1634/theoncologist.2012-0169.
2. Prado CM, Baracos VE, McCargar LJ, Reiman T, Mourtzakis M, Tonkin K, et al. Sarcopenia as a determinant of chemotherapy toxicity and time to tumor progression in metastatic breast cancer patients receiving capecitabine treatment. Clin Cancer Res. 2009;15(8):2920-6. doi: 10.1158/1078-0432.CCR-08-2242.
3. Deluche E, Leobon S, Desport JC, Venat-Bouvet L, Usseglio J, Tubiana-Mathieu N. Impact of body composition on outcome in patients with early breast cancer. Support Care Cancer. 2018;26(3):861-8. doi: 10.1007/s00520-017-3902-6.
4. Klassen O, Schmidt ME, Ulrich CM, Schneeweiss A, Potthoff K, Steindorf K, et al. Muscle strength in breast cancer patients receiving different treatment regimes. J Cachexia Sarcopenia Muscle. 2017;8(2):305-16. doi: 10.1002/jcsm.12165.
5. Villaseñor A, Ballard-Barbash R, Baumgartner K, Baumgartner R, Bernstein L, McTiernan A, et al. Prevalence and prognostic effect of sarcopenia in breast cancer survivors: the HEAL Study. *J Cancer Surviv.* 2012;6(4):398-406. doi: 10.1007/s11764-012-0234-x.
6. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. *Age Ageing.* 2010;39(4):412-23. doi: 10.1093/ageing/afq034.

7. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. *J Am Med Dir Assoc*. 2011;12(4):249-56. doi: 10.1016/j.jamda.2011.01.003.
8. Muscaritoli M, Anker SD, Argilés J, Aversa Z, Bauer JM, Biolo G, et al. Consensus definition of sarcopenia, cachexia and pre-cachexia: joint document elaborated by Special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics". *Clin Nutr*. 2010;29(2):154-9. doi: 10.1016/j.clnu.2009.12.004.
9. Morley JE, Abbatecola AM, Argiles JM, Baracos V, Bauer J, Bhasin S, et al. Sarcopenia with limited mobility: an international consensus. *J Am Med Dir Assoc*. 2011;12(6):403-9. doi: 10.1016/j.jamda.2011.04.014.
10. Rossi F, Valdora F, Barabino E, Calabrese M, Tagliafico AS. Muscle mass estimation on breast magnetic resonance imaging in breast cancer patients: comparison between psoas muscle area on computer tomography and pectoralis muscle area on MRI. *Eur Radiol*. 2019;29(2):494-500. doi: 10.1007/s00330-018-5663-0.
11. Mann RM, Cho N, Moy L. Breast MRI: State of the Art. *Radiology*. 2019;292(3):520-36. doi: 10.1148/radiol.2019182947.
12. Bahat G, Tufan A, Tufan F, Kilic C, Akpinar TS, Kose M, et al. Cut-off points to identify sarcopenia according to European Working Group on Sarcopenia in Older People (EWGSOP) definition. *Clin Nutr*. 2016;35(6):1557-63. doi: 10.1016/j.clnu.2016.02.002.
13. Oflazoglu U, Alacacioglu A, Varol U, Kucukzeybek Y, Salman T, Taskaynatan H, et al. Prevalence and related factors of sarcopenia in newly diagnosed cancer patients. *Support Care Cancer*. 2020;28(2):837-43. doi: 10.1007/s00520-019-04880-4.
14. Tan BH, Birdsell LA, Martin L, Baracos VE, Fearon KC. Sarcopenia in an overweight or obese patient is an adverse prognostic factor in pancreatic cancer. *Clin Cancer Res*. 2009;15(22):6973-9. doi: 10.1158/1078-0432.CCR-09-1525.
15. Prado CM, Lieffers JR, McCargar LJ, Reiman T, Sawyer MB, Martin L, et al. Prevalence and clinical implications of sarcopenic obesity in patients with solid tumours of the respiratory and gastrointestinal tracts: a population-based study. *Lancet Oncol*. 2008;9(7):629-35. doi: 10.1016/S1470-2045(08)70153-0.
16. Jung HW, Kim JW, Kim JY, Kim SW, Yang HK, Lee JW, et al. Effect of muscle mass on toxicity and survival in patients with colon cancer undergoing adjuvant chemotherapy. *Support Care Cancer*. 2015;23(3):687-94. doi:10.1007/s00520-014-2418-6.
17. Prado CM, Lieffers JR, Bowthorpe L, Baracos VE, Mourtzakis M, McCargar LJ. Sarcopenia and physical function in overweight patients with advanced cancer. *Can J Diet Pract Res*. 2013;74(2):69-74. doi: 10.3148/74.2.2013.69.
18. Wang SL, Zhuang CL, Huang DD, Pang WY, Lou N, Chen FF, et al. Sarcopenia Adversely Impacts Postoperative Clinical Outcomes Following Gastrectomy in Patients with Gastric Cancer: A Prospective Study. *Ann Surg Oncol*. 2016;23(2):556-64. doi: 10.1245/s10434-015-4887-3.
19. Huang DD, Wang SL, Zhuang CL, Zheng BS, Lu JX, Chen FF, et al. Sarcopenia, as defined by low muscle mass, strength and physical performance, predicts complications after surgery for colorectal cancer. *Colorectal Dis*. 2015;17(11):O256-64. doi: 10.1111/codi.13067.
20. Shachar SS, Williams GR, Muss HB, Nishijima TF. Prognostic value of sarcopenia in adults with solid tumours: A meta-analysis and systematic review. *Eur J Cancer*. 2016;57:58-67. doi: 10.1016/j.ejca.2015.12.030.
21. Pamoukdjian F, Bouillet T, Lévy V, Soussan M, Zelek L, Paillaud E. Prevalence and predictive value of pre-therapeutic sarcopenia in cancer patients: A systematic review. *Clin Nutr*. 2018;37(4):1101-13. doi: 10.1016/j.clnu.2017.07.010
22. Group UCSW. US cancer statistics: 1999–2009 incidence and mortality web-based report. Atlanta GA: USDHHS, CDC and National Cancer Institute. 2013.
23. Sayer AA, Syddall H, Martin H, Patel H, Baylis D, Cooper C. The developmental origins of sarcopenia. *J Nutr Health Aging*. 2008;12(7):427-32. doi: 10.1007/BF02982703.
24. Paddon-Jones D, Short KR, Campbell WW, Volpi E, Wolfe RR. Role of dietary protein in the sarcopenia of aging. *Am J Clin Nutr*. 2008;87(5):1562s-6s. doi: 10.1093/ajcn/87.5.1562S.
25. Kim EY, Kim K, Kim YS, Ahn HK, Jeong YM, Kim JH, et al. Prevalence of and Factors Associated with Sarcopenia in Korean Cancer Survivors: Based on Data Obtained by the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2011. *Nutr Cancer*. 2017;69(3):394-401. doi: 10.1080/01635581.2017.1267776.
26. Broughman JR, Williams GR, Deal AM, Yu H, Nyrop KA, Alston SM, et al. Prevalence of sarcopenia in older patients with colorectal cancer. *Journal of geriatric oncology*. 2015;6(6):442-5. doi: 10.1016/j.jgo.2015.08.005.
27. Zhang X-M, Dou Q-L, Zeng Y, Yang Y, Cheng AS, Zhang W-W. Sarcopenia as a predictor of mortality in women with breast cancer: a meta-analysis and systematic review. *BMC cancer*. 2020;20:1-11. doi: 10.1186/s12885-020-6645-6.

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