

## **Physical Activity for Adult Cancer Survivors: A Literature Review**

**Apichai WATTANAPISIT**

*School of Medicine, Walailak University, Nakhon Si Thammarat 80161, Thailand*

**(Corresponding author's e-mail: apichai.wa@wu.ac.th)**

*Received: 3 September 2015, Revised: 8 November 2015, Accepted: 22 December 2015*

### **Abstract**

Cancer survivors have suffered from the diseases and are a unique medical population with a wide variety of treatment options that put them at risk for both short- and long-term side effects. Physical activity is one of the healthy behaviours which can decrease suffering and improve health quality. This article reviews the evidence-based data about the benefits of physical activity, a physical activity programme, and precautions and special considerations of physical activity among adult cancer survivors. The current evidence supports the view that cancer survivors get physiological and psychological benefits from physical activity. Aerobic and resistance training activities are main components of physical activity for cancer survivors during and after treatment. However, cancer survivors need cancer-specific approaches and individualised physical activity or exercise programmes to decrease the risk of injuries and complications. In summary, cancer survivors should do enough physical activity and avoid inactivity, depending on their health conditions. Most studies in this field have been done in breast, prostate, colon, haematologic, and gynaecologic cancer survivors. The knowledge in other types of cancers is still required.

**Keywords:** Benefits, cancer survivor, exercise, physical activity, physical activity programme

### **Introduction**

In general, scientific evidence suggests that physical activity reduces the risk of several cancer types, for instance, colon, breast, and endometrial cancers [1,2]. Healthy people can benefit from physical activity, in terms of cancer prevention. However, cancer survivors (cancer survivors are defined as cancer patients who have had diagnoses of cancers and have had treatments; they have survived from the cancers) [3,4] have suffered from cancer. They are a unique medical population with a wide variety of treatment options (surgery, chemotherapy, radiotherapy, hormonal therapy, and targeted therapy) that put them at risk of both short- and long-term side effects. Recently, research includes awareness that cancer survivors can achieve the same physiological and psychological benefits of physical activity as those in the general population [5], for example, cardiorespiratory fitness, muscular strength, flexibility, body composition, quality of life, and other psychosocial factors.

The physical activity guidelines for Americans [6] suggest that adults with chronic conditions obtain health benefits from regular physical activity. The guidelines also recommend that adults with chronic conditions should be under the care of a health-care provider. People with chronic conditions and symptoms should consult their health-care providers regarding the types and amounts of activity appropriate for them. Basically, many cancer survivors will be deconditioned from the disease and its treatments (as a person with chronic conditions), moreover, they are concerned about many aspects of their health since diagnosis of the cancer. Consequently, cancer survivors might need specific information on physical activity behaviours.

This article includes both background and foreground knowledge from textbooks, guidelines, review articles, and research articles. The primary objective of this article is to explore the important

considered aspects about physical activity in adult cancer survivors. The main contents of the article consist of benefits of physical activity among cancer survivors, physical activity programme for cancer survivors, and precautions and special considerations of physical activity in cancer survivors. In addition, knowledge gaps and current evidence regarding associated factors of physically active behaviours are represented in the discussion. This review is intended to highlight the important issues of physical activity and exercise for health-care providers and fitness professionals who are interested in implementing physical activity programmes for adult cancer survivors.

