

## Analyzing Exercises Types for Cancer Patients

### Kanser Hastalarında Egzersiz Türlerinin Analizi

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#### ABSTRACT

Exercise, a non-pharmacologic therapeutic approach has a crucial role to reduce the side effects of patients with cancer. In this review the possible explanations of the mechanism for how exercise reduces the side effects of cancer and its' treatments were reported. The exercise types that commonly used such as aerobic, resistance, yoga, pilates, breathing, relaxation and stretching exercises and their characteristics were summarized. The most effective exercise strategies and protocols are needed to be determined in further studies. The aim of this literature review is to reveal the parameters and role of exercises in cancer rehabilitation.

**Keywords:** Exercise prescription, oncology, physical therapy, rehabilitation

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#### ÖZET

Farmakolojik olmayan bir terapötik yaklaşım olan egzersiz, kanser hastalarında görülen yan etkileri azaltmada çok önemli bir role sahiptir. Bu derlemede, egzersizin kanserin yan etkilerini nasıl azalttığına ve tedavilerine yönelik mekanizmanın olası açıklamaları rapor edilmiştir. Aerobik ve dirençli egzersiz, solunum egzersizi, gevşeme, germe egzersizleri, yoga, pilates gibi yaygın olarak kullanılan egzersiz türleri ve özellikleri özetlenmiştir. En etkili egzersiz stratejileri ve protokollerinin ileri çalışmalarla belirlenmesi gerekmektedir. Bu literatür taramasının amacı, kanser rehabilitasyonunda egzersizlerin parametrelerini ve rolünü ortaya koymaktır.

**Anahtar Sözcükler:** Egzersiz reçetesi, onkoloji, fizyoterapi, rehabilitasyon

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## INTRODUCTION

The number of cancer cases and cancer related-deaths are growing worldwide. The increasing age, population and lifestyle behaviors such as tobacco use, being overweight, physical inactivity are some of the risk factors for cancer (1, 2). Increased physical activity level could provide some physiologic and functional benefits and improves quality of life. Exercise is a therapeutic modality for cancer patients (3). The importance of cancer care rehabilitation has increased with the rise in the survival of cancer patients (3). Studies have shown that exercise is beneficial during and after curative oncological treatment in various types of cancer (4). Exercise not only plays a vital role in cancer prevention and control (5) but also the primary way to combat the harmful effects of cancer treatments (6). Studies indicate that exercise is a non-pharmacologic therapeutic approach that reduces the side effects of patients with cancer (7). Exercise provide some benefits such as increasing the physical capacity of patients with cancer reducing the side effects of cancer treatment such as fatigue, polyneuropathy, depression, anxiety, and lymphedema, etc. (8). In addition, exercise can support the patient while coping with emotions, sleep problems, sexuality, or functions in society (9).

There are possible explanations of the mechanism for how exercise reduces the side effects of cancer and its' treatments. The exercise relieves the muscle wasting in tumor hosts which could be related to improved redox balance, reduced accumulation of damaged proteins, improved C-Reactive protein levels (10) and an efficient mitochondrial turnover (7). Moreover, performing exercise may reduce chronic systemic inflammation, activate the host tumor defense (e.g., by mobilizing and activating tumor competitive immune cells) and alter hormones (sexual and metabolic) and growth factor (8).

Many studies have shown that low physical activity level is associated with an increased risk for different types of cancer (5, 8). The level of physical activity is important during both pre and post-diagnosis term as well as cancer duration (8). Recent studies have shown that moderate levels of physical activity can decrease the risk of death related to breast cancer; for this reason, exercise may prove to be a valuable intervention to improve not only the quality of life but also survival (11).

