



# The Effects of Concurrent Training on the Body Composition, Quality of Life, and Sleep Quality of Postmenopausal Women with Breast Cancer

Amirabbas Monazzami <sup>1,\*</sup>, Roya Momenpour <sup>1</sup>, Elham Alipoor <sup>1</sup>, Kheirollah Yari <sup>2</sup> and Mehrdad Payandeh <sup>3</sup>

<sup>1</sup>Department of Sport Physiology, Faculty of Sport Sciences, Razi University, Kermanshah, Iran

<sup>2</sup>Medical Biology Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran

<sup>3</sup>Department of Hematology and Medical Oncology, Kermanshah University of Medical Sciences, Kermanshah, Iran

\*Corresponding author: Department of Sport Physiology, Faculty of Sport Sciences, Razi University, Kermanshah, Iran. Email: monazzami.amirabbas@gmail.com

Received 2020 February 17; Revised 2020 July 29; Accepted 2020 August 17.

## Abstract

**Background:** Concurrent training is more effective in developing fitness indicators than doing endurance and resistance training separately. However, there has been limited research to evaluate the effects of this type of exercise training on improvement of body composition and quality of life indicators in postmenopausal women with cancer.

**Objectives:** The present study aimed to determine the effects of eight-week of concurrent training on body composition, quality of life, and sleep quality in postmenopausal women with breast cancer.

**Methods:** This study was conducted on 42 women with breast cancer who were selected randomly and divided into exercise training and control groups. The training group followed eight-week of resistance training (2 - 3 sets, 10 - 18 repetitions, and 50% - 70% 1RM) and aerobic training (50% - 70% maximum heart rate, 12 - 14 Borg scale, and 20 - 40 minutes). Anthropometric characteristics were measured based on body composition (ZEUS 9.9), the sleep quality was measured by the Pittsburgh sleep quality index (PSQI), and the quality of life was measured by the McGill quality of life (MQOL) questionnaire. Two-way repeated measures ANOVA has been used for McGill's analysis of variance ( $P < 0.05$ ).

**Results:** The results showed a significant decrease in sleep quality score, weight, fat percentage, BMI, and waist circumference in the training group ( $P < 0.05$ ), as well as an increase in quality of life index in the training group ( $P < 0.05$ ). However, no significant changes were observed in the Waist-hip ratio (WHR) values of the training group compared with the control group ( $P > 0.05$ ).

**Conclusions:** Although the changes in WHR index were not significant after eight weeks of concurrent training, this type of training program could be considered as a beneficial way for improving body composition, quality of life, and sleep quality in patients with breast cancer.

**Keywords:** Anthropometric Characteristics, Endurance Training, Strength Training, Pittsburgh Sleep Quality Index, McGill Questionnaire

## 1. Background

Breast cancer is the most common and emotionally traumatic type of cancer among women (1-3). More than 120,000 women in the UK and more than 40,000 women in the United States die from breast cancer every year. In Iran, breast cancer accounts for 25% of all cancers and is the most common cancer among women (3).

Numerous studies have shown that metabolic dysfunction, hormones, and inflammatory mechanisms affect the progression of breast cancer (4-7). Evidence suggests that stressors in various forms can trigger physical stimulation and changes in the immune system (8). Epidemiological

studies have shown a connection between obesity and increased risk of developing different subtypes of breast cancer, including triple-negative breast cancer, a particularly aggressive form of breast cancer with poor outcome and few therapeutic options (8).

Depression and sleep disturbance occur in patients with breast cancer; 20% to 30% of breast cancer patients suffer from depression and anxiety, due to the negative consequences of a cancer diagnosis and the sequelae of cancer-related treatments (9). Also, chemotherapy followed by breast cancer can have a major impact on patients' quality of life, disrupting their physical, mental, so-

cial and spiritual well-being, and in other words, reducing their quality of life indicators (10). The depression and anxiety symptoms can persist for several years, leading to adverse effects on the patient's quality of life, compliance to medical treatment, recurrence, survival and also recovery from surgery during hospital stay (11). Metastatic breast cancer and its treatment have a major impact on the survivor's quality of life (8-11). Following a diagnosis of breast cancer, an assessment of QOL is an important clinical outcome measure, because patients have to face major stressors that are likely to deteriorate their QOL, not only just after diagnosis but also in the long term (e.g., facing a life-threatening illness, painful and impairing treatments, significant role changes, and issues about body image) (8-11).

