Anthropometric and Somatotype Characteristics of Women with Breast Cancer

Características Antropométricas y Somatotipos de Mujeres con Cáncer de Mama

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SUMMARY: Inconsistent data are available on the relation between breast cancer, adiposity, body size and somatotype. The aim of our study was to compare anthropometric characteristics, body composition and somatotype between breast cancer patients and healthy controls. Study group consisted of 106 breast cancer patients while control group consisted of 100 healthy women who underwent 29 anthropometric measurements. Women with breast cancer expressed more male anthropometric features like higher stature (160.75±6.91 vs. 158.17±4.89 cm, p=0.020), shorter trunk (sitting height in premenopausal: 84.94±5.07 vs. 88.50±3.84 cm, p=0.001 and postmenopausal women: 81.96±6.08 vs. 85.19±3.36 cm, p=0.001), narrower hips (29.20±3.78 vs. 32.24±1.78 cm, p=0.000), higher biepicondylar diameter of humerus (premenopausal: 6.64±0.71 vs. 6.31±0.42 cm, p=0.012; postmenopausal: 6.95±0.63 vs. 6.54±0.49 cm, p=0.000), larger upper- and forearm as well as upper thigh circumferences followed by lower biceps and higher thigh skinfold thicknesses. They also had significantly lower endomorphy (premenopausal: 5.84±1.78 vs. 6.55±0.96, p=0.027; postmenopausal: 6.89±1.52 vs. 7.37±0.86, p=0.035) and significantly higher ectomorphy (premenopausal: 2.05±1.30 vs. 1.41±0.99, p=0.018; postmenopausal: 1.06±0.90 vs. 0.68±0.56, p=0.007), as well as higher mesomorphy only in postmenopausal women (6.10±2.04 vs. 5.37±1.34, p=0.022). Most represented somatotype among breast cancer patients was endomorph-mesomorph while the most healthy controls were mesomorphic endomorph. Android body type increases the risk of development of breast cancer. Indicators of skeletal dimensions, muscle volume and peripheral adiposity had better predictive value over markers of central and overall adiposity.

KEY WORDS: Breast cancer; Obesity; Anthropometry; Somatotype.

INTRODUCTION

Breast cancer represents one of the major health problems worldwide, since it has been the most common malignant disease in women. The number of newly diagnosed breast cancer patients in 2012 was 1.67 million of women which was 20 % more when compared to year 2008 (IARC, 2015). According to the data given in the National Guideline of Good Clinical Practice for Breast Cancer Diagnose and Treatment the average standardized incidence rate of breast cancer in central Serbia in the period from 1999 to 2009 was 60.8/100000 and the mortality rate was 20.2/100000 (National Guideline of Good Clinical Practice for Breast Cancer Diagnose and Treatment, 2013).

Besides well established risk factors such as female sex, age, positive family history, BRCA 1 and BRCA 2 gene mutations, previously diagnosed breast cancer or proliferative breast changes (including atypical hyperplasia), greater density of breast gland tissue, obesity, hormonal factors causing early menarche and late menopause or contraception use, and exposure to radiation especially during puberty, some researchers have tried to determine specific body constitution susceptible to breast cancer development (Harvie *et al*., 2003; Lahmann *et al*., 2004; Tehard & Clavel-Chapelon, 2006; Rose &Vona-Davis, 2010; Amadou *et al*., 2013b; Pacholczak *et al*., 2016). The majority of these studies highlighted obesity as a risk factor, while others focused on height, leg length and overall body size (van den Brandt *et al*., 2000; Friedenreich, 2001; Lahmann *et al*.; Fagherazzi *et al*., 2012; Pacholczak *et al*.). Obesity has been considered to be a risk factor for breast cancer in postmenopausal women while in premenopausal women it could have a protective role (Bulun *et al*., 1994; Ursin *et al*., 1995; van den Brandt *et al*.; Lorincz & Sukumar, 2006; Rose & Vona-Davis;

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Zunurain *et al*., 2016). The relationship between obesity and breast cancer in postmenopausal women has been explained by the fact that adipose tissue is the main place for peripheral conversion of androgen precursor to estradiol under the influence of aromatase. Obesity-associated low-grade inflammation and adipose tissue dysfunction that includes alterations in adipocytokines production promote the development and cancer progression (Divella *et al*., 2016). Only few studies have analyzed body constitution of women with breast cancer highlighting their android characteristics (Butova *et al*., 2005; Ronco *et al*., 2008), while two studies dealt with their somatotype characteristics (Butova *et al*.; Ronco *et al*.).

In view of the breast cancer as a global public health concern, the aim of our study was to compare the anthropometric characteristics, body composition and somatotype between women diagnosed with breast cancer and healthy women and to define the specific anthropometric profile of women with breast cancer.