Therapeutic exercises are noninvasive, non pharmaceutical, relatively risk-free and safe intervention when implemented with competent personnel and correct guidance (12). Exercises must be done under the supervision of a physiotherapist or other health professional. If the programs are not done in the right form of exercise, intensity, or number of repetitions, the risk of fracture or lymphedema can increase. Therapists should observe their patients' laboratory test results and vital values such as heart rate, blood pressure, and respiratory frequency before, after and during exercise therapy. In literature, the most commonly used types of exercises are aerobic (walking, cycling...) aquatic, resistance, range of motion (ROM), relaxation and breathing can use within the scope of cancer rehabilitation (12). Moreover proprioceptive neuromuscular facilitation (PNF) techniques, yoga, Qigong, Tai Chi can be used in oncological rehabilitation (9, 13).

The studies showed that the FITT principle (Frequency, Intensity, Time, Type of exercise) and progression of exercise (8,9). The aim of this study was to contribute information to the literature and review the current studies about therapeutic exercises for patients with cancer.

### Aerobic exercise

Aerobic exercises reduce the risk of cancer and cancer related problems. According to The American Collage of Sports Medicine's guideline, 150-300 min/week moderate or 75-150 min/week vigorous aerobic exercise prevents from 7 common cancers types. (bladder, breast, colon, endometrial, esophageal, kidney and stomach cancers)(5).

Supervised aerobic exercise has some therapeutic impacts on cancer survivors and reduce cancer-related fatigue (14), insulin levels, sleep disturbance, anxiety and depressive symptoms (15, 12). It is also an important component for survival for lung, breast, colon and prostate cancer rehabilitation (12).

Exercise training seems to be a feasible therapeutic approach for most of the cancer survivors, and effective for improving functional movements, body composition and emotions (16). It improves the quality of life in several aspects, such as increasing general health (10).

In cancer patients, aerobic exercise programs vary from 2 to 4 days per week. The encountered data of aerobic exercise programs in the literature include at least 6 weeks and more than 12 weeks.

When determining the intensity of aerobic exercises, maximum heart rate or Borg scale: a common measurement to evaluate fatigue values are taken into consideration. Studies have conducted the moderate to vigorous intensity between 60 and 80 percent of the maximum heart rate, and at perceived exhaustion between 11-13 point according to Borg Scale (6 to 20 point, Borg Scale).

In these studies, aerobic exercises have been performed with various types such as treadmill (walking / jogging), cycling, etc. However, other types of exercises like swimming, trekking in nature are not preferred owing to the fact that they can have some risks for cancer patients (10,15,17-20).

### Resistance exercise

Resistance exercise can help to decrease in the risk of coronary artery disease, hypertension and heal glycemic control. The studies show that a supervised resistive exercise training can set against side effects of cancer treatment such as fatigue, weakness, decreased function, pain (12,13). The improvement in pain can be associated with the increases in upper/lower extremity strength and endurance (21). Resistance exercise decreases muscle wasting, enhances the ability for activities of daily living, improves health status perceptions and quality of life in cancer patients (22).

Muscle strength training can be performed for all major muscle groups in the upper and lower extremities, trunk and to affected areas by cancer or cancer treatments (13). Resistance exercises are performed in an average between 6-12 repetitions and 2-4 sets per exercise (10,21,22). The intensity of the exercise is determined according to 1 Repetition Maximum (RM) test and the exhaustion is determined on Borg Scale. According to the Borg Scale, the perceived effort is 13 out of 20, which means the intensity of exercise is moderate (21,22). The intensity of the exercise can be started at 25-30% and progress to 65-70% of their 1 RM(23). The progression of training can be performed according to Delorme's method (24).

Free weights, dumbbells (average of 1-5 kg), weight machines, pulleys and elastic resistance bands can be used to supply resistance (21,22). The PNF approach is a method used to improve strength, endurance, and length/stretch of muscles (13). The patient's acute medical condition should be consider for progression of resistance exercise. If the patient is unable to tolerate RM assessment or vigorous exercise, progression of resistance can be ensured based on patient's symptoms, vital signs and rating of perceived exertion (RPE). Some functional movements (chair rises, ambulation...) can help for increasing strenght in elderly cancer patients (12).