Exercise therapy has been studied in a variety of populations with cancer to counteract the side effects of treatments (12). Concurrent endurance and strength training are particularly relevant to improving overall health as they combine the benefits of each single exercise modality to bring about local. Therefore, aerobic resistance training is more effective than aerobic exercise in improving body composition, quality of life, and cardiovascular strength and fitness (12).

Hojan et al. (13) showed that mixed type physical activity (aerobic training, AT, and resistance training, RT) during endocrine therapy for breast cancer could prevent negative changes of the treatments, in body build in premenopausal women. Battaglini et al. (14) suggest that exercise with an emphasis on resistance training promotes positive changes in body composition and strength in breast cancer patients undergoing treatment. Sprod et al. (15) showed that four weeks of moderate home-based aerobic exercise and resistance training can be helpful for patients with breast cancer under radiotherapy and sleep quality was higher in the training group but not significantly different. Ohira et al. (16) showed that QOL scores improved in the training group after 6-months of weight-loss training in women who survived from breast cancer, however, the previous research literature on the effects of this type of exercise training on body composition improvement and quality of life indicators in postmenopausal women with cancer is limited.

## 2. Objectives

The present study aimed to determine the effects of eight weeks of concurrent training on body composition, quality of life, and sleep quality in postmenopausal women with breast cancer.

## 3. Methods

This study was conducted on 42 postmenopausal women from Kermanshah city with breast cancer were randomly selected and divided into the control group and the training groups. Entry requirements for subjects were determined by an oncologist. All of them were at stage one of the disease. They were diagnosed postmenopausal by a gynaecologist. The inclusion criteria were having at least 30 years of age at the start of adjuvant tamoxifen or Letrozole therapy, not having menstruation or having no exercises in the last 6-months. Before starting the training protocol, the purpose of the study was explained to the subjects. The control group did not perform a training program and they just did daily chores. They did not perform training protocols subsequently the written and oral consent of which was obtained from the subjects. This study was conducted based on ethical principles in the research of the Helsinki Statement. One week before starting the main training protocol, anthropometric indicators including age, weight, body mass index (BMI), waist-to-hip ratio (WHR), %fat, and waist circumference were measured.

The one-repetition maximum (1RM) test was measured from subjects by using the Brzysky method (Equation 1 indirects estimation formula for one repetition maximum).

$$1 \text{ RM} = \frac{\text{Displaced weight}}{[1.0278 - (\text{Repeat to fatigue} \times 0.278)]} \quad (1)$$

### 3.1. Training Protocol

The training protocol included eight weeks of concurrent training, three-days per week. Each section included 10 minutes of warm-up and cool-down with 40% maxHR and the main part of the training was divided into resistance and aerobic training (17-19). The motion resistance training included barbell chest press, barbell curl, lying barbell triceps, behind-the-neck lat pulldowns and lower body movements, including smith machine squat, leg extensions, lying leg curls, and standing calf raises. The subjects had active rests between one to three minutes for each movement and set depending on weeks of the training protocol. Also, during aerobic training (walking and running), the heart rate of the subjects was evaluated by counting the pulse of the subjects in 15 seconds and calculated for one minute every 10 - 15 minutes. Also, the Borg RPE scale was used to control the intensity of aerobic training (12 - 14 degrees) (18, 19). The intensity and duration of each training section are shown in Table 1.

Anthropometric characteristics were measured by using body composition, ZEUS 9.9. All measurements were carried out in the same conditions between 8 AM and 11 AM. The sleep quality was estimated using the Pittsburg sleep quality index (PSQI) questionnaire. It is a self-completed

**Table 1.** Resistance and Aerobic Exercise Protocols

| Weeks                                  | 1         | 2         | 3         | 4         | 5         | 6         | 7         | 8         |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Resistance training intensity          | 2 (50/18) | 2 (55/16) | 2 (60/14) | 2 (60/14) | 3 (65/12) | 3 (65/12) | 3 (70/10) | 3 (70/10) |
| Resistance training time, min          | 20        | 25        | 30        | 30        | 35        | 35        | 40        | 40        |
| Aerobic training intensity (max HR), % | 50        | 55        | 60        | 60        | 65        | 65        | 70        | 70        |
| Borg scale (aerobic training)          | 12        | 12        | 12        | 13        | 13        | 13        | 14        | 14        |
| Aerobic training time, min             | 20        | 25        | 30        | 30        | 35        | 35        | 40        | 40        |

