Effectiveness of specific types of structured physical activities in the rehabilitation of post-mastectomy women: a systematic review

Typy treningów i aktywności fizycznej w rehabilitacji onkologicznej oraz ich skuteczność u kobiet po mastektomii: systematyczny przegląd literatury

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Key words: mastectomy, physical activity, systematic review, breast cancer, strength.

Słowa kluczowe: rak piersi, aktywność fizyczna, mastektomia.

Abstract

Around 40% of post-mastectomy women meet the requirements of general guideline recommendations of 150 minutes of moderate-intensity physical activity as a sufficient minimum for adults. However, Kyu et al. disagree with this concept in their systematic review of literature on energy expenditure, claiming it to be insufficient in breast cancer prevention. The aim of the present study is to determine which specific type of physical activity is most commonly pursued among post-mastectomy women, as well as which type of exercise proves the most beneficial for those patients. One hundred and ten original papers were identified in all 4 research databases, out of which 8 were subjected to final evaluation. The exercise programs under evaluation comprised aerobic exercise (n = 4), muscle strengthening exercise (n = 2), and mixed aerobic and muscle strengthening activities (n = 2). Aerobic exercises were established as the most frequently pursued type of physical activity in post-mastectomy women. Presently, the task of credibly evaluating overall effectiveness of rehabilitation programs featuring different types of physical activities proves rather challenging, as there is still no consensus as to the actual methods of designing a set of uniformly structured evaluation tools to be applied by all investigators.

Streszczenie

Około 40% kobiet po mastektomii podejmuje wysiłek fizyczny o umiarkowanej intensywności trwający 150 minut w tygodniu. Kyu i wsp. stwierdzają w systematycznym przeglądzie literatury dotyczącym wydatku energetycznego, że normy te nie są wystarczające do zapobiegania nowotworowi piersi.

Celem pracy była odpowiedź na pytanie, jaki typ aktywności fizycznej jest najczęściej stosowany przez kobiety po mastektomii oraz jaki typ treningu wydaje się przynosić najlepsze korzyści dla pacjentek. Znaleziono 110 oryginalnych prac w 4 bazach naukowych. Do ostatecznej analizy włączono 8 prac naukowych. Interwencje aktywności fizycznej u kobiet po mastektomii były wykonywane w programach aerobowych (n = 4), siłowych (n = 2) oraz mieszanych, aerobowo-silowych (n = 2). Aerobic exercises were established as the most frequently pursued type of physical activity in post-mastectomy women. Presently, the task of credibly evaluating overall effectiveness of rehabilitation programs featuring different types of physical activities proves rather challenging, as there is still no consensus as to the actual methods of designing a set of uniformly structured evaluation tools to be applied by all investigators.

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Brak spójnych narzędzi oceny efektywności programów zawierających różne typy aktywności fizycznej nie pozwala na jednoznaczne określenie, który z programów wydaje się najbardziej korzystny dla kobiet po zabiegach mastektomii.
Introduction

Physiotherapeutical interventions in the form of physical activity contribute to an increased range of motion in the upper limbs, higher muscle strength in both the upper and lower limbs, overall aerobic endurance, and improved quality of life in the post-mastectomy patients [1]. As a rule, these components are the subject of comprehensive assessment within one year of concluding the oncological treatment management [2]. However, information on the long-term evaluation is not available.

As the long-term outcomes of interventions are not the subject of regular monitoring, this may lead to much reduced physical activity, since very few post-mastectomy women conform to the recommended volume of such an activity.

In fact, over two-thirds of the post-mastectomy women do not meet the requirements for physical activity, namely 150 minutes of moderate-intensity physical activity, or 75 minutes of moderate-to-vigorous physical activity (MVPA) per week [3]. It would appear that oncological rehabilitation is very much oriented towards the short-term goal of completing the maximum achievable level of fine motor skills, especially in view of the fact that daily physical activity recommendations are not effectively followed by patients. Furthermore, as Biskup et al. noted, 1/3 of woman treated for breast cancer had a medium and high falls-risk [4].