### Yoga

Yoga has been shown to improve health, quality of life, physical functions, cardiopulmonary capacity and decrease distress, anxiety, depression, sleep disturbances, and fatigue (25). In addition, mind-body exercises in yoga provides cognitive, perceptual, spiritual improvement, and relaxation (35). The effects of yoga were researched for some cancer groups such breast, gastrointestinal, lymphoma, gynecological, genitourinary, sarcoma and etc (25).

Yoga affects relieving symptoms caused by cancer and cancer treatments like chemotherapy, radiotherapy, etc. Yoga is a mind-body combined therapy which includes yoga *asanas* or physical postures, *pranayama*, controlled breathing, relaxation, and meditation (25). Neck bending, hand clenching, elbow bending, shoulder rotation, toe bending, standing and sitting postures, flexibility and breathing exercises can be performed in Yoga. There are different types of exercises, named as Yogic sukshma (vyayamas, yoga asanas, tadasana, sasanksana, bhujangasana, makarasana, etc.) (26).

In the literature, Yoga exercises are performed between 60-90 minutes per week and in total of 6-12 weeks. Yoga can be performed in 30 minutes sessions daily. The exercise program should include warm up, loading and cool down periods. There are several intensities such as low to moderate intensity for beginner/ intermediate level or moderate to high intensity level according to patient's health situation. It can be advised to the patients as a part of home program (27-34).

### Pilates

Pilates exercises can be recommended to cancer patients for beneficial effects like increase in muscle strength, flexibility, body awareness, etc. (36,37).

Exercise programs include core stabilization, which is the basis for Pilates exercises, spinal stabilization and appropriate posture techniques. Pilates exercise programme can include breathing exercises combined with shoulder rotation, neck flexion-extension, body rotation and lateral flexion, mini-squat, leg stretch, dorsal-plantar flexion of ankle. There are different kinds of Pilates exercises, for example Cleopatra, Toy Soldier, Chester stretch, and swinging exercises in the standing position, Hundreds, one-leg stretch, double-leg stretch, scissors, shoulder bridge, etc.(38,39). The exercise program should be designed to include warm up, loading and cool down periods. This program can be progressed with resistance of elastic bands (39).

Pilates exercises can be performed for 45-60 minutes per day and 3 days a week. It is recommended that these exercises are performed on average of 8 weeks. Each exercise can be done in 10 repetition/2 sets (40,41). Pilates exercises improve physical condition, core stability, body and self-awareness, joint range of motions, muscle strength, relaxation, control of the mind, and decrease stress. Pilates exercises are used in cancer patients due to these effects (37,40).

#### Breathing exercise

Breathing exercises improve quality of life and pulmonary functions in cancer patients. Especially, it may significantly improve post-operative pulmonary functions in patients with cancer (42).

Breathing training includes thoracic and abdominal (deep, slow and segmental) breathing exercises, lung expansion technique, pursed lip breathing, coughing exercise, and forced respiratory training. Spirometers and inspiratory muscle trainer (IMT) can be used for assisting the breathing exercises. Also, aerobic, resistance, endurance and strength training for upper and lower limbs can be combined with breathing exercises (43-45).

Breathing exercises can be performed 2-4 times a day, in the form of 15-30 minute sessions. In the literature, the duration of breathing exercises vary from 1 week to 6 months. Breathing exercises can be performed in the preoperative, perioperative and postoperative periods (43,45).

Breathing exercises have a lot of curative effects like correct breathing errors, adjusting breathing pattern, increase diaphragm activity, elevate alveolar ventilation, decrease energy consumption and dyspnea (42).

#### Relaxation exercises

Muscle relaxation exercises are performed for 20-50 minutes in one session, for 3-8 weeks, 2 or 3 times per week in cancer patients. The programs including muscle relaxation exercises are usually practiced at home visit or can be followed from a compact disc (46,47). Relaxation exercises are first taught by practicing with the patient in the form of a home visit. Patients after perform the exercise by watching the compact disc on which the exercises are recorded (47).

Muscle relaxation exercises are reported to decrease fatigue and pain, and increase the quality of life in cancer patients (46,48). Relaxation exercises can also reduce dyspnea in cancer patients(12). It is recommended that relaxation exercises be done in a room with sufficient light and heat, where patient will feel comfortable (46).