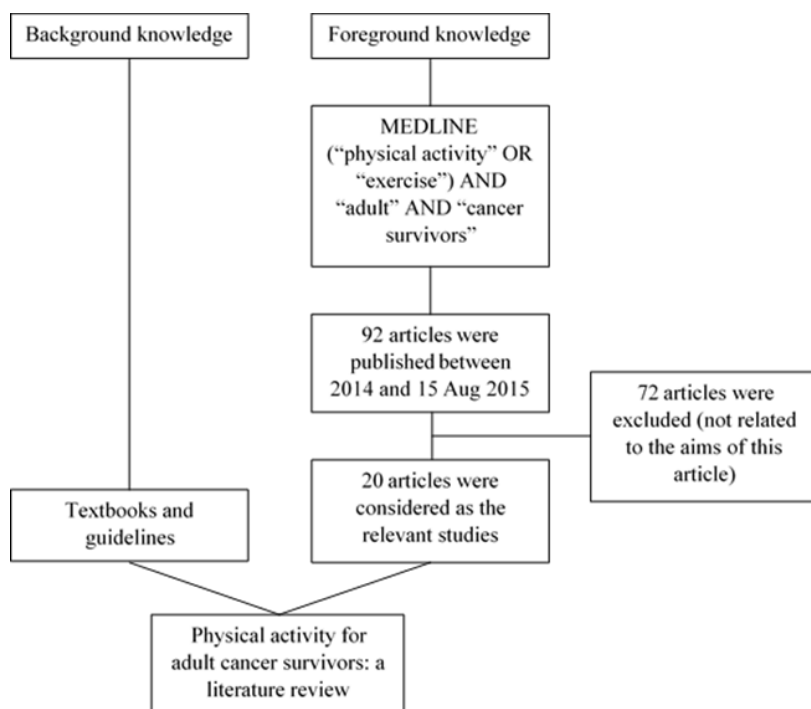
### Methods

The author reviewed textbooks and guidelines. The online database was searched from MEDLINE on 15<sup>th</sup> August 2015. The search terms were (“physical activity” OR “exercise”) AND “adult” AND “cancer survivors”, and the articles must be published from 2014 in the English or Thai language. The studies from MEDLINE were excluded if their titles, abstracts, or contents were unrelated to the purpose of this article. The studies, which investigated physical activity or exercise in patients with metastatic cancers, were excluded.

### Results and discussion

#### Relevant studies

The background knowledge was taken from a review of chapters in relevant textbooks in the field of physical activity and 2 guidelines (American College of Sports Medicine Roundtable on Exercise Guidelines for Cancer Survivors and Nutrition and Physical Activity Guidelines for Cancer Survivors) [4,7]. For the foreground knowledge, a total of 92 articles were found from the online database (MEDLINE); 72 articles were excluded because their titles, abstracts, or contents were not related to the aims of this article (**Figure 1**). Finally, 20 articles were considered as relevant studies (**Table 1**).



**Figure 1** Process of the review.

**Table 1** List of the relevant studies.

<b>Titles</b>	<b>Year of publication</b>
1. Working toward a good life as a cancer survivor: a longitudinal study on positive health outcomes of a rehabilitation program for young adult cancer survivors [8]	2015
2. High-intensity functional training improves functional movement and body composition among cancer survivors: A pilot study [9]	2015
3. Physical activity, fitness, and cardiometabolic risk factors in adult survivors of childhood cancer with a history of hematopoietic cell transplantation. Biology of blood and marrow transplantation [10]	2015
4. A clinic-supported group exercise program for head and neck cancer survivors: Managing cancer and treatment side effects to improve quality of life. Supportive care in cancer [11]	2015
5. Adolescents and young adult cancer survivors: exercise habits, quality of life and physical activity preferences [12]	2015
6. The influence of comorbid chronic diseases and physical activity on quality of life in lung cancer survivors [13]	2015
7. Quality of life, body mass index, and physical activity among uterine cancer patients [14]	2014
8. Mediators of physical exercise for improvement in cancer survivors' quality of life [15]	2014
9. A multimodal physiotherapy programme plus deep water running for improving cancer-related fatigue and quality of life in breast cancer survivors [16]	2014
10. Evidence for adapted physical activity as an effective intervention for upper limb mobility and quality of life in breast cancer survivors [17]	2014
11. The effect of aerobic exercise on quality of life among breast cancer survivors: A randomized controlled trial [18]	2014
12. Biobehavioral factors mediate exercise effects on fatigue in breast cancer survivors [19]	2014
13. Depressed mood in breast cancer survivors: associations with physical activity, cancer-related fatigue, quality of life, and fitness level [20]	2014
14. Experiences of breast cancer survivors participating in a tailored exercise intervention -a qualitative study [21]	2014
15. Rationale for promoting physical activity among cancer survivors: Literature review and epidemiologic examination [22]	2014
16. The effect of resistance exercise on all-cause mortality in cancer survivors [23]	2014

