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Efficacy of Aerobic Exercise on Postural Balance and Quality of Life in Osteoporotic Women Post Bariatric Surgery

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Abstract : The bariatric procedures were related to calcium and vitamin D deficiencies, which prompted to osteoporosis and brown tumours after bariatric surgery. Osteoporosis consequently reduces their balance and quality of life. Purpose of the study to assess the viability of aerobic exercise on postural balance and quality of life in osteoporotic women post bariatric surgery. Forty pre-menopausal osteoporotic women post bariatric surgery, volunteered to participate in this study, their age were ranged from 35 to 45 years, classified randomly into two groups equal in number; study group received sub-maximal aerobic exercises program graded treadmill walking and stepping exercises, three times per week for 12 weeks in addition to their routine medical treatment for osteoporosis, while control group received the routine medical treatment for osteoporosis only. Balance ability of all subjects was measured by timed up and go test (TUG) and four square step test (FSS). The ECOS-16 (European compromise osteoporosis questions) was developed with the aim of measuring health-related quality of life in osteoporotic women. The participants were tested twice; before and after the training program. The results of this study revealed high significant differences (P values < 0.01) between both groups in favor to study group. The present study revealed that sub-maximal aerobic exercise program can improve postural balance and quality of life in osteoporotic women post bariatric surgery.
Key words : Aerobic exercise, Postural balance, Quality of life, osteoporosis, Bariatric surgery.

Introduction

Bone loss after bariatric surgery has turned into a clinical challenge [(1)]. The different strategies, which incorporates biliopancreatic diversion with duodenal switch, gastric banding, and Roux-en-Y gastric bypass, are related with variable extents concerning reduced fractional calcium absorption and vitamin D absorption [1]. Bone loss may be moderately severe and closely identified with the level of weight reduction [2]. A preparatory review showed multiplying grades fracture risk after bariatric surgery.

Osteoporosis introduced as the third health problem. In accordance with the latest studies, about 40% regarding the younger women's life is threatened by way of osteoporosis[3]. In the current century, the importance of osteoporosis has become clearer, because the situation will begin from 20 to 35 years old with 1 to 5 percent intensity per year and will be increased remarkably after menopause [4.]

Falls are recognized as the most critical risk factor that increases the tendency to osteoporotic fractures that have a high rate of morbidity and mortality [5].The reasons for falls are multifactorial. Among most commonly reported risk factors are gait and balance disorders [6]. One-fourth of the falls result in serious injuries, even falls without complications may also lead to decrease in self-confidence and quality of life [7].

Going for walks, which is a very safe form of weight bearing exercise that will not require any special equipment, also boosts muscle strength, balance, coordination, proprioception and reaction time; and eventually increasing postural balance; exercise might contribute to reducing the incidence of falls [8]. The results of a previous study recommended that exercise may maintain, or even increase, bone mass, overall flexibility and muscle force; thus bettering postural balance, gait and quality of life in these subject [9]. Regular weight bearing exercises have great benefits on bone mineral denseness. Exercise comes with an important role in the management of the physical and psychological consequences of osteoporosis. The purpose this study is to check into the effect of a 12-week aerobic exercise program on postural balance and quality of life in osteoporotic women post bariatric surgery.

Materials and Methods

Subjects:

Subjects were recruited from volunteered patients who have been admitted to an outpatient clinic in Cairo University Hospital. This research was completed on 40 premenopausal women post bariatric osteoporosis, their age groups ranged from 35-45 years, they were free from any other diseases that may affect or impact the results. Subjects with musculoskeletal disorders such as joint disease, amputations; neurologic disorders such as peripheral neuropathy; visual and vestibular disorders were not included. All subjects were categorized into two groups equal in number; study group received submaximal aerobic exercises program graded treadmill machine walking and stepping exercises, in addition with their routine medical treatment for osteoporosis, while the control group received the routine medical treatment for osteoporosis only. Demographic information, systemic diseases, medications used and risk factors for falling were recorded.

Procedure:

Balance ability of all subjects was evaluated by timed up and go test (TUG) and four square step test (FSS) were used to examine balance.