This supposition is further corroborated by Mason et al., who demonstrated that the number of patients that conform to the established physical activity norms within 10 years of mastectomy drops by almost one third, i.e. from 34 to 21.4% [5]. This result may be considered surprising, since physical activity at the level of 10 MET-hours/week (an equivalent of five 1-hour walks at a steady pace of 4.8 km/h) is required, with a view to appreciably reducing the risk of a patient’s premature death due to breast cancer [6].

Having said that, patients fail to conform to the WHO recommendations on the required scope of physical activity, consequently rendering them ineffective. Additionally, the recommended scope of physical activity might well be inadequate for the purpose.

One of the arguments in favor of this assertion was provided in a systematic review by Kyu et al., who showed that morbidity among persons who were exercising at submaximal heart rate levels and with an energy expenditure of > 8000 METs/week (an equivalent of two hours of jogging five times per week) was lower by 14%, than among those whose energy expenditure did exceed 600 METs/week (five 30-min walks at a pace of 4.8 km/h per week) [7]. Morbidity due to breast cancer in the group of subjects who often engaged in exercise at submaximal intensity was lower by 21% [6]. For comparison, radiotherapy as an adjuvant therapy reduced breast-cancer-related morbidity over the span of 10 years by 19.3-35% [8].

The purpose of their review did not consist in explaining the actual mechanism of cancer prevention aided by a pursuit of physical activity of moderate and sub-maximal intensity. Having said that, in 2015, Pedersen et al. came up with a review study mining specific data on the impact of physical activity and likely mechanisms of its effectiveness, including therapeutic management in support of cancer treatment. They highlighted the reduction of tumor growth thanks to several mechanisms, e.g. “vascularization and blood perfusion, increasing immune function, tumor metabolism” [9]. These mechanisms, further corroborated by the results described in the study by Kyu et al., seem to be an interesting starting point, with a view to pursuing further research into the matter.

The present review aimed to determine which specific type of physical activity is most commonly pursued among post-mastectomy women, as well as which specific type of structured exercise programs proves functionally the most beneficial for them.

Material and methods

Search strategy

Two investigators conducted independent searches across four databases with PubMed, EBSCO, BASE (Bielefeld Academic Search Engine) and SciELO publications released between January 2016 and June 2016. The following search terms were used: physical activity, breast cancer, randomized clinical trial, PA, RCT, physical activity regimen, strength training, endurance training, aerobic, working age.

Article selection

Articles were selected by two independent investigators. Studies whose scope overlapped were excluded. Reports regarding the studies in which randomization had not been applied, or in which selection had been quasi-random (https://en.wikipedia.org/wiki/Low-discrepancy_sequence), were also disregarded.

Exclusion criteria

All studies which reported other types of oncological events within the study group were excluded, and so were the study protocols, materials used for information purposes only, and all meta-analyses.

Types of compared measurements

The following study variables were evaluated: range of motion of the upper limbs (goniometric measurements), aerobic endurance (VO2max, VO2peak), results of the six-minute walk test – 6MWT, strength of the upper (grip strength) and lower limbs (leg press), relative appendicular skeletal muscle mass, severity of fatigue symptoms (FAQ – Fatigue Assessment Questionnaire, SCFS – Schwartz Cancer Fatigue Scale, FSS –
fatigue Severity Scale, MFI – Multidimensional Fatigue Inventory, FQL – Fatigue Quality List), quality of life (the EORTC QLQ-C30 questionnaire of the European Organization for Research and Treatment of Cancer), SF-36 – the short form (36) health survey (variables comprising fatigue, depression symptoms, and anxiety), anthropometric data (lean body mass, fat mass %, body fat %, METs, total body mass), and information-processing rate (trail making test).

**Evaluation of research quality**

After the selection of the articles, they were checked in the PEDro database to evaluate methodological restrictions. Five out of eight articles included in the systematic review were found, with a mean score of 6.2 (4–8) points in the database.

