Turk Neurosurg 31(5):699-703, 2021

Original Investigation

Received: 29.05.2020
Accepted: 14.12.2020

DOI: 10.5137/1019-5149.JTN.30936-20.2

Published Online: 29.04.2021

The Impact of Various Breast Sizes of Women on Vertebral Column and Spinopelvic Parameters

Tamer TUNCKALE[1], Sibel OZKAN GURDAL[2], Tezcan CALISKAN[1], Birol TOPCU[3], Mehmet Onur YUKSEL[4]

[1]Tekirdag Namik Kemal University School of Medicine, Department of Neurosurgery, Tekirdag, Turkey
[2]Tekirdag Namik Kemal University School of Medicine, Department of General Surgery, Tekirdag, Turkey
[3]Tekirdag Namik Kemal University School of Medicine, Department of Biostatistics, Tekirdag, Turkey
[4]Istanbul Medipol University School of Medicine, Department of Neurosurgery, Istanbul, Turkey

Corresponding author: Tamer TUNCKALE ✉ ttunckale@hotmail.com

ABSTRACT

AIM: To find out the anatomical changes in spine and pelvis, and the impact of various breast sizes of women on the quality of life.

MATERIAL and METHODS: Sixty women with back pain volunteered to participate in this study. Their body mass index (BMI) was calculated. Clinical evaluation of the pain was assessed using the Oswestry Disability Index and visual analogue scale. Breast volumes were measured using the Grossman Rounder device. Scoliosis radiograms were obtained, and the cervical lordosis, thoracic kyphosis, lumbar lordosis, sacral slope, pelvic incidence and pelvic tilt angles were measured in patients. The relationship between the increasing breast size and BMI was investigated through all these parameters.

RESULTS: Increase in breast size positively changes the sagittal balance (r=0.356, p=0.005) and increases cervical lordosis (r=0.300, p=0.020). Increase in BMI leads to a positive sagittal balance (r=0.329, p=0.010) and increases the pelvic tilt (r=0.460, p=0.000). In patients with a positive sagittal balance, the sacral slope (r=-0.350, p=0.006) and the lumbar lordosis angle decrease (r=-0.552, p=0.000), whereas the pelvic tilt increases (r=0.298, p=0.021).

CONCLUSION: Macromastia has an impact on cervical lordosis and sagittal balance, while indirectly impacting the pelvic tilt rather than the thoracic kyphosis and lumbar lordosis.

KEYWORDS: Breast volume, Spine, Body mass index, Sagittal balance

ABBREVIATIONS: ODI: Oswestry Disability Index, **BMI:** Body mass index, **VAS:** Visual analogue scale, **TNKU:** Tekirdag Namık Kemal University, **BGA:** Breast Group A, **BGB:** Breast Group B, **COG:** Centre of gravity

INTRODUCTION

In recent times, neck, back and lumbar pain are considered as significant public health issues, and are becoming increasingly prevalent in every age group. Spinal disorders, affecting 60%–80% of the population at any period of their life, result in severe pain, loss of workforce and decreased quality of social life (1,15). Two-thirds of adults have spinal problems resulting from a sedentary life, associated with the use of laptops, computers, tablets, mobile phones, television and gaming consoles, leading to spinal posture disorders and also pain even in adolescent period (15,19). Hence, understanding the factors that lead to these spinal problems to become chronic within ageing process is essential.

Many unchangeable factors, such as female sex, genetics and ageing, play a role in the spinal-originated pain formation beside various changeable factors, such as physical inactivity, weight, smoking, stress, coronary artery disease, dyslipidemia, diabetes mellitus, trauma and occupation (12,20). The spinal

Tamer TUNCKALE : 0000-0002-4534-0864
Sibel OZKAN GURDAL : 0000-0001-5649-6699
Tezcan CALISKAN : 0000-0001-7735-0584
Birol TOPCU : 0000-0003-0771-2505
Mehmet Onur YUKSEL : 0000-0003-0922-4249

disorder prevalence is more in women than in men. This is mostly associated with muscle and bone weakness, weight increase on the muscular and skeletal systems during gestation, childcare and heavy working conditions and thus needs to be studied in detail (13).