MATERIAL AND METHOD

The study group included 106 women diagnosed with breast cancer aged 29-86 years (59.05±11.69 years), while control group consisted of 100 healthy women aged 19-82 years (51.10±15.73 years). Women with breast cancer were measured at the Oncology Institute of Vojvodina in Sremska Kamenica prior to surgical tumor removal, while the healthy women were recruited among the medical staff and students of the Faculty of Medicine Novi Sad. All breast cancer patients were newly diagnosed who did not receive chemo-, radio- or hormonal therapy. The research was approved by Ethical Committee and Expert Council of Oncology Institute of Vojvodina in Sremska Kamenica. All the respondents were given the detailed explanation about the purpose of the research and had signed the informed consent.

All participants were divided in two groups according to their menopausal status: premenopausal and postmenopausal. Anamnestic obtained data on the absence of menstrual bleeding for more than a year was used as criteria for menopause. Research group included 30 premenopausal and 76 postmenopausal women, while con-trol group counted 46 premenopausal and 54 postmenopausal women. Histopathological examination of the surgically removed tissue revealed the presence of invasive ductal carcinoma in 84.91 %, invasive lobular carcinoma in 10.38 %, mixed ductal and lobular carcinoma in 2.83 % and phyllodes tumor in 1.88 % of women with breast cancer.

Anthropometric measurements

All subjects underwent 29 anthropometric measurements in order to assess longitudinal and transverse dimensionality of the body, body composition, nutritional status, body fat distribution and somatotype. Standing body height and sitting body height were used as parameters of longitudinal dimensionality of the body, while shoulder and hip width and bone diameters were measured to assess transverse dimensionality. Body weight, fat mass, body mass index (BMI), body adiposity index (BAI), body circumferences, skinfold thicknesses and sagittal abdomi-nal diameter were used to assess body composition and fat distribution pattern.

Body height (standing and sitting) were measured by GPM anthropometer (Sieber & Hegner, Zürich, Switzerland) to the nearest 0.1 cm. Body height was measured in an upright position as a distance between the vertex and the floor when the head was placed in Frankfurt plane. Sitting height was measured from the sitting platform to the vertex when the head was held in the Frankfurt plane. Relative trunk length (Cormic index) was calculated as the ratio between sitting and standing height.

Measurements of body girths included upper arm (flexed and relaxed), forearm, thigh, calf, chest, waist and hip girth were done using Holtain flexible but non-stretchable tape (Holtain Ltd, Croswell, UK) to the nearest 0.1 cm. Upper arm girth was measured at the level of mid-acromiale-radiale with flexed and relaxed elbow. Forearm girth was measured as maximal girth of the forearm approximately 5 cm below the elbow. Neck girth was measured immediately superior to the thyroid cartilage while the head was in Frankfurt plane. Thigh girth was measured as upper (between the upper and middle third of thigh), middle (at mid-trochanterion-tibiale laterale site) and lower (just above the knee). Calf girth was measured as the greatest girth of the calf. Chest girth was measured at the level of mesosternale. Waist girth was measured at the level midway between the lowest point of the rib margin and the highest point of the iliac crest. Hip girth was measured at the level of the greatest posterior protuberance of the buttocks which corresponded anteriorly to the level of symphysis pubis.

Harpenden skinfold caliper (Holtain Ltd, Croswell, UK) to the nearest 0.2 mm was used for measuring the thicknesses of following skinfolds: triceps, biceps, anterior and lateral forearm, subscapular, supraspinal, abdominal, thigh and calf. All measurements of the skinfold thicknesses were done on the right side of the body in triplicate and average score was calculated. Triceps skinfold thickness was measured in the vertical direction at the level halfway

between the acromion and olecranon. Biceps skinfold thickness was measured in the vertical direction at the same level where triceps skinfold was measured just at the front side of the upper arm. Anterior and lateral forearm skinfold thicknesses were measured at the upper third of front and lateral side of forearm. Subscapular skinfold thickness was measured below the inferior angle of the scapula in an oblique direction downwards and laterally at 45 degrees. Supraspinal skinfold thickness was measured above the anterior superior iliac spine on a line to the anterior axillary margin and on a diagonal line going downwards and medially at 45 degrees. Abdominal skinfold thickness was measured as a vertical fold 3 cm lateral and 1 cm below umbilicus. Thigh skinfold thickness was a vertical fold measured on the middle third of front side of thigh. Calf skinfold thickness was measured in the vertical direction on the medial side of the leg, at the level of the maximum calf girth.

Biepicondylar diameter of humerus and biepicondylar diameter of femur were measured using Holtain bicondylar caliper (Holtain Ltd, Croswell, UK) to the nearest 0.1 cm, sagittal abdominal diameter was measured using Holtain-Kahn abdominal caliper (Holtain Ltd, Croswell, UK), to the nearest 0.1 cm, while biacromial shoulder width and hip width were measured by upper section of anthropometer. Biepicondylar diameter of humerus and femur were measured between lateral and medial epicondylus of humerus and femur. Shoulder width was measured between the most lateral points on the acromion process (acromiale) and hip width was measured as the most lateral points on the iliac crests (bi-iliocristal diameter). Sagittal abdominal diameter was measured as an anteroposterior diameter of abdomen at the level of iliac crests.