---

<b>Titles</b>	<b>Year of publication</b>
17. Physical activity and telomere length in early stage breast cancer survivors [24]	2014
18. Effects of supervised exercise on motivational outcomes in breast cancer survivors at 5-year follow-up [25]	2014
19. Exercise bra discomfort is associated with insufficient exercise levels among Australian women treated for breast cancer [26]	2014
20. Physical activity preferences of early-stage lung cancer survivors [27]	2014

---

### **Benefits of physical activity among cancer survivors**

Historically, cancer patients were advised to rest and avoid activity; however, emerging evidence-based data on physical activity and exercise challenged this belief [4]. Physical activity and exercise during and after cancer treatment can improve physical functions and various aspects of quality of life [4,5,7]. There are many studies that support physical activity and exercise giving positive effects on both physiological and psychological aspects; most studies focus on breast, prostate, colon, haematologic, and gynaecologic cancer survivors [4,5]. Therefore, different studies have various methods and outcomes, so some issues are still dilemmatic or inconclusive. The following paragraphs mention evidence-based data on the benefits of physical activity and exercise in cancer survivors.

#### **Cardiorespiratory (aerobic) fitness**

The studies in breast, prostate, and haematologic cancer survivors [4,5] show strong evidence of positive effects of exercise on aerobic fitness. One study [8] showed a significant improvement of physical fitness ( $P < 0.01$ ) and lung capacity ( $P < 0.05$ ) among 24 - 35 years old cancer survivors (lymphoma, gynaecological, breast, testes, colon, sarcoma, and head and neck) after implementing a rehabilitation programme which included physical exercise.

#### **Muscular strength and endurance**

In general, resistance exercise is an activity which aims to improve strength and endurance of the muscular system; the evidence showed the positive effects in cancer survivors, especially breast and prostate cancer survivors [4,5]. Additionally, a study showed that high-intensity functional training could improve the ability to carry a weighted object and strength of lower body ( $P < 0.01$ ) [9].

#### **Flexibility**

There are several randomised control trials (RCTs) that proved statistical significance of exercise intervention and improved flexibility in breast cancer survivors after treatment (surgery or radiation) [4,5].

#### **Body composition**

The American College of Sports Medicine (ACSM)'s exercise guidelines for cancer survivors [4] stated evidence category B (results are inconsistent) about body composition which some studies showed statistically significant positive effects on one or more following variables: body weight, body mass index (BMI), fat mass, body fat percentage, and waist circumference in breast and prostate cancer survivors. Some previous studies supported these outcomes, for example, Heinrich *et al.* [9] found that high-intensity functional training could significantly decrease fat mass and percentage of body fat. Another study [10], which studied the differences of body composition and blood chemistry among inactive ( $< 150$  min per week of moderate-intensity physical activity) and active ( $\geq 150$  min per week of moderate-intensity physical activity) haematologic cancer survivors, depicted lower waist circumference

in active participants. In contrast, a study in uterine (gynaecologic) cancer patients [14] did not find significantly different BMI among active and inactive patients.

### **Quality of life**

The ACMS's guidelines [4] summarised that physical activity and exercise could improve the quality of life as evidence category B for breast and prostate cancer survivors; as evidence category C (results stem from uncontrolled, nonrandomised studies) for haematologic cancer survivors. Numerous studies [8,11-13,15-18] showed significant improvement in the quality of life among multiple groups of cancer survivors (breast, lung, haematologic, gynaecologic, testes, colon, sarcoma, head and neck, etc.).