#### Stretching exercises

Restricted normal joint movements often causes decreased function and difficulties activities of daily living such as ambulation, dressing, bathing. Studies have shown that fibroblast formation and soft tissue remodeling are induced by prolonged stretching. Still, reports on the exact ideal duration for stretching have been varied, from 30 seconds to at least 20 minutes (12). Stretching exercises are an essential part of physical activity programs, but it remains unclear whether they reduce the risk of injury or not. Stretching exercises are used in the exercise programs in combination with aerobic, resistance, and yoga exercises to improve flexibility in cancer patients.

Stretching exercises usually involve the calf muscles, quadriceps, and hamstrings and can be performed to stretch major muscle groups for 10 minutes a day between other activities. These exercises consist of a static stretching set in which muscle elongation is ensured for at least one minute (16,18-20). Patients should be careful during stretching exercise because there are some risk for lymphedema and infection who are immune-compromised (especially use of equipment at public gyms) and fracture risk for osteoporosis or bony metastases (5).

Although it is not clear whether stretching exercise reduce risk of injury, some physical activities require flexibility (18). In these days there is a growing preference for stretching and flexibility related exercises (20). Stretching exercises are recommended for cancer survivors but there is a limited number of studies on the safety of this exercise type (5).

#### Effects of exercises programs in cancer patients

In the studies, it has been found that regular exercise programs have many benefits in cancer patients (10,14,16). Exercises can have therapeutic effect in cancer survivors on depression and anxiety, sleeping disorders, cancer-related fatigue, body composition and function(16). Additionally exercise has been known to have an effective method for improving emotional functioning, quality of life (48) and general health (10) in cancer patients.

Moreover, aerobic exercises are also known to reduce the recurrence risk of cancer which is the major effect of exercises in cancer survivors. It is needed to investigate which exercise is beneficial in different cancer types. Exercise training is shown as a feasible approach for most of the cancer patients (14-16,19). The body parts affected by cancer and their treatment can be recovered throughout exercise during the period of cancer treatments. In this review, the commonly used exercise types and their characteristics were reported. The most effective exercise strategies and protocols are needed to be determined in further studies.

#### CONCLUSION

In the literature review, it was seen that the most common type of exercise which has been used in cancer patients was aerobic exercise. However, a large number of studies investigated the effects of a combination of several exercise types and found them useful. It is clear that the exercises have beneficial effects when they are used correctly with appropriate number of repetitions. The type and frequency of exercises vary in studies. There is a need to determine the effects of individualized programs for the cancer patients (14).

While planning a specific exercise program for a cancer patient, it is important to know patient's request/demand, physical capacity, general physical functions, mobilization level of the patient, blood values, chemotherapy and radiotherapy process, and stage of cancer. Moreover, there are several types and determinants of exercise, such as intensity, severity, frequency, duration, and timing. It is necessary to know how to plan the exercise (14).

Finally, some sort of exercises need further investigation owing to the fact that there is a limited number of studies in the literature that apply specific exercise kinds and report their effects. For example, the individual effects of stretching exercises, which are commonly included in yoga and pilates exercise programs, have not been widely examined (16,18-20). Therefore, future studies may focus on the effects of individual exercises on cancer population.

#### Conflict of interest

No conflict of interest was declared by the authors.