In order to assess the nutritional status, body mass index (BMI) and body adiposity index (BAI) were calculated. Body mass index was calculated as the ratio of the weight of the body in kilograms to the square of its height in meters, while body adiposity index (BAI) was calculated using the equation given by Bergman *et al.* (2011). Bioelectric impedance analyzer Omron BF-511 (Omron Matsusaka Co, Ltd, Matsusaka, Japan) was used for estimation of body fat percent (BF %) and body fat mass (kg).

In the assessment of somatotype, the Heath & Carter method was used (Carter & Heath, 1990). Standard procedures were used for endo-, meso- and ectomorphy calculations and somatotype was defined according to the position of calculated values of endo-, ecto- and mesomorphy on the somatochart (Eston & Reilly, 2001).

Fat distribution was assessed according to the values of skinfold thicknesses and body circumferences and following ratios: waist to hip ratio (WHR), waist to stature ratio (WSR), waist to thigh ratio (WTR), abdominal diameter index (ADI) - ratio of the sagittal abdominal diameter and middle girth of the thigh, and body shape index (BSI) derived from waist girth adjusted for height and weight (Krakauer & Krakauer, 2012).

The results were statistically processed in software program SPSS 24.0. Differences between case and control groups were determined by multivariate analysis of variance (MANOVA). Data in the text and tables are presented as mean values±SD. Differences were considered statistically significant if p level was less than 0.05.

RESULTS

Reproductive characteristics of women in case and control group are represented in the Table I. Premenopausal women diagnosed with breast cancer had significantly higher number of pregnancies compared to the controls (2.37±1.50 vs. 1.57±1.21, p=0.012).

Table I. Comparison of case and control group on reproductive characteristics.

	Premenopausal women Mean (SD)			Postmenopausal women Mean (SD)		
	Cases	Controls	p	Cases	Controls	p
Age at menarche	12.87 (1.75)	13.39 (1.29)	0.137	13.67 (1.35)	13.64 (1.27)	0.906
Age at menopause	-	-	-	49.43 (2.75)	49.44 (3.84)	0.982
Duration of reproductive life span	-	-	-	35.76 (4.91)	35.99 (4.01)	0.777
Number of pregnancies	2.37 (1.50)	1.57 (1.21)	0.012*	2.73 (1.95)	2.35 (1.40)	0.222
Number of labors	1.57 (0.94)	1.22 (0.99)	0.128	1.56 (0.87)	1.74 (0.71)	0.212

The results of comparison between the case and control group on the anthropometric parameters of body dimensionality are displayed in the Table II. Standing body height was significantly greater in the postmenopausal women with breast cancer (160.75±6.91 vs. 158.17±4.89 cm, p=0.020), while the sitting body height was significantly lesser in all breast cancer patients (premenopausal: 84.94±5.07 vs. 88.50±3.84 cm, p=0.001; postmenopausal: 81.96±6.08 vs. 85.19±3.36 cm, p=0.001), as well as the Cormic index (premenopausal: 51.06±3.09 vs. 54.03±1.05, p=0.000; postmenopausal: 50.99±3.08 vs. 53.85±1.01, p=0.000).

Among parameters of transverse dimensionality women with breast cancer had significantly larger diameter of humerus than healthy controls (premenopausal: 6.64±0.71 vs. 6.31±0.42 cm, p=0.012; postmenopausal: 6.95±0.63 vs. 6.54±0.49 cm, p=0.000), while premenopausal breast cancer patients had significantly narrower hips (29.20±3.78 vs. 32.24±1.78 cm, p=0.000) and smaller biepicondylar diameter of femur (9.98±0.63 vs. 10.28±0.54 cm, p=0.029) than controls.

Values of body composition parameters in the case and control group are given in the Table III. Both, premenopausal and postmenopausal women with breast cancer had significantly lower BMI values when compared to controls (premenopausal: 23.56±3.54 vs. 26.03±5.16 kg/m^2, p=0.025; postmenopausal: 27.60±5.19 vs. 29.91±4.59 kg/m^2, p=0.010). Postmenopausal women with breast cancer had significantly lower BAI values than controls (33.53±5.74 vs. 36.40±5.74 kg/m^2, p=0.005).

Premenopausal and postmenopausal breast cancer patients had significantly higher relaxed and flexed upper arm circumference (relaxed: premenopausal: 26.93±3.28 vs. 24.53±3.29 cm, p=0.003; postmenopausal: 28.90±3.65 vs. 25.47±3.21 cm, p=0.000; flexed: premenopausal: 27.83±3.38 vs. 25.07±3.34 cm, p=0.001; postmenopausal: 29.79±3.97 vs. 26.09±3.29 cm, p=0.000), forearm circumference (premenopausal: 23.78±1.95 vs. 21.91±2.08 cm, p=0.000; postmenopausal: 24.54±2.66 vs. 22.71±2.08 cm, p=0.000), and upper thigh circumference (premenopausal: 55.11±5.05 vs. 51.24±5.51 cm, p=0.003; postmenopausal: 54.77±6.43 vs. 51.59±4.39 cm, p=0.002). Hip circumference was nearly significantly lower only in postmenopausal breast cancer patients (104.68±9.50 vs. 108.02±9.95 cm, p=0.055), and lower thigh circumference was significantly lower in premenopausal breast cancer patients (41.88±3.27 vs. 44.02±3.86 cm, p=0.014).