questionnaire evaluating the quality of sleep during the last month, and includes 19 questions in 7 parts (mental sleep quality, late sleep, sleep sufficiency, sleep period, sleep disorder, use of soporific drugs and defective function during the day). Each part can be scored from '0' to '3' The total score of PSQI ranges between '0' and '21,' with higher scores indicating the lower quality of sleep. A score higher than '5' indicates low-quality sleep and many problems in at least two of three dimensions of this index (20). The quality of life was also measured by the McGill quality of life (MQOL) questionnaire. This questionnaire consists of 17 self-report items whose validity and reliability have been confirmed in cancer patients. This questionnaire includes three dimensions of quality of life, physical and psychological dimensions (21).

### 3.2. Statistical Analysis

To describe the characteristics of the subjects, the descriptive statistic was used. Kolmogorov-Smirnov test was used for data normality and Levene's test was used for data homogeneity. Two-way repeated measures ANOVA was used to compare the difference between the variables. To examine significant differences, the Bonferroni test was used. The significance level was  $P < 0.05$  in all tests. Finally, SPSS 24 was used for data analysis.

## 4. Results

The results showed that after eight weeks of concurrent training in breast cancer patients, the score of sleep quality decreased significantly and the effect of time and group interaction was also significant ( $P = 0.007$ ) in the training group. Also, the effect of this type of training on the quality of life in the training group was significant based on physical and mental dimensions, respectively ( $P = 0.012$ ). The overall QOL increases significantly in the training group, and also, the effect of time and group interaction on QOL was significant (Figure 1) ( $P = 0.012$ ). Besides, the results of weight, BMI, Fat percentage and waist circumference data showed that both variables were lower in the training group and these changes were significant Figure 2 ( $P < 0.05$ ). The effect of time and group interaction

in these variables were significant ( $P < 0.05$ ). There wasn't any significant change in WHR and the effect of time and group interaction on this indicator wasn't significant ( $P > 0.05$ ). These changes are shown in Table 2.

## 5. Discussion

The present study aimed to determine the effects of eight weeks of concurrent training on body composition, sleep quality, and quality of life in postmenopausal women with breast cancer. We tried to find out; does concurrent training change body composition, sleep quality, and quality of life in postmenopausal women with breast cancer?

This study showed that after eight weeks of concurrent training, the sleep quality improved in the training group and its score decreased significantly ( $P < 0.05$ ). Pooranfar et al. (22) examined the effect of 10-weeks concurrent training on the quality and quantity of sleep on renal transplant patients. Their finding showed that after 10-weeks of concurrent training, sleep quality increased by 27% and the duration increased by 30 minutes. This improves can lead to a state that the melatonin hormone secreted by the allergic pineal glands, which has a hypnotizing effect with central body temperature. Also, anabolic activity is stronger in sleep, whereas the catabolic activity is more intense during vigilance. Therefore, for a possible balance of energy, the body consumes more energy to relax and the body tends to more sleep. exercise training causes favourable changes in daily rhythms and elevated adenosine levels that improve sleep (22). Our findings agree with these results, but not agree with the findings of Sprod et al. (15). They found that four weeks of moderate aerobic and resistance training on patients with breast cancer under radiation therapy improved sleep quality in the training group, but this improvement hasn't been significant ( $P = 0.05$ ). Sleep quality and sleep mediators, as a result of concurrent training, can be adjusted by the H-P-A axis. Radiation therapy also can activate the signalling pathways that are associated with a short sleep period and sleep disorder (15).

We found that eight weeks of concurrent training can improve the overall score of QOL significantly in patients