### **Fatigue**

Fatigue could be reduced by aerobic and resistance exercise training among prostate cancer survivors (evidence category A: Overwhelming data from RCTs) [4]. In breast cancer survivors, the evidence was category B. For haematologic cancer, the data demonstrated evidence category B or C, depending on the treatments of cancer [4]. The supporting evidence from studies in breast, head and neck, and mixed cancer survivors [11,15,16,19] represented statistically significant improvement of fatigue after exercise interventions.

### **Other psychosocial factors**

The ACSM's guidelines [4] verified evidence category B of efficacy of exercise training on anxiety, depression, and body image in breast cancer survivors. Capozzi *et al.* study [11] found that the group exercise programme could improve depression ( $P < 0.05$ ) and anxiousness ( $P < 0.05$ ) of head and neck cancer survivors. A study in mixed cancer survivors [15] reported positively significant effects of physical exercise on mental distress ( $\beta = -0.86$ , 95 % CI  $-1.25; -0.52$ ). Another study [20], which investigated the association between depressed mood in breast cancer survivors and physical activity, discovered the significant negative correlation ( $r = -0.19$ ,  $P = 0.04$ ) between depression and physical activity level. Qualitatively, one study [21] showed that breast cancer survivors, who participated in a tailored exercise intervention, had better psychological functions and mood.

### **Risk of cancer recurrence and cancer-related mortality**

The guidelines and reviews of scientific evidence [2,4,7,22] supported the belief that physical activity could reduce risk of cancer recurrence. In addition, it could lower risk of cancer-related mortality [22]. Hardee *et al.* [23] reported that among cancer survivors who participated in resistance exercise had a 33 % lower risk for all-cause mortality (95 % CI 0.45; 0.99).

### **Physical activity programme for cancer survivors**

The 2008 Physical Activity Guidelines for Americans [6] recommends adults (18 - 64 years old) should have at least 150 min per week of moderate-intensity physical activity (physical activity that is done at 3.0 to 5.9 times the intensity of rest) or 75 min per week of vigorous-intensity physical activity (physical activity that is done at 6.0 or more times the intensity of rest), and at least 2 times a week of muscle strengthening activities. For older adults, the recommendations are the same as adults' recommendations, and balance training should be done at least 3 days a week for older adults at risk of fall. The guidelines also suggest that adults with chronic medical illnesses should engage in regular physical activity for promoting quality of life and reducing risk of developing new conditions. The recommendation encourages people with chronic medical conditions to avoid being inactive and do appropriate types and amounts of physical activity under health-care providers' supervision [6].

Generally, cancer survivors have chronic medical conditions from cancer itself and side effects of treatments (surgery, radiation, chemotherapy, hormonal therapy, and targeted therapy); they should follow the guidelines for adults with chronic medical illness. However, exercise prescription for cancer survivors have some different considerations among each type of cancer. The next section emphasises the

important considerations and recommendations on physical activity and exercise for breast, prostate, colon, haematologic, and gynaecologic cancer survivors.

#### **Aerobic exercise training [4,5]**

Breast, prostate, colon, haematologic (no haematopoietic stem cell transplantation [HSCT]) cancer survivors should follow the age-appropriate guidelines from the 2008 Physical Activity Guidelines for Americans. Furthermore, haematologic cancer survivors who received HSCT should do lighter intensity and lower progression of intensity activities. Gynaecologic cancer survivors are suggested to do the same as age-appropriate guidelines, but morbidly obese women may require additional supervision.

#### **Resistance trainings [4,5]**

Prostate and haematologic cancer survivors can follow the 2008 Physical Activity Guidelines for Americans. Breast cancer survivors should start with a supervised programme and very low resistance; progress resistance at small increments. For colon cancer survivors with a stoma or an ostomy, the recommendations are same as the age-appropriate guidelines, but the training programme should be started with low resistance and progress slowly to avoid herniation at the stoma. Gynaecologic cancer survivors should be cautioned if they have had lymph node removal or radiation to lymph nodes in the groin.