Thigh skinfold thickness was significantly higher in breast cancer patients (premenopausal: 39.74±11.23 vs. 31.60±5.77 mm, p=0.000; postmenopausal: 41.18±10.89 vs. 33.21±6.86 mm, p=0.000), while abdominal skinfold thickness was significantly lower (premenopausal: 24.44±9.26 vs. 29.73±6.47 mm, p=0.004; postmenopausal: 30.63±10.20 vs. 35.02±6.33 mm, p=0.006), as well as supraspinal (premenopausal: 17.50±8.32 vs. 23.53±6.23 mm, p=0.001; postmenopausal: 21.76±8.47 vs. 28.47±5.60 mm, p=0.000) and biceps skinfold thicknesses (premenopausal: 14.47±6.05 vs. 18.87±5.47 mm, p=0.002.

Among anthropometric indicators of central fat distribution only WTR was significantly lower in breast cancer women (premenopausal: 1.45±0.13 vs. 1.59±0.27, p=0.012; postmenopausal: 1.64±0.30 vs. 1.79±0.26, p=0.003).

Table IV represents the values of somatotype components in the case and control group. Women with breast cancer had significantly lower endomorphy (premenopausal: 5.84±1.78 vs. 6.55±0.96, p=0.027; postmenopausal: 6.89±1.52 vs. 7.37±0.86, p=0.035) and significantly higher ectomorphy (premenopausal: 2.05±1.30 vs. 1.41±0.99, p=0.018; postmenopausal: 1.06±0.90 vs. 0.68±0.56, p=0.007). Mesomorphy was significantly higher only in the group of postmenopausal women (6.10±2.04 vs. 5.37±1.34, p=0.022).

Table II. Comparison of case and control group on anthropometric parameters of longitudinal and transversal skeletal dimensionality.

	Premenopausal women Mean (SD)			Postmenopausal women Mean (SD)		
	Cases	Controls	p	Cases	Controls	p
Parameters of longitudinal dimensionality						
Standing body height (cm)	166.49 (6.00)	163.82	0.088	160.75	158.17	0.020*
Sitting body height (cm)	84.94 (5.07)	88.50 (3.84)	0.001*	81.96 (6.08)	85.19 (3.36)	0.001*
Sitting/ standing height (Cormic index)	51.06 (3.09)	54.03 (1.05)	0.000*	50.99 (3.08)	53.85 (1.01)	0.000*
Parameters of transverse dimensionality						
Shoulder width (cm)	34.65 (3.06)	35.42 (1.96)	0.188	35.73 (3.18)	35.98 (2.39)	0.761
Hip width (cm)	29.20 (3.78)	32.24 (1.78)	0.000*	32.94 (4.19)	32.38 (2.47)	0.382
Biepicondylar diameter of humerus (cm)	6.64 (0.71)	6.31 (0.42)	0.012*	6.95 (0.63)	6.54 (0.49)	0.000*
Biepicondylar diameter of femur (cm)	9.98 (0.63)	10.28 (0.54)	0.029*	10.45 (1.17)	10.36 (0.45)	0.571

Table III. Body composition parameters in the case and control group.