**Table 2.** Changes in Pre-Test and Post-Test Variables in the Control and Training Groups<sup>a</sup>

|                        | Measurement Steps |              |              |                                 |
|------------------------|-------------------|--------------|--------------|---------------------------------|
|                        | Control           |              | Training     |                                 |
|                        | Pretest           | Posttest     | Pretest      | Posttest                        |
| SQL, score             | 13.26 ± 0.70      | 12.38 ± 0.76 | 12.76 ± 1.00 | 9.47 ± 0.67 <sup>b, c, d</sup>  |
| QOL (physical), score  | 4.35 ± 0.71       | 3.48 ± 0.58  | 4.2 ± 0.34   | 3.76 ± 0.33 <sup>b, c, d</sup>  |
| QOL (mental), score    | 4.35 ± 0.39       | 4.01 ± 0.38  | 4.27 ± 0.35  | 3.78 ± 0.39 <sup>b, c, d</sup>  |
| QOL (overall), score   | 4.94 ± 0.53       | 5.23 ± 0.55  | 4.52 ± 0.89  | 7.52 ± 0.67 <sup>b, d, e</sup>  |
| Weight, kg             | 70.59 ± 2.21      | 70.86 ± 2.14 | 70.13 ± 1.71 | 68.72 ± 1.70 <sup>b, c, d</sup> |
| BMI, kg/m <sup>2</sup> | 28.26 ± 0.89      | 43.28 ± 0.88 | 28.42 ± 0.55 | 26.78 ± 0.55 <sup>b, c, d</sup> |
| WHR, m                 | 0.87 ± 0.01       | 0.88 ± 0.01  | 0.86 ± 0.01  | 0.87 ± 0.01 <sup>e</sup>        |
| Fat, %                 | 37.07 ± 1.31      | 37.53 ± 1.30 | 37.23 ± 0.89 | 35.99 ± 0.90 <sup>b, c, d</sup> |
| Waist, m               | 94.82 ± 2.25      | 94.21 ± 2.28 | 93.39 ± 1.89 | 92.04 ± 1.90 <sup>b, c, d</sup> |

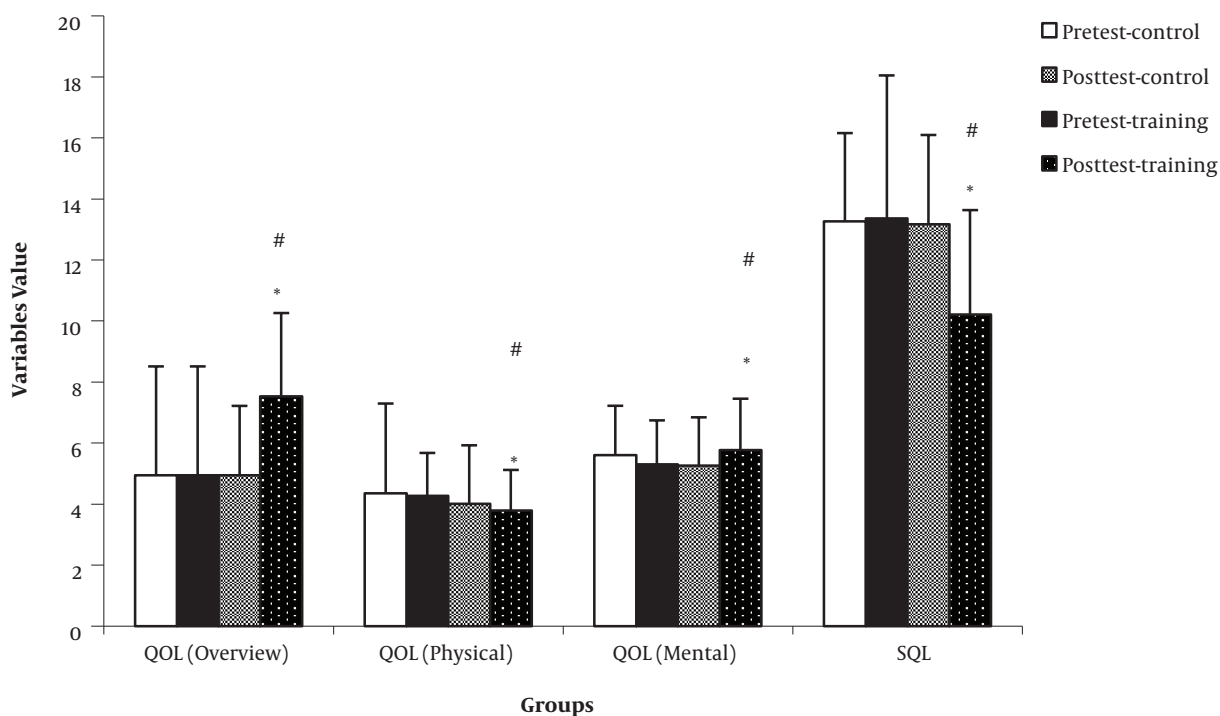
<sup>a</sup>Values are expressed as mean ± SD.

<sup>b</sup>Significant difference with pretest.

<sup>c</sup>Significant difference with the control group by interaction

<sup>d</sup>Decrease.

