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Short Communication

COMPARATIVE ANALYSIS OF ANTHROPOMETRIC PARAMETERS AND BODY COMPOSITION OF PATIENTS WITH BREAST CANCER AND HEALTHY WOMEN IN THE POSTMENOPAUSAL PERIOD

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According to a statistical review (2018) in Latvia, there are more than one thousand women (n = 1266) with the diagnosis of breast cancer. Assessments of anthropometrical parameters were made according to the World Health Organisation recommendations for morbidity risk analysis. The aim of the study was to determine the differences and changes of anthropometric parameters and indices in a control group and in a clinical group (initial oncological diagnosis without treatment intervention). We examined women in their postmenopausal period. The control group included apparently healthy women (n = 181) and the clinical group included women (n = 44) with initial oncological diagnosis (breast cancer 1st and 2nd stage). In order to assess body anthropometric characteristics we used the body mass index (BMI), waist circumference, waist/height ratio and skin fold thickness measurement. The study results were assessed using statistical analyses in the IBM SPSS Statistics for Windows, Version 22.0 software: Shapiro–Wilk and Mann–Whitney tests with a two-tailed p-value *< 0.05). The analysis of statistical data showed that, despite the low number of patients in the clinical group, we found a significantly lower waist-to-hip ratio, skinfold thickness above* m. biceps brachii*, skinfold thickness above* m. triceps brachii*, and subscapular and suprailiac skin fold thickness in this group.*

Key words: *body mass index, anthropometric measures, general adiposity.*

Malignant diseases are the second cause of death after cardiovascular pathology. The level of the breast cancer incidence in Latvia is similar to that in the European Union member states as well the United States, China and Japan (Ferlay *et al.*, 2013). In recent decades, there has been a high prevalence of risk factors in the female population, such as anthropometric factors (increase of body mass and obesity, low physical activity) (Vander *et al.*, 2012), harmful habits (tobacco-use etc.), inadequate dietary habits (low fruit and vegetable intake), various manipulations (injections, hormonal replacement therapy) (Majeed *et al.*, 2014). The growth of obesity and physical inactivity of the population is associated to breast cancer in more than 30% of cases in Western Europe (Matthews *et al.*, 2016; Godinho-Mota *et al.*, 2018). The adiposity of oncological patients develops as a response to the combination of the generalised inflammation syndrome and dominance of catabolic processes in muscular tissue due to low physical activity level (Cederholm *et al.*, 2017), as well as fat-infiltrates in muscular tissues causing decrease of muscular tissue functional capacities (Cruz-Jentoft *et al.*, 2019). Obesity is an important risk factor of oncological pathology (the breast cancer) and causes high mortality of patients in the postmenopausal women group. Adiposity has a harmful effect on differential stage of a malignant tumour, its size, angio-lymphatic invasion and lymph node involvement in metastatic process. The combination of adiposity and breast cancer results in increased aggressive characteristics of the tumour and increased rate of mortality (Hilmi *et al.*, 2019). The most practical and effective approach of adiposity assessment is the usage of body mass index (BMI), waist circumference (WC), waist-to-height ratio (WHtR) and the skinfold thickness measurement test (Roriz *et al*., 2017). BMI is commonly considered as a valid instrument for identification of obesity, but may yield a false diagnosis of body fatness (Shah *et al*., 2012), especially in young healthy adults (Zaccagni *et al*., 2014). The evaluation of anthropometric data as risk factors becomes more precise by combine use of BMI and WC (Wu *et al.*, 2018). Higher incidence of malignant tumour is associated with the fat distribution type (as a risk factor) in the upper abdominal region (visceral fat). Abdominal fatness is a high risk factor for oncological pathology (without increase of BMI) in the female population. A Body Shape Index (ABSI) was specifically developed for evaluation of central obesity. ABSI was found to be superior to BMI and WC in determining metabolic changes and disease risks in the general USA population (Krakauer *et al*., 2014). Studies in China also found a positive association between ABSI and disease risk and mortality (He *et al*., 2013). Moreover, ABSI is considered to be a predictor of total mortality, as found in several cohort observational studies with follow-ups ranging from 5 to 25 years (Krakauer *et al*., 2012). Studies of body composition have shown that ABSI is positively associated with fat mass and negatively associated with fat-free mass (Dhana *et al*., 2016). The body roundness index (BRI) has been applied as a new approach in assessment of body fat and visceral adipose tissue volume (Thomas *et al*., 2013). BRI is used for risk assessment in clinics to identify diabetes mellitus and cardiovascular health status (Chang *et al*., 2015). One of the most effective indicators of cardiovascular diseases is the conicity index (CI), an indicator of abdominal adiposity, which is used as instrument for assessment of body fat distribution and morbidity risk (de Sousa *et al*., 2020). The association between fat distribution in the body and health level has been studied (Ehrampoush *et al*., 2017; Eickemberg *et al*., 2020). WHR was used as a specific indicator for increased health risk assessment for the middle-aged population in a longitudinal study of cardiovascular disease and mortality (Quaye *et al.,* 2019). The classic anthropometric method — the skinfold thickness measurement test (SFT) — was used to determine body composition and body fat percentage. Increased risk of breast cancer in post-menopausal women is associated with obesity. Analysis of body composition had importance for oncological patients, as it allowed to start treatment activities and maintain long-life quality (Brown *et al*., 2019).