	Premenopausal women Mean (SD)			Postmenopausal women Mean (SD)		
	Cases	Controls	p	Cases	Controls	p
Body weight (kg)	65.10 (8.67)	70.13 (15.72)	0.114	71.25 (13.70)	74.78 (11.55)	0.126
BMI (kg/m^2)	23.56 (3.54)	26.03 (5.16)	0.025*	27.60 (5.19)	29.91 (4.59)	0.010*
Fat mass (%)	29.68 (6.40)	30.54 (7.27)	0.601	38.54 (6.08)	40.09 (5.27)	0.135
Fat mass (kg)	20.02 (6.64)	22.43 (10.04)	0.250	27.92 (8.59)	30.46 (7.70)	0.085
BAI	28.82 (4.67)	30.66 (5.65)	0.143	33.53 (5.74)	36.40 (5.74)	0.005*
Circumferences (cm)						
Upper arm relaxed	26.93 (3.28)	24.53 (3.29)	0.003*	28.90 (3.65)	25.47 (3.21)	0.000*
Upper arm flexed	27.83 (3.38)	25.07 (3.34)	0.001*	29.79 (3.97)	26.09 (3.29)	0.000*
Forearm	23.78 (1.95)	21.91 (2.08)	0.000*	24.54 (2.66)	22.71 (2.08)	0.000*
Neck	32.63(1.34)	32.65 (1.84)	0.948	35.10 (3.03)	34.15 (2.28)	0.053
Chest	86.06 (6.16)	86.04 (7.31)	0.994	91.70 (8.00)	91.76 (7.05)	0.965
Waist	79.76 (10.18)	81.11 (15.95)	0.683	90.15 (13.41)	92.11 (13.40)	0.412
Hip	100.31 (7.83)	102.02 (12.79)	0.514	104.68 (9.50)	108.02 (9.95)	0.055
Thigh - upper	55.11 (5.05)	51.24 (5.51)	0.003*	54.77 (6.43)	51.59 (4.39)	0.002*
Thigh -middle	48.22 (3.97)	47.59 (4.28)	0.517	48.23 (6.13)	47.91 (3.57)	0.731
Thigh - lower	41.88 (3.27)	44.02 (3.86)	0.014*	42.76 (5.95)	44.07 (3.33)	0.144
Calf	35.79 (2.92)	35.13 (2.50)	0.299	35.72 (3.62)	35.52 (1.80)	0.713
Skinfold thicknesses (mm)						
Subscapular	19.52 (8.75)	21.16 (4.91)	0.301	23.86 (7.70)	23.11 (5.14)	0.531
Abdominal	24.44 (9.26)	29.73 (6.47)	0.004*	30.63 (10.20)	35.02 (6.33)	0.006*
Supraspinal	17.50 (8.32)	23.53 (6.23)	0.001*	21.76 (8.47)	28.47 (5.60)	0.000*
Triceps	24.32 (8.39)	23.17 (4.35)	0.439	26.93 (7.98)	25.45 (3.85)	0.210
Biceps	14.47 (6.05)	18.87 (5.47)	0.002*	18.14 (8.23)	20.66 (6.08)	0.058
Lateral forearm	13.24 (5.96)	12.58 (3.30)	0.536	13.18 (5.72)	13.60 (4.22)	0.647
Anterior forearm	10.25 (4.16)	10.56 (3.49)	0.727	12.01 (4.22)	11.48 (3.34)	0.439
Thigh	39.74 (11.23)	31.60 (5.77)	0.000*	41.18 (10.89)	33.21 (6.86)	0.000*
Calf	26.52 (9.16)	23.50 (4.17)	0.054	26.81 (9.06)	24.43 (4.98)	0.083
Diameters (cm)						
SAD	19.31 (2.50)	19.58 (2.39)	0.647	21.76 (4.02)	21.51 (2.54)	0.688
Ratios						
WHR	0.80 (0.06)	0.79 (0.07)	0.694	0.85 (0.12)	0.85 (0.08)	0.949
WHtR	0.49 (0.07)	0.50 (0.09)	0.725	0.55 (0.11)	0.58 (0.08)	0.107
WTR	1.45 (0.13)	1.59 (0.27)	0.012*	1.64 (0.30)	1.79 (0.26)	0.003*
SADH	0.12 (0.02)	0.12 (0.01)	0.300	0.13 (0.03)	0.14 (0.02)	0.816
ADI	0.40 (0.04)	0.41 (0.04)	0.292	0.45 (0.08)	0.45 (0.06)	0.752
BSI	0.07 (0.01)	0.07 (0.01)	0.056	0.08 (0.01)	0.07 (0.01)	0.089

Table IV. Comparison of case and control group on somatotype components.

	Premenopausal women Mean (SD)			Postmenopausal women Mean (SD)		
	Cases	Controls	p	Cases	Controls	p
Endomorphy	5.84 (1.78)	6.55 (0.96)	0.027*	6.89 (1.52)	7.37 (0.86)	0.035*
Mesomorphy	4.50 (1.66)	4.19 (1.24)	0.356	6.10 (2.04)	5.37 (1.34)	0.022*
Ectomorphy	2.05 (1.30)	1.41 (0.99)	0.018*	1.06 (0.90)	0.68 (0.56)	0.007*