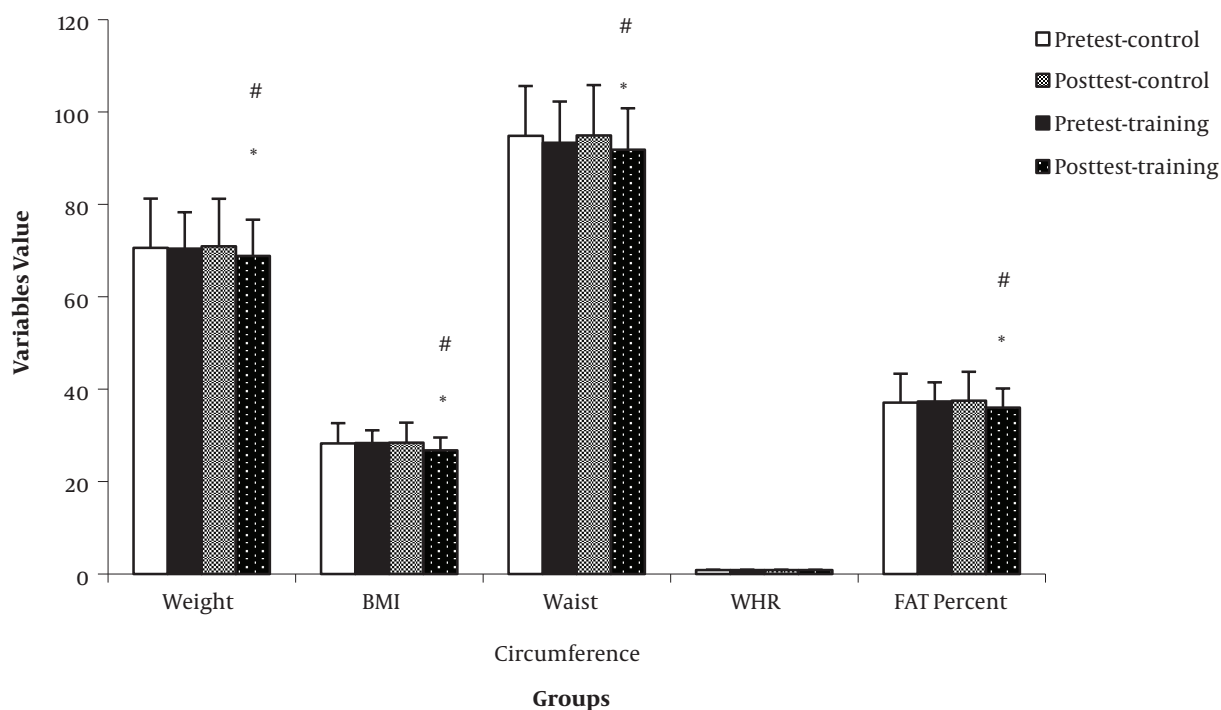
<sup>e</sup>Increase.



**Figure 1.** Changes in pretest and posttest variables in control and training groups (\*, significant difference with pretest; #, significant differences with control group)

with breast cancer. It seems that concurrent training is more effective than aerobic and strength training alone on improving body composition, cardiovascular strength and fitness, and decreasing weight and eventually increasing the quality of life (17-19). Our finding is consistent with

the results of Raghavendra et al. (17), and De Luca et al. (18). There is also evidence of positive effects of concurrent training on maximum output power, happiness, self-esteem, fatigue, and several subsets of QOL (17-19). Herrero et al. (19) studied the effect of 8-week concurrent training



**Figure 2.** Changes in Pretest and posttest variables in control and training groups (\*, significant difference with pretest; #, significant differences with control group)

on body composition and quality of life in women survived from breast cancer. They concluded that combined cardiorespiratory and resistance training, even of very brief duration, improves the QOL and the overall physical fitness of women survived from breast cancer (19).

We found that eight weeks of concurrent training in patients with breast cancer decreased the weight, BMI, fat percent and waist circumference in the training group significantly ( $P < 0.05$ ). Also, there was no significant change in WHR in the training group ( $P > 0.05$ ). This could be due to our limitation in this study that the control of the subject's nutrition was not possible during the training period and maybe more research on gender, numbers of subjects and duration of training protocols are necessary. Studies show that exercise training improves body composition and fitness while the findings of Matthews et al. (23) are different. They did not observe any significant change in weight, BMI, and body composition due to exercise training in women with breast cancer. This discrepancy seems to be due to the type, intensity, duration, and weeks of training, the type and age of the subjects, and the methods for measuring these indicators. Kim et al. (24) examined the effects of 12 weeks of walking on body composition and immune system in patients with breast cancer. This study was consistent with our findings regarding weight, fat per-

centage, and BMI (24).