#### **Precautions and special considerations of physical activity in cancer survivors**

Cancer survivors may be at risk of injuries from their conditions, inappropriate exercise programme or accidents during activities. The following parts of the review consider issues before and during an exercise programme.

#### **Cancer-specific risk of injury and contraindications for starting exercise [3,4]**

##### *Breast cancer*

Women with immediate shoulder or arm problems from cancer treatment should seek medical care. Lymphoedema and fracture (osteoporosis secondary to hormonal therapy) risks should be aware.

##### *Prostate cancer*

Men, who are treated with hormonal therapies, have a higher risk of fracture. Weight bearing exercise and resistance exercise should be evaluated properly before prescribing an exercise programme.

##### *Colon cancer*

Increasing intra-abdominal pressure may induce herniation at the stoma, so patients with a stoma or an ostomy should be concerned regarding this issue. Participating in contact sports should be under permission of physicians.

##### *Haematologic cancer*

Patients, who have had haematopoietic stem cell transplantation, should avoid overtraining given immune effects of vigorous exercise. Multiple myeloma patients might have osteoporosis, so the risk of fractures should be considered.

##### *Gynaecologic cancer*

Women with swelling or inflammation in the abdomen, groin, or lower extremity should seek medical care before exercise training. Lymphoedema of lower extremities should be aware. Risk of fractures are cautioned in patients with osteoporosis secondary to hormonal therapies.

#### **Safety and injury prevention [28]**

Safety and injury prevention is a very important aspect to consider prior to the exercise programme. Each cancer survivor has different risk factors, depending on the type, stage, severity of cancer, physical fitness status, etc. Patients with metastases of cancers might have a higher risk of injuries, however, it is beyond the scope of this article. This topic states some cancer-specific safety considerations.

#### *Immune changes*

Cancer survivors might be at risk of infection from cancer itself or related treatment. Some cancers involve the bone marrow. Some treatments suppress or interfere with the immune system, for example, chemotherapy can decrease the number and function of white blood cells; radiation to sites of active bone marrow production may reduce blood cells production.

According to immune changes, prevention of infection is critical, especially when a cancer survivor is actively receiving treatment. Strategies to reduce risks of infection include good hygiene, clean environment, and avoiding sick people and crowd. Moreover, the proper time to stop and restart exercise training is essential to avoid serious illness secondary to infection.

#### *Neurological changes*

Neurological disturbance can cause impairment of both physical and psychological functions, and may be a complication of cancer or its treatment. There is a wide spectrum of neurological symptoms from minimal numbness to complete paralysis. For instance, spinal cord compression is one of the medical emergency conditions in cancer patients, which represents back pain, motor weakness, decreased sensation, and can occur suddenly during exercise; peripheral neuropathy is a condition that may increase the risk of injury from decreased sensation, gait problems, and reduced proprioception.

These issues should be considered, and the exercise programme needs to be aware of cancer survivors' conditions. For example, a cancer survivor with peripheral neuropathy may prefer using stationary equipment rather than dumbbells to avoid an injury from unconsciously dropping the weights.

#### *Musculoskeletal changes*

Musculoskeletal changes can range from weakness and atrophy to actual loss of limb or limb function. Either invasion of cancer or complication of treatment can involve the musculoskeletal system. Limb amputation is a surgical treatment for bone cancer (sarcoma); bone density and structure can be negatively affected by chemotherapy and hormonal therapy. Muscle atrophy can occur after a long-term disuse. An exercise programme may need to be modified to accommodate for a cancer survivors' conditions to prevent injuries, in terms of abnormality of the musculoskeletal system and physical functions.