The study was conducted in Latvia (Rīga) from January 2016 to March 2019. The participants in the control group were selected randomly from a post-menopausal women group. The women in the control group (n = 181) were aged from 40 to 66; the mean age was 53.3 ± 8.3 (SD). The inclusion criteria for the control group were lack of oncological diseases, diabetes, severe cardiovascular diseases, pulmonary diseases, neurological diseases, kidneys' diseases and gastrointestinal diseases. The patient group consisted of women (n = 44) aged from 40 to 66 with diagnosed breast cancer in stage I and stage II; mean age was 55.3 ± 7.7 (SD). Inclusion criteria for the clinical group were initial diagnosis of breast cancer (1^{st} or 2^{nd} stage) and no treatment procedures according to diagnosis. All subjects gave their informed consent. The Medical Ethics Committee of Rīga Stradiņš University (Rīga, Latvia, No. 18/28.04.2016) approved the study protocol for biomedical research. Anthropometric measurements of the women were collected by specialists of the Anthropological Laboratory of the Institute of Anatomy and Anthropology, Rīga Stradiņš University.

Weight and height were measured using the Martin R. and Saller K. method to the nearest 0.1 kg and 0.1 cm, respectively, with the participant in lightweight clothing and without shoes. WC was measured using a tape measure placed halfway between the lower border of the ribs and the iliac crest in a horizontal plane at the end of normal expiration (to the nearest 0.1 cm). The skinfold thickness was measured precisely at several standardised sites above *m. biceps brachii*, above *m. triceps brachii*. Both the subscapular and suprailiac skin folds thickness was measured. Indices were calculated by the following formulas:

Body mass index (BMI) as ratio of weight (kg) and squared body height (m); Weight Height Ratio (WHtR) as weight (g) to height (cm) ratio; Body Shape Index (ABSI) was

$$ABSI = \frac{WC}{(BMI^{2/3} \times height^{1/2})},$$ body roundness index (BRI) as

$$BRI = 364.2 - 365.5 \times \sqrt{1 - \frac{(WC/2\pi)^2}{(0.5 \times height)^2}},$$ the conicity index (CI) as

$$CI = \frac{WC}{0.109 \times \sqrt{weight/height}}.$$

For statistical analysis, the Shapiro–Wilk test and Mann–Whitney test with a two-tailed p-value < 0.05 were conducted using IBM SPSS Statistics for Windows, Version 22.0.

Anthropometric characteristics were collected for women in postmenopausal age divided into clinical and control groups. The clinical group included women (n = 44) at the age of 55.30 ± 7.72 years, with the initial diagnosis of breast cancer, first and second stage, before admitted for treatment. The control group included healthy women (n = 181), average age 53.25 ± 8.27 years (Table 1).

Assessment of the clinical and control group showed that, despite different sample sizes in the studied groups, there were no significant differences in anthropometric characteristics like height (p = 0.941) and weight (p = 0.941). The average body height in the clinical group was 163.39 ± 6.24 cm (minimum 145.0 cm; maximum 170.0 cm), and the average body height for the control group was 163.44 ± 5.93 cm (minimum 159.4 cm, maximum 176.4 cm). The range of body mass in the clinical study group was 44.8–118 kg, and in the control from 49.1 kg to 135 kg. There was a tendency (not significant) of lower body mass in the clinical group

Table 1. Age, height, weight, anthropometric indices, and skinfold thickness in the clinical (n = 44) and control (n = 181) groups (women in postmenopausal period)