**Results**

The total number of original papers found in all four research databases was 110. The final analysis was conducted for eight papers. Physical activity interventions in women after mastectomy included programs consisting of aerobic exercise ($n = 4$), muscle strengthening exercise ($n = 2$), and mixed aerobic and muscle strengthening exercise ($n = 2$). Exercise time (20–90 minutes) varied depending on a specific type of activity. Strength training regimen significantly increased the muscle strength, ranging 12.2–50%, depending on a specifically applied method of measurement, and a respective muscle group. The results for the upper limbs and torso muscles increased by 12.2% (Bench Press), strength of the knee extensors increased by approximately 17.5% (Leg Press), and appendicular skeletal muscle mass also significantly increased.

**Aerobic exercise**

Interventions involving aerobic exercise were performed from 6 to 12 weeks, one to three times per week, in sessions of 20–60 minutes. It was established that the results were followed up in the long-term (six months) in 16.6% of the studies on aerobic exercise ($n = 2$), and mixed aerobic and muscle strengthening exercise ($n = 2$). Exercise time (20–90 minutes) varied depending on a specific type of activity. Strength training regimen significantly increased the muscle strength, ranging 12.2–50%, depending on a specifically applied method of measurement, and a respective muscle group. The results for the upper limbs and torso muscles increased by 12.2% (Bench Press), strength of the knee extensors increased by approximately 17.5% (Leg Press), and appendicular skeletal muscle mass also significantly increased.

**Muscle strengthening exercise**

Interventions featuring muscle strengthening exercise were performed for periods of 12–13 weeks, twice a week, in sessions lasting from 60 to 90 minutes. Two studies reported the long-term follow-up of the outcomes. Exercise load was calculated based on the percentage of the IRM and arbitrarily selected weight.

**Mixed aerobic and muscle strengthening exercise**

Interventions involving mixed aerobic and muscle strengthening exercise were performed within a span of 12–18 weeks, twice a week, in 60-minute sessions. The long-term follow-up of the results lasted 4–6 months ($n = 2$). It was demonstrated that maximal oxygen uptake ($\text{VO}_{2\text{max}}$, $\text{VO}_{2\text{peak}}$) increased, when compared against the control groups. No significant differences were observed regarding the quality of life, using different research tools ($n = 2$). The results achieved via mixed interventions lasted 4–6 months.

**Discussion**

Regular physical activity can reduce morbidity by 20–30%, depending on the specific type of disease [10]. Its efficacy was confirmed in more than 25 chronic conditions [10]. Nevertheless, the dependence between the actual volume of exercises performed and the result of the intervention must be emphasized. Kyu et al. demonstrated that high-intensity exercise at the level of 8000 METs/week reduced the risk of premature death due to breast cancer by 21% [7]. It seems interesting that a tenfold increase in exercise intensity, compared to the 600 METs/week recommended as the normal level of physical activity and treated as the reference value in the present review, yields a 7% decrease in morbidity. According to some authors, considerable energy expenditure expressed in the metabolic equivalent reduces morbidity by as much as 26%. The results expressed in METs, raise the question as to whether this variable is suitable for the estimation of anti-inflammatory effects; however, these particular effects of moderate- and high-intensity exercise are associated with reduced morbidity due to breast cancer [11]. At least three discrepancies seem to offer persuasive rationale for the pursuit of further, in-depth studies. Firstly, 60–75 minutes of moderate-intensity physical exercise per day merely mitigates the adverse everyday effects of a sedentary lifestyle [12]. Moderate-intensity exercise thus only helps maintain overall fitness, but it fails to contribute to its further development. Secondly, very high intensity of physical exercise proposed by Kyu et al., i.e. two hours per every day of the week, does not appear to be overly effective. Finally, reporting physical activity in terms of METs in the studies focused on breast cancer, seems to be reasonable, but it fails to address the metabolic reaction and associated hormonal response, which offer vital information.
Effectiveness of specific types of structured physical activities in the rehabilitation of post-mastectomy women: a systematic review