#### REFERENCES

- 1.Torre LA, Siegel RL, Ward EM, Jemal A. Global cancer incidence and mortality rates and trends - An update. *Cancer Epidemiology Biomarkers and Prevention*. 2016;25(1):16-27.
- 2.Morris GS, Barbe C, Miller L. Increasing the clinical utility of exercise training as a modality in the oncology setting—What we learned in 2019. *Physical Therapy Reviews*. 2020;25(4):225-234.
- 3.Douglas E. Exercise in cancer patients. *Physical Therapy Reviews*. 2005;10(2):71-88.
- 4.Igelström H, Berntsen S, Demmelmaier I, Johansson B, Nordin K. Exercise during and after curative oncological treatment—a mapping review. *Physical Therapy Reviews*. 2017;22(3-4):103-115.
- 5.Schmitz KH, Courneya KS, Matthews C, et al. American college of sports medicine roundtable on exercise guidelines for cancer survivors. *Med Sci Sports Exerc*. 2010;42(7):1409-1426.
- 6.Murphy R, Wassersug R, Dechman G. The role of exercise in managing the adverse effects of androgen deprivation therapy in men with prostate cancer. *Physical Therapy Reviews*. 2011;16(4):269-277.
- 7.Ballarò R, Penna F, Pin F, Gómez-Cabrera MC, Viña J, Costelli P. Moderate exercise improves experimental cancer cachexia by modulating the redox homeostasis. *Cancers (Basel)*. 2019;11(3):1-20.
- 8.Eschke RCKR, Lampit A, Schenk A, et al. Impact of Physical Exercise on Growth and Progression of Cancer in Rodents—A Systematic Review and Meta-Analysis. *Front Oncol*. 2019;9(February).