Variable	Clinical group, average value and standard deviation M ± SD	Control group, average value and standard deviation M ± SD	U value	*p* value
Age, years	55.30 ± 7.72	53.25 ± 8.27	6797.0	0.102
Height, cm	163.39 ± 6.24	163.44 ± 5.93	7913.0	0.941
Weight, kg	73.61 ± 17.45	75.30 ± 15.31	7328.5	0.373
Chest circumference, cm	95.40 ± 13.36	98.13 ± 10.82	7129.0	0.243
Waist circumference, cm	86.28 ± 14.47	88.55 ± 14.31	7317.0	0.365
Hip circumference, cm	107.62 ± 14.14	106.79 ± 10.67	7871.5	0.895
Indices				
BMI	27.56 ± 6.23	28.17 ± 5.49	7276.5	0.336
WHtR	0.53 ± 0.09	0.54 ± 0.09	7295.0	0.349
WHR	0.80 ± 0.07	0.83 ± 0.08	6592.5	0.055
ABSI	0.0074 ± 0.0004	0.0075 ± 0.0006	7454.0	0.475
BRI	4.07 ± 1.85	4.35 ± 1.95	7295.0	0.349
CI	1.18 ± 0.08	1.20 ± 0.11	7488.0	0.504
Skinfold thickness				
M. biceps brachi, mm	8.73 ± 3.39	10.67 ± 4.95	6175.0	0.012
M. triceps brachi, mm	16.16 ± 4.27	18.49 ± 5.81	6150.5	0.011
M. subscapularis, mm	19.71 ± 7.17	21.69 ± 7.63	6756.0	0.091
M. suprailiaca, mm	19.71 ± 7.17	22.62 ± 8.14	6423.5	0.031

Notes: U, Mann–Whitney test value; BMI, body mass index; WHtR, waist-to-height ratio; WHR, waist-to-hip ratio; ABSI, a body shape index; BRI, body roundness index; CI, conicity index.

(mean 73.61 ± 17.45 kg) compared to the control group (75.30 ± 15.31 kg). The chest circumference ($p = 0.0243$), hip circumference ($p = 0.895$) and waist circumference ($p = 0.365$) did not significantly differ between respondents of clinical and control groups. The anthropometric data was evaluated by combined use of BMI and WC (Wu, *et al*, 2018). A higher incidence of malignant tumour is associated with the fat distribution type (as a risk factor) in the upper abdominal region (visceral fat). There was a lower chest circumference, waist circumference and hip circumference for the clinical group, but the differences were not significant (Table 1). The adiposity assessment was made by using body mass index (BMI), waist circumference (WC), waist-to-height ratio (WHtR), and skinfold thickness t (Roriz, *et al*., 2017). The mean value of indices such as BMI ($p = 0.336$), ABSI ($p = 0.475$), BRI ($p = 0.349$), CI ($p = 0.504$) and WHtR ($p = 0.349$) did not significantly differ between clinical and control groups. However, there was a tendency of lower mean BMI in the clinical group (27.56 ± 6.23, range 15.0–37.0) than in the control group (28.17 ± 5.49, range 15.0–45.0). Based on the values of BMI, adiposity was more common (22.7 % of women) in the clinical group, than in the control group (12.2% of women). Our data support the suggestion that adiposity is a risk factor for oncological pathology (breast cancer). Combination of adiposity and breast cancer diagnosis was observed to be associated with more aggressive characteristics of tumour and higher morality rate in a patient group (Hilmi *et al*., 2019). Overweight was observed in 40.9% of women in the clinical group and in 30.9% respondents of the control group. The standard value of BMI was observed in 36.4% of women of the clinical group and 56.9% of women in the control group. Increased risk of breast cancer in post-menopausal women is associated with obesity; analysis of body composition has importance for oncological patients, as it allows to start treatment and maintain long-life quality (Brown, *et al*., 2019). The WHR standard level is 0.67–0.8, according to the WHO Guidelines (Anonymous, 2016). Higher WHR over 0.8 is associated with increased health risk (metabolic disorders, diabetes mellitus, and cardiovascular diseases). Analysis of the mean WHR (waist to hip ratio) showed significant differences ($p = 0.055$) between clinical and control groups. Health risk assessment for the middle age population can be made using WHR as a specific indicator for cardiovascular disease and mortality (Quaye *et al*., 2019). The average WHR in the clinical group was 0.8 ± 0.07 (range 0.74–0.86), and in the control group 0.83 ± 0.08 (mean 0.7–0.86). The skinfold thickness measurement test (SFT) is a classic anthropometric method for determining body composition and body fat percentage; it is a non-invasive method of body fat estimation (Rodriguez *et al*., 2005). The skinfold thickness is measured precisely at several standardised sites (skinfolds above *m. biceps brachii,* above *m. triceps brachii*, and also subscapular and suprailiac skinfolds are measured). We found significantly lower skin fold thickness in the clinical group at the standardised sites above *m. biceps brachii* ($p = 0.012$), above *m. triceps brachii* ($p = 0.011$), and at subscapular ($p = 0.091$) and suprailiac ($p = 0.031$) sites.

