Evaluation of the impact of aquatic exercises and virtual reality exercises feedback (combined with gym exercises) on selected psychophysical parameters in women treated for breast cancer

Introduction

Breast cancer is a malignant tumor, commonly diagnosed throughout the world. Breast cancer survivors often develop complications related to the disease and the treatment provided, which reduce the women's quality of life. Complications include physical, emotional, and cognitive disorders as well as family and social issues. Patients also experience fatigue, localized pain in various parts of the body, increased fear of falling, static and dynamic imbalance. In the prevention and treatment of breast cancer, an important role is that of physical activity, which, if undertaken regularly, reduces the impact of the disease and its treatment.

Novelty of the research

To the author's knowledge, this study is the first randomized controlled trial (RCT) to evaluate the effects of aquatic exercise (in combination with gym exercises), and workouts with virtual reality (VR) feedback (in combination with gym exercises) on fear of falling, static balance as well as functional gait performance and dynamic balance in women treated for breast cancer. It is also one of the few RCTs that assessed pain intensity and quality of life in women treated for breast cancer, and the first RCT to compare the effects of study interventions on selected complications that tend to occur in these patients, including pain, fatigue, fear of falling as well as on static balance, functional gait efficiency, dynamic balance, gait speed and quality of life.

Aim

The general aim of the study was to develop knowledge about the impact of aquatic exercises (combined with gym exercise) and workouts with VR feedback (combined with gym exercise), on selected psychophysical women treated parameters due to breast cancer.

The application-related aim was to highlight the potential of aquatic exercises and workouts with VR feedback, both combined with gym exercises, in the therapy of selected complications that develop in women undergoing breast cancer treatment.

Methods

Study design

The study was designed as a prospective randomized controlled trial conducted in three groups of women treated for breast cancer including the control group (CG, n = 48) in which women did not perform regular exercise, experimental group whose members used aquatic and gym exercises (GA, n = 48), and another experimental group in which workouts with VR feedback were combined with gym exercises (GVR , n = 48). The duration of the intervention was 6 weeks. Long-term outcomes were also assessed at 6 weeks of the intervention in 16 GEA and 20 GEVR participants. Group allocation was performed at random. Blinding included the physician and the person conducting the statistical analysis. Blinding did not include patients, persons who conducting the diagnostic module and physical therapists conducting the physical exercises. The study was conducted in accordance with CONSORT standards.

Inclusion and exclusion criteria

Women included in the study were between the ages of 30 and 70; they consented to participate in the study, were diagnosed with stage I to III breast cancer, had undergone surgical treatment for breast cancer with neoadjuvant and/or adjuvant treatment (chemotherapy and radiation therapy had been completed between 1 and 36 months before the start of the study); they did not engage in structured and supervised exercise, as well as exercise lasting more than 60 minutes per week in the period of at least 3 months before the start of the study; any treatment for other cancers had been completed at least 5 years before the study started.

Exclusion criteria included contraindications to the physical training used in the study and conditions/diseases other than breast cancer that could affect mobility and body balance, as well as the presence of pain and fatigue.

Primary outcomes of the study were quality of life in the domain of general health, functional gait efficiency and dynamic balance, gait speed and fear of falling.

Secondary outcomes were quality of life in the domain of functioning and complaints related to the occurrence and treatment of cancer (including breast cancer), pain, fatigue and static balance.

Methods of assessing the progress of therapy

Quality of life was evaluated using the EORCT QLQ – C30 (European Organization on Research and Treatment of Cancer Specific Quality of Life Questionnaire – C30) and EORCT QLQ – BR 23 (European Organization on Research and Treatment of Cancer Specific Quality of Life Questionnaire – BR23). Functional gait efficiency and dynamic balance were assessed with the Timed Up and Go test (TUG), gait speed with a 4 – Metre Gait Speed Test (4MGST), pain severity with a Numerical Rating Scale (NRS), and fear of falling with the Short Falls Efficacy Scale – International (sFES – I). Static balance was assessed on a stabilometric platform by determining such variables as COP Range, COP RMS and COP Velocity.

Results

Primary outcomes

Both 6-week interventions contributed to a statistically significant improvement in functional gait performance and dynamic balance, as noted after the intervention in the experimental groups relative to the CG ($p(GA;CG) = 0,021$; $n = 144$ and $p(GVR;CG) = 0,020$; $n = 144$). At 6 weeks of GA completion, functional gait efficiency and dynamic balance were significantly greater compared to GVR ($p(GVR;GA) = 0,050$; $n = 36$). Quality of life in the domain of general health improved in the GVR group compared to the CG ($p(GVR;CG) = 0,025$; $n = 144$); gait speed in the GVR was greater compared to the CG ($p(GVR;CG) = 0,015$; $n = 144$).

Secondary outcomes

Six-week GVR resulted in quality of life improvement in the category of breast area complaints compared to the CG ($p(GVR;CG) = 0,040$; $n = 144$). Compared to the CG, mediolateral stabilograms of the GEA group revealed an increase in COP range ($p(GA;CG) = 0,013$; eyes closed), COP Velocity ($p(GA;CG) = 0,021$; eyes open), and COP Velocity ($p(GA;CG) = 0,005$; eyes closed). COP Velocity (eyes closed) was also significantly greater in the GA group compared to GVR ($p(GA;GVR) = 0,008$). At 6 weeks of therapy completion quality of life in the category of pain was better in the GVR compared to GA ($p(GVR;GA) = 0,004$; $n = 36$). The intensity of pain also decreased after 6 weeks of intervention in GVR compared to GA ($p(GVR;GA) = 0,040$; $n = 144$), also pain severity in the GVR group was significantly lower than in the GEA ($p(GVR;GA) = 0,030$; $n = 36$).

Conclusions

Workouts with virtual reality feedback (combined with gym exercises) improve gait performance and dynamic balance, gait speed, quality of life in terms of general health and complaints in the breast area and reduce the severity of pain. Workouts with virtual reality feedback (combined with gym exercises) do not reduce fear of falling and have no effect on fatigue severity or other domains/categories of quality of life.

In the evaluation of long-term effects (i.e., at 6 weeks of intervention completion), workouts with virtual reality feedback (combined with gym exercises) are superior to aquatic exercises (combined with gym exercises) in terms quality of life in the category of pain, and pain severity assessment. Regarding the other variables, VR exercises (combined with gym exercises) do not show better results than aquatic exercises (combined with gym exercises).

Aquatic exercises (in combination with exercises in the gym) improve gait efficiency and dynamic balance. Aquatic exercises (in combination with exercises in the gym) do not improve gait speed, quality of life, and do not show a positive effect in reducing fear of falling, fatigue severity and pain.

In the evaluation of long-term effects (i.e., at 6 weeks of intervention completion), aquatic exercises (combined with gym exercises) are superior to VR exercises (combined with gym exercises) in terms gait efficiency and dynamic balance. Regarding the other variables, aquatic exercises (combined with gym exercises) do not show better results than VR exercises (combined with gym exercises).

Further studies should be carried out to verify the results of the present research. The intervention period and follow-up should be extended to examine the long-term effects in a larger population of women suffering from breast cancer.

Key words

breast cancer, physical activity, physical exercise, aquatic exercise, virtual reality, workouts with virtual reality feedback, quality of life, dynamic balance, gait performance, gait speed, pain, fear of falling, fatigue, static balance