- 9.Mishra SI, Scherer RW, Geigle PM, Berlanstein DR, Topaloglu O, Gotay CC SC. Exercise interventions on health-related quality of life for cancer survivors ( Review ) Exercise interventions on health-related quality of life for cancer survivors. *Cochrane Database of Systematic Reviews Exercise*. 2015;(8).
- 10.Galvão DA, Taaffe DR, Spry N, Joseph D, Newton RU. Combined resistance and aerobic exercise program reverses muscle loss in men undergoing androgen suppression therapy for prostate cancer without bone metastases: A randomized controlled trial. *Journal of Clinical Oncology*. 2010;28(2):340-347.
- 11.Margaret L. McNeely, Kristin L. Campbell, Brian H. Rowe, Terry P. Klassen, John R. Mackey KSC, Abstract. Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. *research*. 2006;175(1):34-41.
- 12.Stubblefield MD. *Cancer Rehabilitation: Principles and Practice*.
- 13.Alan PV Carvalho, Flávia MR Vital BGS. Exercise interventions for shoulder dysfunction in patients treated for head and neck cancer ( Review ) Exercise interventions for shoulder dysfunction in patients treated for head and neck cancer. *Cochrane Database of Systematic Reviews Exercise*. 2012;(4):10-12.
- 14.Brown JC, Winters-Stone K, Lee A, Schmitz KH. Cancer, Physical Activity, and Exercise. *Compr Physiol*. 2014;2(4):2775-2809.
- 15.Segar ML, Katch VL, Roth RS, Garcia AW, Portner TI, Glickman SG, Haslanger S, Wilkins EG. The effect of aerobic exercise on self esteem and depressive and anxiety symptoms among breast cancer survivors. 1998;vol 25, no.
- 16.Heinrich KM, Intensity F, Heinrich KM, et al. High-intensity functional training improves functional movement and body composition among cancer survivors : a pilot study. 2015;(April):812-817.
- 17.Dimeo FC, Tilmann MHM, Bertz H, Kanz L, Mertelsmann R, Joseph Keul. Aerobic exercise in the rehabilitation of cancer patients after high dose chemotherapy and autologous peripheral stem cell transplantation. *Cancer*. 1997;79(9):1717-1722.
- 18.Bultjinc R, Van Ruymbeke B, Everaert S, et al. Availability of prostate cancer exercise rehabilitation resources and practice patterns in Belgium: Results of a cross-sectional study. *Eur J Cancer Care (Engl)*. 2018;27(1):1-8.
- 19.Steffens D, Young J, Beckenkamp PR, et al. Feasibility and acceptability of PrE-operative Physical Activity to improve patient outcomes After major cancer surgery: Study protocol for a pilot randomised controlled trial (PEPA Trial). *Trials*. 2018;19(1):1-9.
- 20.Vallance J, Lavallee C, Culos-Reed N, Trudeau M. Rural and small town breast cancer survivors' preferences for physical activity. *Int J Behav Med*. 2013;20(4):522-528.
- 21.Mcneely ML, Parliament MB, Seikaly H, et al. Effect of Exercise on Upper Extremity Pain and Dysfunction in Head and Neck Cancer Survivors. *Cancer*. 2008;113(May):214-222.
- 22.Hacker ED, Larson JL,Peace D. Exercise In Patients Receiving Hematopoietic Stem Cell Transplantation: Lessons Learned And Results From A Feasibility Study. *Oncol Nurs Forum*. 2013;38(2):216-223.
- 23.Jonna K. Van Vulpen, Miranda J. Velthuis, Charlotte N. Steins Bisschop, Noe' Mie Travier, , Bram J. W. Van Den Buijs FJGB. Effects of an Exercise Program in Colon Cancer Patients Undergoing Chemotherapy. *Official Journal of the American College of Sports Medicine*. Published online 2016:767-775.
- 24.Fish DE, Krabak BJ, Johnson-Greene D, DeLateur BJ. Optimal Resistance Training: Comparison of DeLorme with Oxford Techniques. *Am J Phys Med Rehabil*. 2003;82(12).
- 25.Lopez G, Chaoul A, Powers-james C, et al. Group Yoga Effects on Cancer Patient and Caregiver Symptom Distress : Assessment of Self-reported Symptoms at a Comprehensive Cancer Center. *Integr Cancer Ther*. 2018;17(4):1087-1094.
- 26.Buffart LM, Uffelen JGZ, Riphagen II, et al. Physical and psychosocial benefits of yoga in cancer patients and survivors, a systematic review and meta-analysis of randomized controlled trials. *BMC Cancer*. 2012;12(1):1.
- 27.Kaur G, Prakash G, Malhotra P, Ghai S, Kaur S,Singh M and KK. Home-Based Yoga Program for the Patients Suffering from Malignant Lymphoma during Chemotherapy: A Feasibility Study. *Int J Yoga*. 2018;11(3):249-254.
- 28.Yagli VN, Çener G, Arıkan H, et al. Do yoga and aerobic exercise training have impact on functional capacity, fatigue, peripheral muscle strength, and quality of life in breast cancer survivors? *Integr Cancer Ther*. 2015;14(2):125-132.
- 29.Yagli VN, Ülger Ö. The effects of yoga on the quality of life and depression in elderly breast cancer patients. *Complement Ther Clin Pract*. 2015;21(1):7-10.