In timed up and go test (TUG), subjects were seated on theback-supported chair. They were asked to operate from a seat, walk (by using a 3 m route specified on to the floor) 3 m away from the seat(which is marked on the floor), turn, and walk back again to a seat and sit down. Time taken up to complete the test was evaluated in seconds [10].

Timing started out when the first foot made a connection with the floor of the next square and ended when the last foot had a connection with the floor of the first square [(11)]. If the subject did not complete the sequence in the right way, did not protect her balance and had contact with any of the canes on the floor, the test process was repeated. The subject was asked to stand in another of the squares (number 1) facing the adjacent square (number 2). For four square step test (FSS), four squares were shaped by four cane put on to the floor. To be able to familiarize with the test, one practice trial was allowed after describing and demonstrating the test to the subject. In each square, contact of both feet was required. The subject was then asked to step into the squares in confirmed order (2-3-4-1-4-3-2-1) as fast as possible and without coming in contact with the canes. The next squares were numbered as 3 and 4. Time taken up to complete the given sequence was documented in seconds.

Health-related quality of life (HRQoL): The European compromise osteoporosis questions (ECOS-16)originated with the purpose of measuring health-related quality of life in postmenopausal women with osteoporosis. It really is predicated on the blend of two disease-specific. Health-related quality of life questionnaires for females with osteoporosis: the Osteoporosis Quality of Life Questionnaire (OQLQ) [12] and the Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO) [13]. The 16-item Evaluation of Health-Related Quality of Life in Osteoporosis (ECOS-16) is a short questionnaire that is quickly applied and easily administered [14]. The ECOS-16 comprises 16 questions, four which are from the OQLQ, and 12 which are from the QUALEFFO. These 16 questions are grouped into four categories: physical function, disease-related fear, psychosocial status, and pain. The ECOS-16 is a self-reported questionnaire with acceptable primary psychometric properties. The questionnaire is apparently an encouraging tool for use in research and specialized medical practice when assessing postmenopausal women with osteoporosis with or without vertebral fractures [15]. The score of every item varies from 1(best HRQoL) to 5(the worst type of HRQoL).

Exercise Program:

The program consisted of three 50-minute exercise sessions weekly over a 12-week period. Each exercise session included graded treadmill machine walking and stepping exercises. Maximal exercise tolerance test (Bruce protocol) was performed on the preceding day of the exercise program. Maximum heart rate is calculated by the formula (220 -age). The graded treadmill machine walking exercise started out with a 5-minute warm-up period with the intensity of about 40% of maximum heart rate followed by a 30-minutes training phase. The training intensity was arranged at about 70–85% of maximum heart rate and ended with a 5-minute cool down period with the intensity of about 40% of maximum heart rate. The second part of the exercise program was 10 minutes of stepping exercise at a speed of 96 beats per minute using a 20-cm-high bench, with rest after the first 5 minutes.

Data analysis:

Descriptive statistics and t-test were conducted for comparison of subject characteristics between both groups. T-test was conducted to compare mean values of timed up and go test (TUG) and four square step test(FSS) between both groups. Paired t-test was conducted to compare between pre and post-treatment mean values of TUG and FSS in each group. Mann–Whitney U test was conducted for comparison of median values of European compromise osteoporosis questions(ECOS-16) between both groups. Wilcoxon signed ranks test was conducted for comparison of median values of ECOS-16 between pre and post treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical tests were performed through the statistical package for social sciences (SPSS) version 19 for windows (IBM SPSS, Chicago, IL, USA).

Results:

Subject characteristics:

All the patients involved in the study have been continued the study until the end of it. None refused or withdrawn. The physical characteristics of the patients showed that there is no significant difference between both groups. As observed in table (1) showed the mean ± SD age, weight, height, and BMI of study and control groups. There was no significant difference between both groups in any of the basic characteristics ($P > 0.05$).