Body composition changes can be associated with increased risk of development oncological pathology — breast cancer.

The analysis of anthropometric parameters for women in the postmenopausal age in the clinical group (breast cancer diagnosis at the first stage and second stage, before treatment) and women in a control group (healthy women) revealed significant differences in the waist-hip index (WHR), despite different sample sizes. WHR was slightly lower in the clinical group, as was thickness of the skin fold over *m. triceps brachii, m. biceps brachii,* and at subscapular and suprailiac sites. Comparative analysis of body composition in the clinical and control group enriching understanding of cancer biology and aetiology.

REFERENCES

Anonymous (2016). World Health Statistics. World Health Organization. https://www.who.int/gho/publications/world_health_statistics/2016/EN_WHS2016_TOC.pdf (accessed 10.05.2021).

Brown, J. C., Cespesdes, F. E. M., Caan, B. J. (2019). The evolution of body composition in oncology – epidemiology, clinical trials, and the future of patient care: Facts and numbers. *J. Cachexia Sarcopenia Muscle*, **1**, 1200–1208.

Cederholm, T., Jensen, G. L., Correia, M. I. T. D., Gonzalez, M. C., Fukushima, R., Higashiguchi, T., Compher, C. (2019). GLIM criteria for the diagnosis of malnutrition: A consensus report from the global clinical nutrition community. *J. Cachexia Sarcopenia Muscle*, **10** (1), 207–217.

Chang, Y., Guo, X., Chen, Y., Guo, L., Li, Z., Yu, S., Yang, H., Sun, Y. (2015). A body shape index and body roundness index: Two new body indices to identify diabetes mellitus among rural populations in northeast China. *BioMed Central Publ. Health*, **15** (1), 794.

Cruz-Jentoft, A. J., Bahat, G., Bauer, J., Boirie, Y., Bruyére, O., Cederholm, T., Schols, J. (2019). Sarcopenia: Revised European consensus on definition and diagnosis. *Age Ageing,* **48** (1), 16–31.

de Sousa, N. C., MarquesI, F. R. D. M., Pires, G. A. R., da Cruz Scardoelli, I. M. G., da Silva Rêgo, A., Radovanovic I. C. A. T. (2020). Conicity index in people with hypertension followed in the Brazil's Family Health Strategy. *Revista Brasileira de Enfermagem,* **73** (5), e20190484.

Dhana, K., Koolhas, C., Schoufour, J., Rivadeneira, F., Hofman, A., Kavousi, M., (2016). Association of anthropometric measures with fat and fat-free mass in the elderly: The Rotterdam study. *Maturitas,* **88**, 96–100.

Eickemberg, M., Amorim, L. D. A. F., Chagas de Almeida, M. C., Pitanga, F. J. G., Lećo de Aquino, E. M., Mendes da Fonseca, M. J., Matos, S. M. A. (2020). Abdominal obesity in ELSA-Brasil (Brazil's Longitudinal Study of Adult Health): Construction of a latent gold standard and evaluation of the accuracy of diagnostic indicators. *Ciência Saúde Coletiva*, **25** (8), 2985–2998.

Ehrampoush, E., Arasteh, P., Homayounfara, R., Cheraghpour, M., Alipour, M., Mehdi, M., Hadibarhaghtalab, M., Davoodi, S. H., Askari A., Razaz, J. M. (2017). New anthropometric indices or old ones: Which is the better predictor of body fat? *Diabetes Metab. Syndr. Clin. Res. Rev.,* **11** (4), 257–263.

Ferlay, J., Steliarova-Foucher, E., Lortet-Tieulent, J., Rosso, S., Coebergh, J. W., Comber, H., Forman, D., Bray, F. (2013). Cancer incidence and mortality patterns in Europe: Estimates for 40 countries in 2012. *Eur. J. Cancer*, **49** (6), 1374–1403.

Godinho-Mota, J. C. M., Gonçalves L.V., Soares L. R., Mota, J. F., Martins, K. A., Freitas-Junior, I., Freitas-Junior, R. (2018). Abdominal adiposity and physical inactivity are positively associated with breast cancer: A case-control study. *BioMed Res. Int.,* **2018**, 4783710.