### **Discussion**

Although cancer survivors are not as healthy as before the cancer diagnoses, they should not to be inactive [4,7]. Physical activity and exercise is a healthy behaviour and is an important issue to discuss as a preventive health determinant for cancer survivors. However, prescribing physical activity for cancer survivors has a lot of considered issues and is different from healthy people's recommendations.

This article reviews the scientific evidence regarding physical activity for adult cancer survivors, but there are some dilemmas and inconclusive points. Numerous studies have been investigated different outcomes of physical activity in various group of cancer survivals, and there are not enough strong-evidence to support the conclusions in some areas. Most studies of physical activity or exercise have been done among breast cancer survivors (both during and after treatment) [4], so the evidence in breast cancer survivors is quite strong and conclusive, including benefits, programme prescription, and safety.

During the past 2 years (2014 - 2015), several studies have been published, and they have focused on a variety of outcomes, including benefits of exercise, health outcomes, precautions of exercise among cancer survivors, and barriers to exercise.

For example, Garland *et al.* [24] investigated the relationship between level of physical activity and telomere length, which is a biomarker to represent cellular aging process, in 392 breast cancer survivors; they found that a lack of physical activity was associated with shortened telomere length (aged cell). Garland *et al.* noticed that their study was the first study (published in 2014) to evaluate this relationship in early stage breast cancer survivors. The study showed a molecular level benefit of physical activity in breast cancer survivors. One study [25] followed up breast cancer survivors at 5 years after a supervised group exercise; the results of the study showed positive effects on motivational outcomes in exercise group (compared with control group). A study from Australia [26] focused on the barrier of exercise among women treated for breast cancer; they found that exercise bra discomfort was a significant barrier

to achieve the recommended level of exercise. These studies are examples to show scientific evidence that focuses on various points of view about physical activity or exercise in breast cancer survivors.

According to the emerging evidence, exercise prescription is an essential part for promoting exercise of cancer survivors. However, it does not depend on only biological factors because there are many associated factors of exercise behaviours. The social ecological model [29] is a model to understand physical activity or exercise behaviours. The model explains the interaction between intrapersonal and interpersonal (society, organisations, environment, and policies) factors. People who have different intrapersonal and interpersonal factors may need dissimilar approaches. Philip *et al.* [27] studied physical activity preferences of early-stage lung cancer, which found that approximately half of participants would be interested in an exercise programme tailored to lung cancer survivors. Overall, an individual needs different approaches to participate in physical activity or exercise behaviours because each one has diverse intrapersonal and interpersonal factors.

Finally, the studies in this field (physical activity or exercise in cancer survivors) have some knowledge gaps. As mentioned earlier, most studies have been done in breast cancer survivors, however, lung and bronchus cancer are the second most common cancer in both males and females [30]; there are fewer studies. There is a need to study several aspects of physical activity in multiple types of cancers.

### Conclusions

Cancer survivors can have physiological and psychological benefits from physical activity. Cancer-specific contraindication, risk of injuries, safety, and injury prevention should be concerned prior to physical activity or exercise programme. In summary, cancer survivors during or following treatments should avoid inactivity; do appropriate type and amount of physical activity, depending on their physical conditions. However, the knowledge in some types of cancers is still limited.

### Acknowledgements

The author wishes to thank the School of Medicine, Walailak University for their support.