In general, this study shows that concurrent training can improve body composition, QOL, and sleep quality in patients with breast cancer. Concurrent training with the effect on the H-P-A axis may be helpful to the treatment process, and leads to improvements in sleep quality and quality of life; and also causes improvements in body composition which lead to decrease in cancer progression (17-19). This finding suggested that concurrent training can be used in patients with breast cancer.

**Acknowledgments**

We would like to thank the subjects who helped us in our study. Special thanks go to Dr Hamid Reza Mozaffari who examined the subjects for other diseases.

**Footnotes**

**Authors' Contribution:** RM, EA, KY, and MP participated in data evaluation and drafting. AM edited and finalized the manuscript before submission and responsible for overall supervision. All authors read and approved the final manuscript.

**Conflict of Interests:** None declared.



**Ethical Approval:** This study was approved by the Ethics Committee of Kermanshah University of Medical Sciences, Iran (code: IR.KUMS.REC.1397.708). It was in line with the principles of the Helsinki II declarations.

**Funding/Support:** None.

**Informed Consent:** The participant provided written informed consent for the publication of this report.

## References

- Stefansson OA, Moran S, Gomez A, Sayols S, Arribas-Jorba C, Sandoval J, et al. A DNA methylation-based definition of biologically distinct breast cancer subtypes. *Mol Oncol*. 2015;**9**(3):555-68. doi: [10.1016/j.molonc.2014.10.012](https://doi.org/10.1016/j.molonc.2014.10.012). [PubMed: [25468711](https://pubmed.ncbi.nlm.nih.gov/25468711/)]. [PubMed Central: [PMC5528700](https://pubmed.ncbi.nlm.nih.gov/PMC5528700/)].
- Sachs N, de Ligt J, Kopper O, Gogola E, Bounova G, Weeber F, et al. A Living Biobank of Breast Cancer Organoids Captures Disease Heterogeneity. *Cell*. 2018;**172**(1-2):373-386 e10. doi: [10.1016/j.cell.2017.11.010](https://doi.org/10.1016/j.cell.2017.11.010). [PubMed: [29224780](https://pubmed.ncbi.nlm.nih.gov/29224780/)].
- Pace LE, Mpunga T, Hategekimana V, Dusengimana JM, Habineza H, Bigirimana JB, et al. Delays in Breast Cancer Presentation and Diagnosis at Two Rural Cancer Referral Centers in Rwanda. *Oncologist*. 2015;**20**(7):780-8. doi: [10.1634/theoncologist.2014-0493](https://doi.org/10.1634/theoncologist.2014-0493). [PubMed: [26032138](https://pubmed.ncbi.nlm.nih.gov/26032138/)]. [PubMed Central: [PMC4492236](https://pubmed.ncbi.nlm.nih.gov/PMC4492236/)].
- Gunter MJ, Hoover DR, Yu H, Wassertheil-Smoller S, Rohan TE, Manson JE, et al. Insulin, insulin-like growth factor-I, and risk of breast cancer in postmenopausal women. *J Natl Cancer Inst*. 2009;**101**(1):48-60. doi: [10.1093/jnci/djn415](https://doi.org/10.1093/jnci/djn415). [PubMed: [19116382](https://pubmed.ncbi.nlm.nih.gov/19116382/)]. [PubMed Central: [PMC2639294](https://pubmed.ncbi.nlm.nih.gov/PMC2639294/)].
- Morimoto LM, White E, Chen Z, Chlebowski RT, Hays J, Kuller L, et al. Obesity, body size, and risk of postmenopausal breast cancer: the Women's Health Initiative (United States). *Cancer Causes Control*. 2002;**13**(8):741-51. doi: [10.1023/a:1020239211145](https://doi.org/10.1023/a:1020239211145). [PubMed: [12420953](https://pubmed.ncbi.nlm.nih.gov/12420953/)].