He, S., Chen, X. (2013). Could the new body shape index predict the new onset of diabetes mellitus in the Chinese population? *PLoS One*, **8** (1), e50573.

Hilmi, M., Jouinot, A., Burns, R., Pigneur, F., Mounier, R., Gondin, J, Goldwasser, F. (2019). Body composition and sarcopenia: The next-generation of personalized oncology and pharmacology? *Pharmacol. Ther.,* **196**, 135–159.

Krakauer, N. Y., Krakauer, J. C. (2012). A new body shape index predicts mortality hazard independently of body mass index. *PLoS One*, **7** (7), e39504.

Krakauer, N. Y., Krakauer, J. C. (2014). Expansion of waist circumference in medical literature: Potential clinical application of a body shape index. *J. Obes. Weight Loss Ther.,* **4**, 216.

Majeed, W., Aslam, B., Javed, I. (2014). Breast cancer: Major risk factors and recent developments in treatment. *Asian Pac. J. Cancer Prev.,* **15** (8), 3353–3358.

Matthews, S. B., Thompson, H. J. (2016). The obesity-breast cancer conundrum: An analysis of the issues. *Int. J. Mol. Sci*., **17** (6), 989.

Quaye, L., Owiredu, W. K. B. A., Amidu, N., Dapare, P. P. M., Adams, Y. (2019). Comparative abilities of Body Mass Index, Waist Circumference, Abdominal Volume Index, Body Adiposity Index, and Conicity Index as predictive screening tools for metabolic syndrome among apparently healthy Ghanaian adults. *J. Obesity*, **2019**, 8143179.

Roriz, A. K. C., Passos, L. C. S., de Oliveira, C. C., Eickemberg, M., Moreira, P. D., Ramos, L. B. (2017). Anthropometric clinical indicators in the assessment of visceral obesity: An update. *Nutricion Clinica y Dietetica Hospitalaria,* **36** (2), 168–179.

Shah, N. R., Braverman, E. R. (2012). Measuring adiposity in patients: The utility of body mass index (BMI), percent body fat, and leptin. *PLoS One*, **7** (4), e33308.

Thomas, D. M., Bredlau, C., Bosy-Westphal, A. (2013). Relationships between body roundness with body fat and visceral adipose tissue emerging from a new geometrical model. *Obesity*, **21** (11), 2264–2271.

Vander-Walde, A., Hurria, A. (2012). Early breast cancer in the older woman. *Clinics Geriat. Med.,* **28** (1), 73–91.

Zaccagni, L., Barbieri D., Gualdi-Russo, E. (2014). Body composition and physical activity in Italian university students. *J. Transl. Med.,* **12** (1), 120.

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ANTROPOMETRISKO PARAMETRU SALĪDZINOŠAIS VĒRTĒJUMS KRŪTS VĒŽA PACIENTĒM UN VESELĀM SIEVIETĒM POSTMENOPAUZES PERIODĀ

Statistikas dati liecina, ka 2018. gadā 1266 sievietēm Latvijā diagnosticēts krūts vēzis. Pēc Pasaules veselības organizācijas rekomendācijām antropocentrisko rādītāju vērtējums tiek izmantots onkoloģisko patoloģiju riska novērtējumam. Mūsu pētījuma mērķis bija noteikt antropometrisko rādītāju un indeksu atšķirības postmenopauzes vecumā klīniskajā grupā (n = 44) ar agrīna krūts vēža diagnozi (pirmā un otrā stadija) pirms ārstniecisko pasākumu sākuma, un kontroles grupā (n = 181). Tika noteikti antropometriskie radījumi (ķermeņa garums, ķermeņa masa, apkārtmēri un ādas kroku biezums) un indeksi (ķermeņa masas indekss, vidukļa–gurnu indekss, ķermeņa masas un auguma indekss, ķermeņa formas indekss, ķermeņa apaļuma indekss, ķermeņa koniskuma indekss). Iegūto datu statistiskai analīzei tika izmantota IBM SPSS Statistiskā programma, 22.0 Versija, *Shapiro–Wilk* tests, *Mann–Whitney* tests un noteikta *p* vērtība. Neraugoties uz to, ka bija skaitliski maza klīniskā grupa, tika noteiktas statistiski ticamas zemākas vērtības vidukļa–gurnu indeksam un ādas kroku biezumam virs *m. biceps brachii, m. triceps brachii*, kā arī subskapulārās un suprailiakālās ādas kroku biezumam, salīdzinot ar kontroles grupu.