### References

- [1] D Batty and I Thune. Does physical activity prevent cancer? Evidence suggests protection against colon cancer and probably breast cancer. *Br. Med. J.* 2000; **321**, 1424-5.
- [2] HK Neilson and CM Friedenreich. *Lifestyle Factors Associated with Cancer Incidence, Recurrence, and Survival*. In: ML Irwin (ed.). ACSM's Guide to Exercise and Cancer Survivorship. Human Kinetics, Illinois, 2012, p. 29-47.
- [3] K Schmitz. *Exercise Prescription and Programming Adaptations Based on Surgery, Treatment, and Side Effects*. In: ML Irwin (ed.). ACSM's Guide to Exercise and Cancer Survivorship. Human Kinetics, Illinois, 2012, p. 87-112.
- [4] KH Schmitz, KS Courneya, C Matthews, W Demark-Wahnefried, DA Galvao, BM Pinto, ML Irwin, KY Wolin, RJ Segal, A Lucia, CM Schneider, VE von Gruenigen and AL Schwartz. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Med. Sci. Sports Exerc.* 2010; **42**, 1409-26.
- [5] KL Campbell. *Benefits of Physical Activity after a Cancer Diagnosis*. In: ML Irwin (ed.). ACSM's Guide to Exercise and Cancer Survivorship. Human Kinetics, Illinois, 2012, p. 49-71.
- [6] Centers for Disease Control and Prevention. *2008 Physical Activity Guidelines for Americans*. The Secretary of Health and Human Services, Washington DC, 2008.
- [7] CL Rock, C Doyle, W Demark-Wahnefried, J Meyerhardt, KS Courneya, AL Schwartz, EV Bandera, KK Hamilton, B Grant, M McCullough, T Byers and T Ganslerl. Nutrition and physical activity guidelines for cancer survivors. *CA Cancer J. Clin.* 2012; **62**, 242-74.
- [8] MA Hauken, I Holsen, E Fismen and TM Larsen. Working toward a good life as a cancer survivor: A longitudinal study on positive health outcomes of a rehabilitation program for young adult cancer survivors. *Cancer Nurs.* 2015; **38**, 3-15.