Although macromastia in women has been stated to lead to neck, back and lumbar pain, most studies related to the impact of macromastia on the spine alignment are about the changes in the spine after reduction mammoplasty is applied to patients with hypertrophic breast (3,14). Many studies have determined that thoracic kyphosis and lumbar lordosis angles decreased after reduction mammoplasty; however, the question about spinal changes correlating with different breast sizes remained unanswered (6,10,12). In their electromyography-supported study with 15 university-age women, where the patients' spinal movements were assessed via motion capture system , Schinkel et al. stated that the increase in breast size increased the angle between the body and the head and also the activity in the body muscles in the upright and flexion posture (17). This result revealed that the increased breast size may affect the posture and spinopelvic parameters by having an impact on the load distribution on the spine due to axial loading and excessive torso muscle contractions. To understand the impact of increasing breast size on the spinal posture and its effect on the pain and quality of life, we designed a study based on the patient's physical, clinical and radiological features, with the aim of understanding whether to schedule individual physical therapy and exercise programmes for patients with spinal disorders due to macromastia or to take into consideration the breast volumes in cases which needed a spinal surgery.

MATERIAL and METHODS

A group of 60 randomised female patients aged 18–70 years voluntarily applying to the Department of Neurosurgery at Tekirdag Namık Kemal University (TNKU) for neck, back or lumbar pain were included in our study. We received approval from the Local Ethical Board. The patients gave informed consent prior to enrolment in the study. Those with known spinal stenosis, disc herniation or with radicular symptoms, examination findings and a spinal surgery history; paravertebral muscle spasms, rheumatic disease, scoliosis, spinal dysraphism, osteoporosis and orthopaedic problems in the lower extremities (gonarthrosis, coxarthrosis), which may lead to spinal deformities, were excluded from the study. Demographic data (age, occupation, number of children) and height and weight of the patients, whose scoliosis radiographies were taken, were recorded.

The patients were asked for the duration of their symptoms and the pain attack frequency that they had experienced in one year. The neck, back and lumbar pain levels were measured using the visual analogue scale (VAS) score and the Oswestry low back pain disability questionnaire (ODI), consisting of 20 questions. The voluntarily participating patients' breast volumes were measured in ml by a general surgeon using the Grossman-Rounder device in the Breast Polyclinic, classifying breast sizes as small (<350 ml), normal (351–750 ml), big (751–1200 ml) and big and hypertrophic (>1200 ml). Those with small and normal sizes were grouped as Breast Group A (BGA) (<750 ml) and those with big and big and hypertrophic sizes were grouped as Breast Group B (BGB) (>751 ml).

The patients' body mass index (BMI) was measured using the weight/height^2 (kg/m^2) formula. They were divided into two groups according to their BMI as BMA-1 (<25, underweight + normal) and BMA-2 (>25, overweight + obese).

The sagittal balance (mm), sacral slope, pelvic tilt, cervical lordosis, thoracic kyphosis and lumbar lordotic Cobb's angles were calculated by a neurosurgeon using the Sectra Lite View 20.1 programme using the scoliosis radiography obtained from TNKU database.

Statistical Analysis

PASW Statistics 18 for Windows programme was used for data input and statistical analysis. The mean, standard deviation and frequency parameters were used to state the results. Normality was checked. Independent sample t-test was used to compare the two groups. Chi-square analysis was used for categorical data comparison. Pearson correlation analysis was used to determine whether there was a correlation between the variables, with an accepted statistical significance of p<0.05.