Most represented somatotype among breast cancer patients was mesomorph-endomorph while the most healthy controls was mesomorphic endomorph (Figs. 1 and 2).
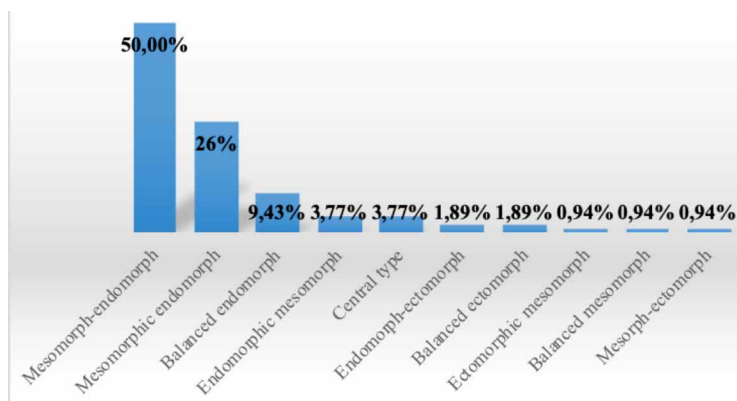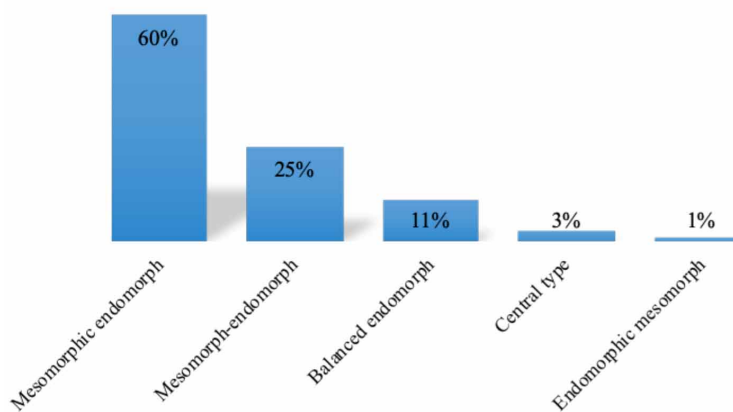
Fig. 1. Somatotype categories in the case group.

Fig. 2. Somatotype categories in the control group.

DISCUSSION

This study was performed in order to compare anthropometric characteristics, body composition and somatotype of women suffering from breast cancer and healthy women and to define specific body constitution of women with breast cancer. Our results showed that breast cancer patients were taller with shorter trunk and had different distribution of adipose tissue comparing to healthy controls. The most prevalent somatotype among breast cancer patients was mesomorph-endomorph.

The majority of previous research studies focused on the relationship between breast cancer and obesity. It is well known that overall obesity is strongly associated with breast cancer development in postmenopausal women (Hunter & Willett, 1993; Garrisi *et al.*, 2012; Biglia *et al.*, 2013) opposite to the results of studies in premenopausal women (Hunter & Willett; Ursin *et al.*; John *et al.*, 2011, 2015). This might be explained by the fact that breast adipose

tissue inflammation in obese postmenopausal women is followed with augmented production of androstenedione and aromatase activity contributing to estradiol production and disturbed balance between estradiol and progesterone blood concentration (O'Neill *et al.*, 1988; Bulun *et al.*, 1993; Baglietto *et al.*, 2009) that could cause proliferation of oestrogen dependent tissue such as breast and endometrium and lead to the development of oestrogen dependent tumours in menopause (Morris *et al.*, 2011; Subbaramaiah *et al.*, 2012). In accordance with previously mentioned, the study of Huang *et al.* (1997) found an increase of 12 % in the risk of breast cancer development in postmenopausal women for every rise of BMI for 5 kg/m^2. However, in premenopausal women risk of breast cancer development has been shown not to be strongly correlated with obesity (Amadou *et al.*, 2013a) which could be justified with reduced oestrogen level due to its storage in adipose tissue, more frequent occurrence of anovulatory and longer menstrual cycles or lower level of progesterone in obese premenopausal women (Henderson *et al.*, 1985; Harvie *et al.*; Tehard & Clavel-Chapelon; Dowsett & Folkerd, 2015). The studies of Suzuki *et al.* (2009), Rose & Vona-Davis and White *et al.* (2015) confirmed this relationship finding that obesity in premenopausal women increases the risk of breast cancer for only 20 % in comparison to postmenopausal women where that risk was estimated to be 82 % (Suzuki *et al.*) or even reduced the risk for 7 % (White *et al.*). Moreover, Lahmann *et al.*, demostrated that BMI in premenopausal women negatively correlated to the risk of breast cancer, but it was not statistically significant. Our study showed significantly lower BMI in both, pre- and postmenopausal breast cancer patients. We believe that small number of obese premenopausal women in our research and limited BMI range could elucidate our inverse relationship between BMI and cancer risk among our participants since in the study van den Brandt *et al.*, was reported that decreased breast cancer risk in obese premenopausal women was limited predominantly to the women whose BMI was higher than 31 kg/m^2. On the other hand, as there were no differences in body weight and overall fat mass, differences in BMI in our study obviously have resulted from significantly different body height values. Our results did not confirm relationship between obesity and breast cancer but they are in line with results of studies by van de Brandt, Lahmann and Friendereich that showed that among anthropometric indicators body height is the factor, most often associated with increased risk of breast cancer development in postmenopausal women (van den Brandt *et al.*; Friedenreich;

Lahmann *et al.*). In our research difference in body height was shown to be statistically significant since postmenopausal women suffering from breast cancer were about 2.5 cm taller than healthy women. Additionally, ectomorphy was also higher in all breast cancer patients pointing to higher body linearity. According to the data for the population of Vojvodina (Pavlica *et al.*, 2010a,b) where this research was conducted, average body heights of women of different ages are: 164.6±6.7 cm (20-29y), 163.9±6.0 (30-39y), 161.6±6.2 cm (40-49 y), 159.6±6.0 cm (50-59 y) and 157.3±7.5 cm (>60 y). These results correspond with values in our control group.