- Garcia-Estevez L, Moreno-Bueno G. Updating the role of obesity and cholesterol in breast cancer. *Breast Cancer Res*. 2019;**21**(1):35. doi: [10.1186/s13058-019-1124-1](https://doi.org/10.1186/s13058-019-1124-1). [PubMed: [30823902](https://pubmed.ncbi.nlm.nih.gov/30823902/)]. [PubMed Central: [PMC6397485](https://pubmed.ncbi.nlm.nih.gov/PMC6397485/)].
- Tiwari P, Blank A, Cui C, Schoenfeld KQ, Zhou G, Xu Y, et al. Metabolically activated adipose tissue macrophages link obesity to triple-negative breast cancer. *J Exp Med*. 2019;**216**(6):1345-58. doi: [10.1084/jem.20181616](https://doi.org/10.1084/jem.20181616). [PubMed: [31053611](https://pubmed.ncbi.nlm.nih.gov/31053611/)]. [PubMed Central: [PMC6547867](https://pubmed.ncbi.nlm.nih.gov/PMC6547867/)].
- Kwekkeboom KL, Tostrud L, Costanzo E, Coe CL, Serlin RC, Ward SE, et al. The Role of Inflammation in the Pain, Fatigue, and Sleep Disturbance Symptom Cluster in Advanced Cancer. *J Pain Symptom Manage*. 2018;**55**(5):1286-95. doi: [10.1016/j.jpainsymman.2018.01.008](https://doi.org/10.1016/j.jpainsymman.2018.01.008). [PubMed: [29360570](https://pubmed.ncbi.nlm.nih.gov/29360570/)]. [PubMed Central: [PMC5899940](https://pubmed.ncbi.nlm.nih.gov/PMC5899940/)].
- Bakhshi R, Akaberian S, Bahreini M, Mirzaei K, Kiani J. The Effect of Group Counseling on the Quality of Life in Patients with Major Thalassemia Referred to the Thalassemia Treatment Center in Bushehr. *Pajouhan Sci J*. 2018;**16**(3):11-9. doi: [10.21859/psj.16.3.11](https://doi.org/10.21859/psj.16.3.11).
- Kayl AE, Meyers CA. Side-effects of chemotherapy and quality of life in ovarian and breast cancer patients. *Curr Opin Obstet Gynecol*. 2006;**18**(1):24-8. doi: [10.1097/01.gco.0000192996.20040.24](https://doi.org/10.1097/01.gco.0000192996.20040.24). [PubMed: [16493256](https://pubmed.ncbi.nlm.nih.gov/16493256/)].
- Sun YS, Zhao Z, Yang ZN, Xu F, Lu HJ, Zhu ZY, et al. Risk Factors and Preventions of Breast Cancer. *Int J Biol Sci*. 2017;**13**(11):1387-97. doi: [10.7150/ijbs.21635](https://doi.org/10.7150/ijbs.21635). [PubMed: [29209143](https://pubmed.ncbi.nlm.nih.gov/29209143/)]. [PubMed Central: [PMC5715522](https://pubmed.ncbi.nlm.nih.gov/PMC5715522/)].
- Brennan B. Combined resistance and aerobic training is more effective than aerobic training alone in people with coronary artery disease. *J Physiother*. 2012;**58**(2):129. doi: [10.1016/S1836-9553\(12\)70095-4](https://doi.org/10.1016/S1836-9553(12)70095-4). [PubMed: [22613245](https://pubmed.ncbi.nlm.nih.gov/22613245/)].
- Hojan K, Milecki P, Molinska-Glura M, Roszak A, Leszczynski P. Effect of physical activity on bone strength and body composition in breast cancer premenopausal women during endocrine therapy. *Eur J Phys Rehabil Med*. 2013;**49**(3):331-9. [PubMed: [23438652](https://pubmed.ncbi.nlm.nih.gov/23438652/)].
- Battaglini C, Bottaro M, Dennehy C, Rae L, Shields E, Kirk D, et al. The effects of an individualized exercise intervention on body composition in breast cancer patients undergoing treatment. *Sao Paulo Med J*. 2007;**125**(1):22-8. doi: [10.1590/s1516-31802007000100005](https://doi.org/10.1590/s1516-31802007000100005). [PubMed: [17505681](https://pubmed.ncbi.nlm.nih.gov/17505681/)].
- Sprod LK, Palesh OG, Janelsins MC, Peppone LJ, Heckler CE, Adams MJ, et al. Exercise, sleep quality, and mediators of sleep in breast and prostate cancer patients receiving radiation therapy. *Community Oncol*. 2010;**7**(10):463-71. doi: [10.1016/s1548-5315\(11\)70427-2](https://doi.org/10.1016/s1548-5315(11)70427-2). [PubMed: [21274408](https://pubmed.ncbi.nlm.nih.gov/21274408/)]. [PubMed Central: [PMC3026283](https://pubmed.ncbi.nlm.nih.gov/PMC3026283/)].