RESULTS

Sixty (21–69-year-old) women patients, with various breast sizes (mean 48.78 ± 11.503), were assessed. The average ages in BGA and BGB were 45.33 ± 2.56 (n=24) and 51.08 ± 1.71 (n=36), showing no significant difference (p>0.05). The BMI average in BGB (31.30 ± 4.76) was found to be significantly higher compared to BGA (25.95 ± 4.58) (p=0.001). There was no significant difference between BGA and BGB in terms of age, number of births, attack frequency, symptom duration and VAS score (p>0.05). The Oswestry Disability Index average was determined to be significantly high in BGB (38.94% ± 15.01%) (p=0.035) compared to BGA (31.21% ± 11.04%) (Figure 1). The sagittal balance average in BGA was determined as -5.09 ± 35.88 mm and 6.60 ± 33.02 mm in BGB. As the breast size increased, it was determined that the C7 plump line tended to move strongly in a positive direction (p=0.022) (Figure 1). There was no significant difference between BGA and BGB in terms of the thoracic kyphosis, lumbar lordosis, sacral slope, pelvic tilt and pelvic incidence values (p>0.05) (Figure 2).

Breast size, independently from the groups, was found to have an evident impact on sagittal balance (r=0.356, p=0.005) (Figure 3). The average cervical lordosis angle was 15.83° ± 8.51° in BGA and 22.19° ± 9.56° in BGB, with a determined significant difference (p=0.011) (Figure 1). As the breast size increased independently from the groups, cervical lordosis also increased (r=0.300, p=0.020) (Figure 4). The mean sagittal balance was found to be -11.32 ± 36.85 kg/m^2 in BMI-1 (n=18) and 7.60 ± 32.06 kg/m^2 in BMI-2, thus showing a significant difference (p=0.05) (Figure 1). It was observed that the BMI, independently of the groups, had an impact on sagittal balance

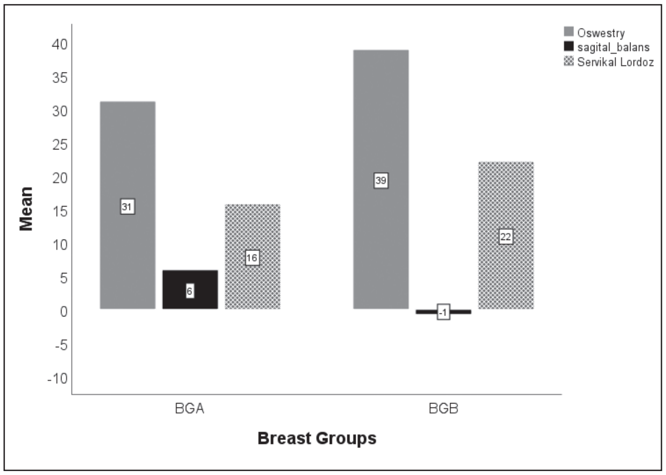

Figure 1: The average values of Oswestry Disability Index, sagittal balance and cervical lordosis in BGA and BGB.

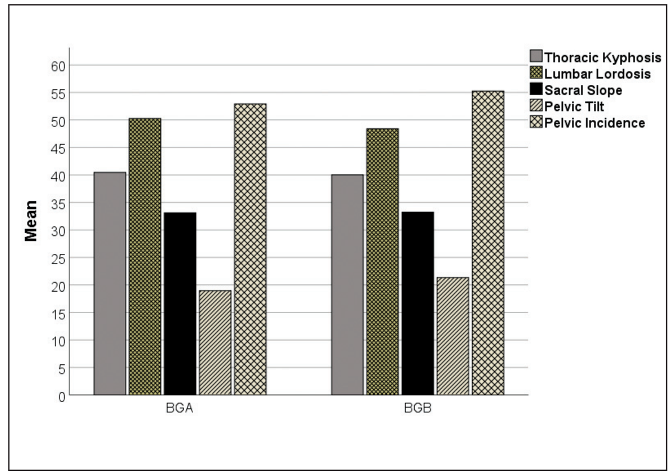

Figure 2: The average values of the thoracic lumbar Cobb's angles and spinopelvic parameters in BGA and BGB.