In the large study of Lahmann *et al.* which included 73542 premenopausal and 103344 postmenopausal women from 9 European countries noticed that body height was also higher in women with breast cancer (Friedenreich). It is supposed that the association between height and breast cancer risk could be clarified by the fact that body height sets the number of the fetal ductal stem cells in breasts (Trichopoulos & Lipman, 1992) and that nutrition, besides determining the body height, has impact on the release of growth hormone and IGF-1 level consequently effecting mammary gland development and carcinogenesis (Stoll, 1992). In our study, measurements of the standing and sitting height as well as the values of Cormic index indirectly speak in favor of greater leg length in pre- and postmenopausal breast cancer women. This finding was not unexpected since the leg length is supposed to be the best indicator of organism exposure to growth hormone effect during early period of life and different nutritional and other external factors and was in accordance with Gunnell *et al.* (2001), who pointed to a positive correlation between greater stature and leg length with prostate, testicular and premenopausal breast cancer possibly explained by higher level of IGF-1 in these people responsible for apoptosis control and carcinogenesis. Moreover, studies of Mellemkjær *et al.* (2012) and Fagherazzi *et al.* found leg length to be important risk factor in breast cancer development. In accordance with the results of Lahmann *et al.*, we found that the ratio between sitting and standing height was lower in cases than controls (Friedenreich). In our study among the parameters of skeletal dimensions, humerus diameter was found to be significantly greater in women with breast cancer. Pacholczak *et al.* in their study revealed similar results, finding larger humerus diameter in pre- and postmenopausal women breast cancer patients. In the same study it was hypothesized that in overweight postmenopausal women with breast cancer, higher concentrations of oestrogen during lifetime causes earlier bone maturation, as well as reduction in bone resorption,   which could be responsible for greater bone diameters in these women. In addition to

this, there is also the effect of androgens which can induce periosteal bone expansion (Vanderschueren *et al.*, 2004). On the other hand, our results showed lower diameter of femur and hip width in premenopausal breast cancer patients.

Besides BMI frequently used as indicator of overall obesity, waist circumference and WHR pointing to central adiposity related to hormonal and metabolic changes, are believed to be better predictors of breast cancer risk (Huang *et al.*, 1999). Although White *et al.* confirmed this relationship finding positive correlation between waist circumference and breast cancer risk, in our research this indicator was not significantly higher in breast cancer patients and in the study of Tehard & Clavel-Chapelon the correlation was even negative in pre- and only weakly positive in postmenopausal women. Besides that, while in the study of Pacholczak *et al.*, WHR in premenopausal women was found to be significantly higher in study than control group in our study values of WHR in premenopausal women did not show significant differences between study and control group. Additionally, among postmenopausal women, neither the previously mentioned study nor our study significantly differ in WHR (Pacholczak *et al.*). Furthermore, our results showed that thicknesses of supraspinal and abdominal skinfolds known as the truncal adiposity indicators, were significantly higher in healthy subjects compared to study group, while Pacholczak *et al.* did not spot significant difference in thickness of supraspinal skinfold (Pacholczak *et al.*). Surprisingly, in our study we did not reveal the expected results indicating to central obesity as a major contributor to breast cancer development. Since it is shown that in premenopausal women estradiol level does not correlate with waist circumference (Freeman *et al.*, 2010) opposite to postmenopausal women where its production in visceral adipose tissue is believed to be related to central adiposity (Calle & Kaaks, 2004), it might suggest that except oestrogen production other mechanisms like hyperinsulinemia and IGF-1 level could be responsible for higher incidence of breast cancer in centrally obese premenopausal women (White *et al.*) while in postmenopausal women central adiposity is believed to associate with oestrogen production in visceral adipose tissue. On the other hand, our results showed lower values of central adiposity indices but only for those that included values of body height - this can be explained by significantly higher values of body height in cases.

Among parameters of peripheral adipose tissue size we found significantly higher values of thigh skinfold thickness in pre- and postmenopausal cases, which corresponded with higher upper thigh circumference while lower