- 30.Chandwani KD, Perkins G, Nagendra HR, et al. Randomized, Controlled Trial Of Yoga İn Women With Breast Cancer Undergoing Radiotherapy. *Journal of Clinical Oncology*. 2014;32(10):1058-1065.
- 31.Raghavendra M Rao, H R Nagendra, Nagarathna Raghuram, C Vinay, S Chandrashekara, K S Gopinath and BSS. Influence of yoga on mood states, distress, quality of life and immune outcomes in early stage breast cancer patients undergoing surgery. *Int J Yoga*. 2008;1(1):11-20.
- 32.Harder H, Langridge C, Solis-Trapala I, Zammit C, Mokshini G, Rees D, Burkinshaw L, Jenkins V. Post-operative exercises after breast cancer surgery: results of a RCT evaluating standard care versus standard care plus additional yoga exercise. *Eur J Integr Med*. 2015;7(3):202-210.
- 33.Lötzke D, Wiedemann F, Rodrigues Recchia D, et al. Iyengar-Yoga Compared to Exercise as a Therapeutic Intervention during (Neo)adjuvant Therapy in Women with Stage I–III Breast Cancer: Health-Related Quality of Life, Mindfulness, Spirituality, Life Satisfaction, and Cancer-Related Fatigue. *Evidence-Based Complementary and Alternative Medicine*. 2016;2016:1-8.
- 34.Alejandro Chaoul, Kathrin Milbury, Amy Spelman, Karen Basen-Engquis, Martica Hall, Qi Wei, Ya-Chen Tina Shih, Banu Arun, Vicente Valero, George Perkins, Gildy Babiera, Tenzin Wangyal, Rosalinda Engle, Carol Harrison, Yisheng Li and LC. Randomized trial of Tibetan Yoga in Breast Cancer Patients Undergoing Chemotherapy. *HHS Public Access*. 2015;40(4):1291-1296.
- 35.Stan DL, Croghan KA, Croghan IT, Jenkins SM, Sutherland SJ, Chevillat AL PS. Randomized pilot trial of yoga versus strengthening exercises in breast cancer survivors with cancer-related fatigue. *Support Care Cancer*. 2016;24(9):4005-4015.
- 36.Eyigor S, Karapolat H, Yesil H, Uslu R, Durmaz B. Effects of pilates exercises on functional capacity , flexibility , fatigue , depression and quality of life in female breast cancer patients : a randomized controlled study C ER IG E IN. *EUR J PHYS REHABIL MED*. 2010;46(4):481-487.
- 37.Kim S Keays, Susan R Harris, Joe Lucyshyn DLM. Effects of Pilates Exercises on Shoulder Range of Motion, Pain, Mood, and Upper-Extremity Function in Women Living With Breast Cancer: A Pilot Study. *Phys Ther*. 2008;88(4):494-510.
- 38.Eyigor S, Karapolat H, Yesil H, Uslu R DB. Effects of pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in female breast cancer patients: a randomized controlled study. *Eur J Phys Rehabil Med*. 2010;46(4):481-487.
- 39.Şener HÖ, Malkoç M, Ergin G, Karadibak D, Yavuzşen T. Effects of Clinical Pilates Exercises on Patients Developing Lymphedema after Breast Cancer Treatment : A Randomized Clinical Trial. *Original Article J Breast Health*. 2017;13:16-22.
- 40.Martin E, Battaglini C, Groff D NF. Improving muscular endurance with the MVE Fitness Chair™ in breast cancer survivors: a feasibility and efficacy study. *J Sci Med Sport*. 2013;16(4):372-376.
- 41.Zengin Alpozgen A, Razak Ozdinciler A, Karanlık H, Yaman Agaoglu F NAN. Effectiveness of Pilates-based exercises on upper extremity disorders related with breast cancer treatment. *Eur J Cancer Care (Engl)*. 2017;26(6).
- 42.Liu W, Pan YL, Gao CX, Shang Z, Ning LJ, Liu X. Breathing exercises improve post-operative pulmonary function and quality of life in patients with lung cancer: A meta-analysis. *Exp Ther Med*. 2013;5(4):1194-1200.
- 43.Yang M, Zhong J Di, Zhang J E, Huang X Xiao, Li C Zhen, Hong Z Xiang. Effect of the self-efficacy-enhancing active cycle of breathing technique on lung cancer patients with lung resection: A quasi-experimental trial Mei. *European Journal of Oncology Nursing*. 2018;34(February):1-7.
- 44.Wang, Ya-Qing, Xin Li, Yong Jia JX. Impact of breathing exercises in subjects with lung cancer undergoing surgical resection : A systematic review and meta- analysis. *J Clin Nurs*. 2020;(September 2018):717-732.
- 45.Jonsson M, Hurtig-wennlöf A, Ahlsson A, Vidlund M, Cao Y, Westerdahl E. In-hospital physiotherapy improves physical activity level after lung cancer surgery : a randomized controlled trial. *Physiotherapy*. Published online 2019:1-8.
- 46.Dikmen HA, Terzioğlu F. Effects of Reflexology and Progressive Muscle Relaxation on Pain, Fatigue, and Quality of Life during Chemotherapy in Gynecologic Cancer Patients. *Pain Management Nursing*. 2019;20(1):47-53.
- 47.Yilmaz SG, Arslan S. Effects of progressive relaxation exercises on anxiety and comfort of Turkish breast cancer patients receiving chemotherapy. *Asian Pacific Journal of Cancer Prevention*. 2015;16(1):217-220.
- 48.Isa RM, Moy FM, Razack AHA. Impact of applied progressive deep muscle relaxation on the health related quality of life among prostate cancer patient- a quasi experimental trial. *Prev Med*. Published online 2013.