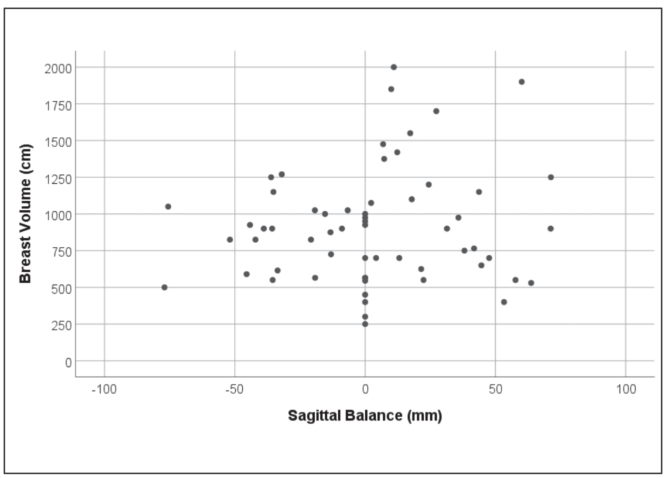

Figure 3: Sagittal balance distribution in various breast sizes.

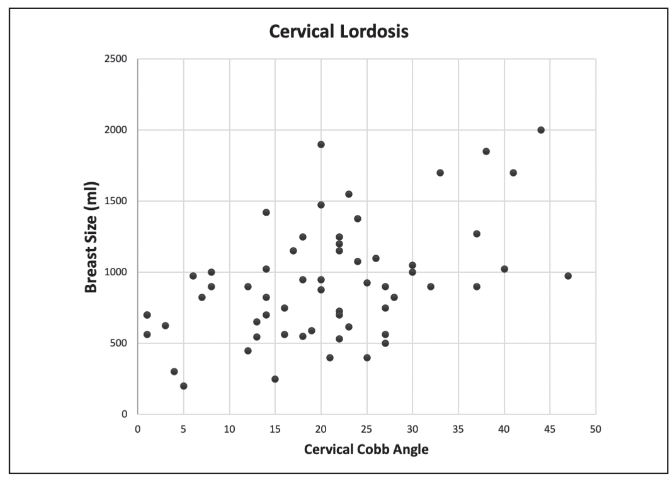

Figure 4: Cervical lordosis distribution in various breast sizes.

(r=0.329, p=0.010) and the pelvic tilt (r=0.460, p=0.000). It was also determined that as the C7 plump line moved towards the anterior, the pelvic tilt increased (r=0.298, p=0.021) and the sacral slope angle (r=−0.350, p=0.006) and lumbar lordosis angle decreased (r=−0.552, p=0.000).

■ DISCUSSION

In this study, the impact of macromastia in women on angular spinal and pelvic changes and its effect on pain and life quality were investigated. From the very beginning of standing upright, mankind has resisted gravity through its pelvis and spine. To be able to stand upright, the centre of gravity (COG) and the line of gravity are needed to be approximated to the spine (11,16). The body does this by using the muscle groups around the spine and the pelvis, lumbar lordosis, thoracic kyphosis, cervical lordosis angle changes, position of the pelvis and even by using the lower extremities. The COG's forward shifts due to pregnancy, abdominal hypertrophy, osteoporosis and age-related kyphosis are thought to result in an increasing lumbar lordosis (4). However, it is not clear whether this is valid for everybody or whether various bodily features trigger various dynamics.

The female sex and big breasts are considered to be predisposing factors for neck, back and lumbar pains (12,18,20). In our study, the ODI percentage, in the cases with a breast size above 750cc, was found to be 38.94% ± 15.01%, with determined moderate disability. While self-care, sexual activity and sleeping parameters were generally not affected in these patients, it was determined that sitting, standing up, standing upright, travelling and social life were affected (5).

Obesity is known to be mostly prevalent in women, which can lead to spine-based pain (2). BMI evidently increases with the increase in breast size; however, its contribution to pain initiation and its impact on the dynamics of the spine independent of obesity are not clear. Findikcioglu et al. conducted a radiological study about the impact of BMI on the spine with 100 volunteers and stated that the increase in BMI had no impact on the spine (6). However, they found a positive correlation between breast size and lumbar lordosis and breast size and thoracic kyphosis but no correlation between breast size and sacral slope (6).