thigh circumference was significantly lower in premenopausal breast cancer patients pointing to greater importance of upper thigh adipose tissue. Also, higher upper thigh circumferences in breast cancer patients were followed with higher upper arm (relaxed and flexed) as well as forearm circumferences. Contrary to the results of Lahmann *et al.* study which showed that in postmenopausal women hip circumference above 108 cm increases the risk of breast cancer for 56 % in comparison to women with hip circumference lower than 94 cm, in our study hip circumference was nearly significantly lower in postmenopausal breast cancer patients (p=0.055). It is supposed that low hip circumference in postmenopausal women is associated with small amount of subcutaneous fat in lower parts of the body followed by lower risk of cardiovascular disease, diabetes mellitus and insulin resistance which could be related to breast cancer development (Parker *et al.*, 2009). Considering adipose tissue distribution, generally speaking, women with breast cancer diagnose are believed to have android body type with adipose tissue distribution predominantly in central and upper parts of the body which is manifested by greater shoulder width, waist circumference, triceps skinfold thickness and subscapular skinfold thickness and, on the other hand, lesser hip circumference and shorter trunk which is assumed to be the consequence of increased androgen level in menopause. Our study confirmed narrow hips in premenopausal breast cancer patients and higher biepicondylar diameter of humerus. Upper arm and forearm circumferences were higher in breast cancer patients, while biceps skinfold thickness was lower indicating higher muscular mass. This is in line with observations of Butova *et al.*, who found lower values of skinfold thicknesses of the upper arm and chest in breast cancer patients.

Among very few studies dealing with somatotype in medicine, the study carried out by Ronco *et al.* pointed to higher endomorphic component in breast cancer patients, while Butova *et al.* reported dominance of mesomorphy. However, our results partialy confirmed these findings. Breast cancer patients in our study had significantly lower endomorphy and higher ectomorphy while mesomorphy was higher only in postmenopausal patients. Most cases displayed balanced mesomorph-endomorph somatotype, while the most of controls was mesomorphic endomorphs showing dominance of endomorphic component.

The major limitation of our study would be the small number of participants especially in premenopausal period and with breast cancer diagnosis as well as limited range of BMI in these women.

Our study confirmed higher body height in postmenopausal breast cancer patients. Body weight and body fat mass didn't differ significantly between breast cancer patients and healthy controls, while indicators of central were lower and indicators of peripheral adiposity were greater in breast cancer patients. Women with breast cancer expressed more male anthropometric features like higher stature, shorter trunk, narrower hips, higher biepicondylar diameter of humerus, larger upper- and forearm circumferences followed by lower skinfold thicknesses. Most frequent somatotype among breast cancer patients was mesomorph-endomorph. These results might contribute to better understanding of the role of obesity and adipose tissue distribution in breast cancer development, as well as to reveal specific anthropometric profile associated with breast cancer.

UDICKI, M.; ADAMOVIC, D.; SRDIC GALIC, B.; PAVLICA, T. & RADOVANOVIC, Z. Características antropométricas y somatotipos de mujeres con cáncer de mama. *Int. J. Morphol., 38(2)*:448-457, 2020.

RESUMEN: La información en la literatura es variable sobre la relación entre el cáncer de mama, la adiposidad, el tamaño corporal y somatotipo de las mujeres. El objetivo de este estudio fue comparar las características antropométricas, la composición corporal y el somatotipo entre pacientes con cáncer de mama y controles sanos. El grupo de estudio consistió en 106 pacientes con cáncer de mama y el grupo de control de 100 mujeres sanas que se sometieron a 29 mediciones antropométricas. Las mujeres con cáncer de mama tenían mayor cantidad características antropométricas masculinas, tal como una estatura más alta (160.75±6.91 vs. 158.17±4.89 cm, p = 0.020), tronco más corto (altura sentada en premenopáusica: 84.94±5.07 vs. 88.50±3.84 cm, p = 0.001 y mujeres posmenopáusicas: 81.96±6.08 vs. 85.19±3.36 cm, p = 0.001), caderas más estrechas (29.20±3.78 vs. 32.24±1.78 cm, p = 0.000), mayor diámetro biepicondilar del húmero (premenopáusico: 6.64±0.71 vs. 6.31 ±0.42 cm, p = 0.012; posmenopáusica: 6.95±0.63 vs. 6.54±0.49 cm, p = 0.000), mayor circunferencia del antebrazo y la parte superior del muslo, bíceps inferiores y mayor grosor del pliegue de la piel del muslo. Además se observó una endomorfia significativamente menor (premenopáusica: 5.84±1.78 vs. 6.55±0.96, p = 0.027; posmenopáusica: 6.89±1.52 vs. 7.37±0.86, p = 0.035) y una ectomorfia significativamente más alta (premenopáusica: 2.05±1.30 vs. 1.41 .990.99, p = 0.018; posmenopáusica: 1.06±0.90 vs. 0.68±0.56, p = 0.007), así como una mayor mesomorfia solo en mujeres posmenopáusicas (6.10±2.04 vs. 5.37±1.34, p = 0.022). El somatotipo más representado entre las pacientes con cáncer de mama fue el endomorfo-mesomorfo, mientras que los controles más sanos fueron el

mesomórfico endomorfo. Las características del cuerpo tipo androide aumenta el riesgo de desarrollar cáncer de mama. Los indicadores de dimensiones esqueléticas, volumen muscular y adiposidad periférica tuvieron un mejor valor predictivo sobre los marcadores de adiposidad central y general.

PALABRAS CLAVE: Cáncer de mama; Obesidad; Antropometría, Somatotipo.

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