- [9] KM Heinrich, C Becker, T Carlisle, K Gilmore, J Hauser, J Frye and CA Harms. High-intensity functional training improves functional movement and body composition among cancer survivors: A pilot study. *Eur. J. Cancer Care* 2015; **24**, 812-7.
- [10] ME Slater, J Steinberger, JA Ross, AS Kelly, EJ Chow, IH Koves, P Hoffmeister, AR Sinaiko, A Petryk, A Moran, J Lee, LS Chow and KS Baker. Physical activity, fitness, and cardiometabolic risk factors in adult survivors of childhood cancer with a history of hematopoietic cell transplantation. *Biol. Blood Marrow Transplant.* 2015; **21**, 1278-83.
- [11] LC Capozzi, KR Boldt, H Lau, L Shirt, B Bultz and SN Culos-Reed. A clinic-supported group exercise program for head and neck cancer survivors: Managing cancer and treatment side effects to improve quality of life. *Support. Care Cancer* 2015; **23**, 1001-7.
- [12] A Murnane, K Gough, K Thompson, L Holland and R Conyers. Adolescents and young adult cancer survivors: Exercise habits, quality of life and physical activity preferences. *Support. Care Cancer* 2015; **23**, 501-10.
- [13] LW Wang, XH Gong, N Ding, XF Chen XF, L Sun, Z Tang, DH Yu, ZP Yuan, XD Wang and JM Yu. The influence of comorbid chronic diseases and physical activity on quality of life in lung cancer survivors. *Support. Care Cancer* 2015; **23**, 1383-9.
- [14] LL Lin, JC Brown, S Segal and KH Schmitz. Quality of life, body mass index, and physical activity among uterine cancer patients. *Int. J. Gynecol. Cancer* 2014; **24**, 1027-32.
- [15] LM Buffart, WJG Ros, MJM Chinapaw, J Brug, DL Knol, I Korstjens, EV Weert, I Mesters, BVD Borne, JEHM Hoekstra-Weebers and AM May. Mediators of physical exercise for improvement in cancer survivors' quality of life. *Psycho Oncol.* 2014; **23**, 330-8.
- [16] AI Cuesta-Vargas, J Buchan and M Arroyo-Morales. A multimodal physiotherapy programme plus deep water running for improving cancer-related fatigue and quality of life in breast cancer survivors. *Eur. J. Cancer Care* 2014; **23**, 15-21.
- [17] D Mirandola, G Miccinesi, MG Muraca, E Sgambati, M Monaci and M Marini. Evidence for adapted physical activity as an effective intervention for upper limb mobility and quality of life in breast cancer survivors. *J. Phys. Activ. Health* 2014; **11**, 814-22.
- [18] A Murtezani, Z Ibraimi, A Bakalli, S Krasniqi, ED Disha and I Kurtishi. The effect of aerobic exercise on quality of life among breast cancer survivors: A randomized controlled trial. *J. Cancer Res. Therapeut.* 2014; **10**, 658-64.
- [19] LQ Rogers, S Vicari, R Trammell, P Hopkins-Price, A Fogleman, A Spenner, K Rao, KS Courneya, KS Hoelzer, R Robbs and S Verhulst. Biobehavioral factors mediate exercise effects on fatigue in breast cancer survivors. *Med. Sci. Sports Exerc.* 2014; **46**, 1077-88.
- [20] N Galiano-Castillo, A Ariza-Garcia, I Cantarero-Villanueva, C Fernandez-Lao, L Diaz-Rodriguez and M Arroyo-Morales. Depressed mood in breast cancer survivors: Associations with physical activity, cancer-related fatigue, quality of life, and fitness level. *Eur. J. Oncol. Nurs.* 2014; **18**, 206-10.
- [21] ML Luoma, L Hakamies-Blomqvist, C Blomqvist, R Nikander, M Gustavsson-Lilius and T Saarto. Experiences of breast cancer survivors participating in a tailored exercise intervention: A qualitative study. *Anticancer Res.* 2014; **34**, 1193-9.
- [22] PD Loprinzi and H Lee. Rationale for promoting physical activity among cancer survivors: Literature review and epidemiologic examination. *Oncol. Nurs. Forum* 2014; **41**, 117-25.
- [23] JP Hardee, RR Porter, X Sui, E Archer, IM Lee, CJ Lavie and SN Blair. The effect of resistance exercise on all-Cause mortality in cancer survivors. *Mayo Clin. Proc.* 2014; **89**, 1108-15.
- [24] SN Garland, B Johnson, C Palmer, RM Speck, M Donelson, SX Xie, A DeMichele and JJ Mao. Physical activity and telomere length in early stage breast cancer survivors. *Breast Cancer Res.* 2014; **16**, 413.
- [25] L Trinh, N Mutrie, AM Campbell, JJ Crawford and KS Courneya. Effects of supervised exercise on motivational outcomes in breast cancer survivors at 5-year follow-up. *Eur. J. Oncol. Nurs.* 2014; **18**, 557-63.

- [26] SA Gho, BJ Munro, SC Jones and JR Steele. Exercise bra discomfort is associated with insufficient exercise levels among Australian women treated for breast cancer. *Support. Care Cancer* 2014; **22**, 721-9.
- [27] EJ Philip, EJ Coups, MB Feinstein, BJ Park, DJ Wilson and JS Ostroff. Physical activity preferences of early-stage lung cancer survivors. *Support. Care Cancer* 2014; **22**, 495-502.
- [28] AL Schwartz. *Safety, Injury Prevention, and Emergency Procedures*. In: ML Irwin (ed.). ACSM's Guide to Exercise and Cancer Survivorship. Human Kinetics, Illinois, 2012, p. 153-60.
- [29] B Lewis and K Schuver. *Theories of Behavior Change*. In: G Liguori, GB Dwyer, TC Fitts and B Lewis (eds.). ACSM's Resources for the Health Fitness Specialist. 1<sup>st</sup> ed. Lippincott Williams & Wilkins, Philadelphia, 2014, p. 234-48.
- [30] LA Korde. *Diagnosis and Treatment of Cancer*. In: ML Irwin (ed.). ACSM's Guide to Exercise and Cancer Survivorship. Human Kinetics, Illinois, 2012, p. 1-14.