There are similar publications in the scientific literature asserting the effect of big-sized breasts in women, leading to increased thoracic kyphosis and lumbar lordosis angles that result in the reduction of those angles after reduction mammoplasty (6,8,11,21).

Contrary to this opinion, Karaaslan et al. stated that they did not observe any changes in thoracic kyphosis and lumbar lordosis angles, according to the study conducted on 34 patients with a 12-month follow up after reduction mammoplasty, strengthening the idea that increasing breast sizes do not lead to thoracic kyphosis and lumbar lordosis angles (9).

However, in our study, it was found that increase in the BMI and breast volume did not increase thoracic kyphosis and lumbar lordosis angles. On the contrary, it was determined that those angles reduced in patients with positive sagittal balance.

While the increase in BMI had no impact on the lordosis and kyphosis angles, it increased the pelvic tilt. The most significant effects of increased breast volume were positive sagittal balance and increase in cervical lordosis (Figure 2). It is also possible to say the opposite, i.e. negative sagittal balance and cervical straightening is more frequent in patients with small breast volume (Figures 1, 4). We believe that the increase in cervical lordosis with increase in the breast volume is a reaction against the line of gravity moving away from the spine (Figures 3, 4). This result is compatible with the study by Schinkel-Ivy and Janessa where they have reported that as breast volume increases, the head moves backwards (17). Although there seems to be a correlation between BMI and breast size, there was no significant difference observed in cervical lordosis angles in those with high BMI, with the result indicating that cervical lordosis is affected by breast size. To understand increase in cervical lordosis better, it is believed that the correlation between breast size and upper thoracic, lower thoracic and T1 slope angles should be studied in more participants.

When cases with positive sagittal balance were assessed, the sacral slope angle and pelvic tilt were found to decrease and increase, respectively; thus, it was concluded that in cases where COG moves forward, the pelvis tends to retrovert, which is compatible with the scientific literature (7,8). In our study, positive sagittal balance was determined in almost all cases with a breast size above 1250 ml (Figure 3), where the pelvis retroverted despite the positive sagittal balance, leading to lumbar lordosis and thoracic kyphosis decreases. We also believe that the patients with neck, back and lumbar pain complaints, those with a breast volume above 750 ml or planned for a spinal surgery should be examined using upright scoliosis radiography and carefully observed in terms of kyphosis, lordosis angles and pelvic parameters.

It is clear that it would be misleading to observe only the thoracic kyphosis and lumbar lordosis angles to understand the breast size effect on the spinal dynamics. The evaluation should be based on the observations of cervical lordosis, sagittal balance and pelvic tilt angle.

CONCLUSION

Increased breast size worsens the patients' quality of life by having an impact on the spinal health. As the breast size increases, a rise in the cervical lordosis angle and a positive sagittal balance are observed. Spinopelvic parameters change in the cases where the sagittal balance is affected. In these patients, the pelvic tilt increases, pelvis becomes retroverted and lumbar lordosis and thoracic kyphosis angles get reduced. Abnormal pelvic parameters and kyphosis and lordosis angles of the spine may lead to pathologies, such as back pain, disc herniation, degenerative disc disease, isthmic spondylolisthesis and coxarthrosis, where increased breast size should be considered as a predisposing factor and should be taken into consideration for exercise programmes, physiotherapy treatments and for pre-operative planning of female patients, who plann to undergo spinal and pelvic surgeries.