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Authors</th>
<th>Year</th>
<th>No. of subjects</th>
<th>Intervention time (weeks/ no. of weekly sessions/no. of minutes)</th>
<th>Follow-up</th>
<th>Tools</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic</td>
<td>Vardar et al. [17]</td>
<td>2015</td>
<td>28</td>
<td>6/3/30</td>
<td>No</td>
<td>6MWT, Grip strength, QOL</td>
<td>Significantly increased 6MWT distance, higher scores in QOL were observed — lower fatigue level was perceived</td>
</tr>
<tr>
<td></td>
<td>Reis et al. [18]</td>
<td>2013</td>
<td>22</td>
<td>12/3/20–60</td>
<td>No</td>
<td>FAQ, QOL, 6MWT</td>
<td>+ Significantly reduced physical and mental fatigue</td>
</tr>
</tbody>
</table>
|                 | Curneya et al. [19] | 2013  | 101             | 12/3/50–60                                                   | No        | SF-36, VO$_{2peak}$, Leg press, Upper-body strength, Lower-body strength, Body mass, LM, FM, BF% | + Non-significant severity of fatigue ($p > 0.05$)  
+ Significantly reduced cardiological symptoms  
+ VO$_{2peak}$ — non-significant difference (2.5 vs. 3.4 ml/kg/min)  
+ Non-significant increase in lower-limb strength (77.6 vs. 83.7 kg)  
+ Non-significant differences in upper-body strength (25.9 vs. 29.6)  
+ Body mass  
+ 1.4 kg ($p > 0.05$)  
+ LM: +0.7 kg ($p > 0.05$)  
+ FM: 0.5 kg ($p > 0.05$)  
+ BF%: 0.1 ($p > 0.05$) |
|                 | Husebo et al. [20] | 2015  | 25              | 12/3/30                                                        | No        | SCFS-6, 6MWT, MET – minutes/week | + Significant difference in fatigue level  
+ Non-significant increased distance after exercise  
+ Significant increase in weekly energy expenditure |
| Muscle-strengthening | Brown et al. [21] | 2015  | 148             | 13/2/90 12 months                                           |            | Bench press, Leg press, Grip strength, BMI, TBM, BF%, Fat mass — RASMM, AASMM | Bench press: 4.9 kg vs. 0.6 kg ($p < 0.001$)  
Leg press: 21.7 vs. 3.8 kg ($p < 0.001$)  
Grip strength: 2.6 kg vs. 1.3 kg ($p < 0.02$)  
BMI: −0.02 vs. 0.22 (0.865)  
TBM: −0.71 vs. −0.79 (0.847)  
BF%: −0.10 vs. 0.23 (0.191)  
Fat mass: −0.35 vs. −0.13 (0.512)  
RASMM: −0.01 vs. −0.08 (0.041)  
AASMM: −0.02 vs. −0.22 (0.038)  
Results lasted 12 months |
|                 | Shmidt et al. [22] | 2013  | 51              | 12/2/60                                                       | No        | TMT, FAQ, EORTC QLQ-C30 | + Increased information processing rate and improved broadly defined skills  
+ Reduced physical and mental fatigue  
+ Improved physical and social function  
+ Reduced fatigability, nausea, insomnia  
+ Improved sex life, reduced markers of depression, improved cognitive function |

Table 1. General characteristics of studies addressing physical activities, stratified by specific evaluation methods and overall effectiveness of the outcomes.
### Table 1. Cont.

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Authors</th>
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<th>Follow-up Tools</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed aerobic and muscle-strengthening</td>
<td>Cesla et al. [23]</td>
<td>2015</td>
<td>44</td>
<td>12/2/60</td>
<td>6 months</td>
<td>VO\textsubscript{max}, Grip strength, BF%, LM, QOL</td>
</tr>
<tr>
<td></td>
<td>Travier et al. [24]</td>
<td>2015</td>
<td>102</td>
<td>18/2/60</td>
<td>4 months</td>
<td>VO\textsubscript{max}, Grip strength, BF%, LM, QOL</td>
</tr>
</tbody>
</table>
Conclusions

1. Aerobic exercise is the most common type of physical activity pursued by post-mastectomy women.

2. The diversity of research tools effectively contributes to impossibility to clearly establish which specific physical exercise models boast the largest potential for yielding the highest functional benefits in post-mastectomy women.

Conflict of interest

The authors declare no conflict of interest.

References


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