- Ohira T, Schmitz KH, Ahmed RL, Yee D. Effects of weight training on quality of life in recent breast cancer survivors: the Weight Training for Breast Cancer Survivors (WTBS) study. *Cancer*. 2006;**106**(9):2076-83. doi: [10.1002/cncr.21829](https://doi.org/10.1002/cncr.21829). [PubMed: [16568409](https://pubmed.ncbi.nlm.nih.gov/16568409/)].
- Raghavendra RM, Nagarathna R, Nagendra HR, Rekha M, Vanitha N, Gopinath KS, et al. Effects of a yoga program on cortisol rhythm and mood states in early breast cancer patients undergoing adjuvant radiotherapy: a randomized controlled trial. *Integr Cancer Ther*. 2009;**8**(1):37-46. doi: [10.1177/1534735409331456](https://doi.org/10.1177/1534735409331456). [PubMed: [19190034](https://pubmed.ncbi.nlm.nih.gov/19190034/)].
- De Luca V, Minganti C, Borriore P, Grazioli E, Cerulli C, Guerra E, et al. Effects of concurrent aerobic and strength training on breast cancer survivors: a pilot study. *Public Health*. 2016;**136**:126-32. doi: [10.1016/j.puhe.2016.03.028](https://doi.org/10.1016/j.puhe.2016.03.028). [PubMed: [27161493](https://pubmed.ncbi.nlm.nih.gov/27161493/)].
- Herrero F, San Juan AF, Fleck SJ, Balmer J, Perez M, Canete S, et al. Combined aerobic and resistance training in breast cancer survivors: A randomized, controlled pilot trial. *Int J Sports Med*. 2006;**27**(7):573-80. doi: [10.1055/s-2005-865848](https://doi.org/10.1055/s-2005-865848). [PubMed: [16802254](https://pubmed.ncbi.nlm.nih.gov/16802254/)].
- Buyse DJ, Reynolds CF, 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;**28**(2):193-213. doi: [10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4). [PubMed: [2748771](https://pubmed.ncbi.nlm.nih.gov/2748771/)].
- Cohen SR, Mount BM, Strobel MG, Bui F. The McGill Quality of Life Questionnaire: a measure of quality of life appropriate for people with advanced disease. A preliminary study of validity and acceptability. *Palliat Med*. 1995;**9**(3):207-19. doi: [10.1177/026921639500900306](https://doi.org/10.1177/026921639500900306). [PubMed: [7582177](https://pubmed.ncbi.nlm.nih.gov/7582177/)].
- Pooranfar S, Shakoor E, Shafahi M, Salesi M, Karimi M, Roozbeh J, et al. The effect of exercise training on quality and quantity of sleep and lipid profile in renal transplant patients: a randomized clinical trial. *Int J Organ Transplant Med*. 2014;**5**(4):157-65. [PubMed: [25426284](https://pubmed.ncbi.nlm.nih.gov/25426284/)]. [PubMed Central: [PMC4243047](https://pubmed.ncbi.nlm.nih.gov/PMC4243047/)].
- Matthews CE, Wilcox S, Hanby CL, Der Ananian C, Heiney SP, Gebretsadik T, et al. Evaluation of a 12-week home-based walking intervention for breast cancer survivors. *Support Care Cancer*. 2007;**15**(2):203-11. doi: [10.1007/s00520-006-0122-x](https://doi.org/10.1007/s00520-006-0122-x). [PubMed: [17001492](https://pubmed.ncbi.nlm.nih.gov/17001492/)].
- Kim JJ, Shin YA, Suk MH. Effect of a 12-week walking exercise program on body composition and immune cell count in patients with breast cancer who are undergoing chemotherapy. *J Exerc Nutrition Biochem*. 2015;**19**(3):255-62. doi: [10.5717/jenb.2015.15092812](https://doi.org/10.5717/jenb.2015.15092812). [PubMed: [26525495](https://pubmed.ncbi.nlm.nih.gov/26525495/)]. [PubMed Central: [PMC4624127](https://pubmed.ncbi.nlm.nih.gov/PMC4624127/)].