ACKNOWLEDGEMENTS

Preparation for publication of this article is partly supported by Turkish Neurosurgical Society

REFERENCES

1. Andersson GB: Epidemiological features of chronic low-back pain. Lancet 354:581-585, 1999
2. Apovian CM: Obesity: Definition, comorbidities, causes, and burden. Am J Manag Care 22:s176-s185, 2016
3. Berg A, Stark B, Malec E: Reduction mammaplasty: A way helping females with neck, shoulder and back pain symptoms. Eur J Plast Surg 17:84-86, 1994
4. During J, Goudfrooij H, Keessen W Beeker TW, Crowe A: Toward standards for posture. Postural characteristics of the lower back system in normal and pathologic conditions. Spine 10:83-87, 1985
5. Fairbank JC, Couper J, Davies JB, O'Brien JP: The oswestry low back pain disability questionnaire. Physiotherapy 66: 271-273, 1980
6. Findikcioglu K, Findikcioglu F, Bulam H, Sezgin B, Ozmen S: The impact of breast reduction surgery on the vertebral column. Ann Plast Surg 70:639-642, 2013
7. Gottfried ON, Daubs MD, Patel AA, Dailey AT, Brodke DS: Spinopelvic parameters in postfusion flat- back deformity patients. Spine J 9:639-647, 2009
8. Harding IJ: Understanding sagittal balance with a clinical perspective. Eur J Phys Rehabil Med 45:571-582, 2009
9. Karaaslan O, Demirkiran HG, Silistreli O, Bedir YK, Can M, Caliskan G, Aslan C, Oral MA, Kankaya Y: The effect of reduction mammaplasty on the vertebral column: A radiologic study. Sci World J 701:391, 2013

10. Karabekmez FE, Gokkaya A, Isik C, Saglam I, Efeoglu FB, Gorgu M: Does reduction mammaplasty revert skeletal disturbances in the vertebral column of patients with macromastia? A preliminary study. Aesthet Plast Surg 38: 104-112, 2014
11. Lehuec JC, Saddiki R, Franke J, Rigal J, Aunoble S: Equilibrium of the human body and the gravity line: The basics. Eur Spine J 20:S558–S563, 2011
12. Manchikanti L, Singh V, Falco FJ, Benyamin RM, Hirsch JA: Epidemiology of low back pain in adults. Neuromodulation 17: 3-10, 2014
13. Meucci RD, Fassa AG, Faria NM: Prevalence of chronic low back pain: Systematic review. Rev Saúde Públ 49:73, 2015
14. Mizgala CL, MacKenzie KM: Breast reduction outcome study. Ann Plast Surg 44:125-133, 2000
15. Myrtveit S, Sivertsen B, Skogen J, Frostholm L, Stormark K, Hysing M: Adolescent neck and shoulder pain-the association with depression, physical activity, screen-based activities, and use of health care services. J Adolesc Health 55:366-372, 2014
16. Roussouly P, Gollogly S, Noseda O, Berthonnaud E, Dimnet J: The vertical projection of the sum of the ground reactive forces of a standing patient is not the same as the C7 plumb line: A radiographic study of the sagittal alignment of 153 asymptomatic volunteers. Spine 31:E320-E325, 2006
17. Schinkel-Ivy A, Janessa DM: Drake Breast size impacts spine motion and postural muscle activation. J Back Musculoskelet Rehabil 29:741-748, 2016
18. Schnur PL, Schnur DP, Petty PM, Hanson TJ, Weaver AL: Reduction mammaplasty: An outcome study. Plast Reconstr Surg 100:875-883, 1997
19. Shan Z, Deng G, Li J, Li Y, Zhang Y, Zhao Q: Correlational Analysis of neck/ shoulder pain and low back pain with the use of digital products, physical activity and psychological status among adolescents in Shanghai. PLoS One 8:e78109, 2013
20. Shiri R, Karppinen J, Leino-Arjas P, Solovieva S, Varonen H, Kalso E, Ukkola O, Viikari-Juntura E: Cardiovascular and lifestyle risk factors in lumbar radicular pain or clinically defined sciatica: A systematic review. Eur Spine J 16:2043-2054, 2007
21. Tuzun C, Yorulmaz I, Cindas A, Vatan S: Low back pain and posture. Clin Rheumatol 18:308-312, 1999