Within group comparison:

Table 1. Mean age, body mass, and height of the study and control groups:

	x̄±SD		***MD***	***t- value***	***p-value***
	Study group(20patients)	***Control group(20patients)***			
Age (years)	*39 ± 3.55*	*38.95 ± 3.45*	*0.05*	*0.04*	*0.96**
Weight (kg)	*72.3 ± 6*	*75 ± 5.98*	*-2.7*	*-1.42*	*0.16**
Height (cm)	*160.8 ± 6.67*	*163 ± 6.06*	*-2.2*	*-1.09*	*0.28**
BMI (kg/m²)	*27.91 ± 0.58*	*28.17 ± 0.76*	*-0.26*	*-1.18*	*0.24**
x̄, Mean; SD, Standard deviation; MD, Mean difference; p value, Probability value; *, Non-significant.					

Study group

There was a significant decrease in TUG and FSS post-treatment in study group compared with that pre-treatment ($p = 0.0001$). The percent of decrease in TUG and FSS were 17.87 and 13.85 respectively. Also, there was a significant decrease of ECOS-16 post-treatment compared with that pre-treatment ($p = 0.0001$). (Table 2, 3).

Table (2): Mean TUG and FSS between pre and post treatment in study and control groups:

	$\bar{x}$±SD		MD	% of change	t-value	p-value
	Pre treatment	Post treatment				
Study group						
TUG (sec)	*9.96 ± 1.47*	*8.18 ± 1.61*	*1.78*	*17.87*	*21.42*	*0.0001***
FSS (sec)	*12.05 ± 1*	*10.38 ± 0.92*	*1.67*	*13.85*	*28.14*	*0.0001***
Control group						
TUG (sec)	*10.19 ± 1.53*	*9.4 ± 1.49*	*0.79*	*7.75*	*15.17*	*0.0001***
FSS (sec)	*11.96 ± 1.05*	*11.14 ± 1.16*	*0.82*	*6.85*	*13.61*	*0.0001***
$\bar{x}$, Mean; SD, Standard deviation; MD, Mean difference; p value, Probability value; **, Significant.						

Table (3): Comparison of ECOS-16 between pre and post treatment in study and control groups:

ECOS-16	Median (IQR)		Z-value	p-value
	Pre treatment	Post treatment		
Study group	*50.5 (13.25)*	*20 (9)*	*3.92*	*0.0001***
Control group	*51 (12.75)*	*38.5 (10.5)*	*3.92*	*0.0001***
IQR, interquartile range; p-value, Probability value; **, Significant.				

Control group:

There was a significant decrease in TUG and FSS post-treatment in control group compared with that pre-treatment ($p = 0.0001$). The percent of decrease in TUG and FSS were 15.17 and 13.61 respectively. Also, there was a significant decrease of ECOS-16 post-treatment compared with that pre-treatment ($p = 0.0001$). (Table 2, 3).

Comparison between groups:

There was no significant difference between both groups in TUG, FSS, and ECOS-16pre-treatment ($p > 0.05$). Comparison between study and control groups post-treatment revealed a significant decrease in TUG and FSS of study group compared with that of control group ($p < 0.05$). Also, there was a significant decrease in ECOS-16of study group post-treatment compared with that of control group ($p = 0.0001$) (Table 4, 5) and (figure1, 2).

Table (4): Mean of TUG and FSS between study and control groups pre and post treatment:

	$\bar{x}$±SD		MD	t-value	p-value
	Study group	Control group			
Pre treatment					
TUG (sec)	*9.96 ± 1.47*	*10.19 ± 1.53*	*-0.23*	*-0.48*	*0.62**
FSS (sec)	*12.05 ± 1*	*11.96 ± 1.05*	*0.09*	*0.28*	*0.77**
Post treatment					
TUG (sec)	*8.18 ± 1.61*	*9.4 ± 1.49*	*-1.22*	*-2.46*	*0.01***
FSS (sec)	*10.38 ± 0.92*	*11.14 ± 1.16*	*-0.76*	*-2.27*	*0.02***
$\bar{x}$, Mean; SD, Standard deviation; MD, Mean difference; p value, Probability value; *, Non-significant; **, Significant.					

Table (5): Median of ECOS-16 between study and control groups pre and post treatment:

ECOS-16	Median (IQR)		U-value	p-value
	Study group	Control group		
Pre treatment	50.5 (13.25)	51 (12.75)	189	0.75*
Post treatment	20 (9)	38.5 (10.5)	20	0.0001**
IQR, interquartile range; p-value, Probability value; ** Significant				

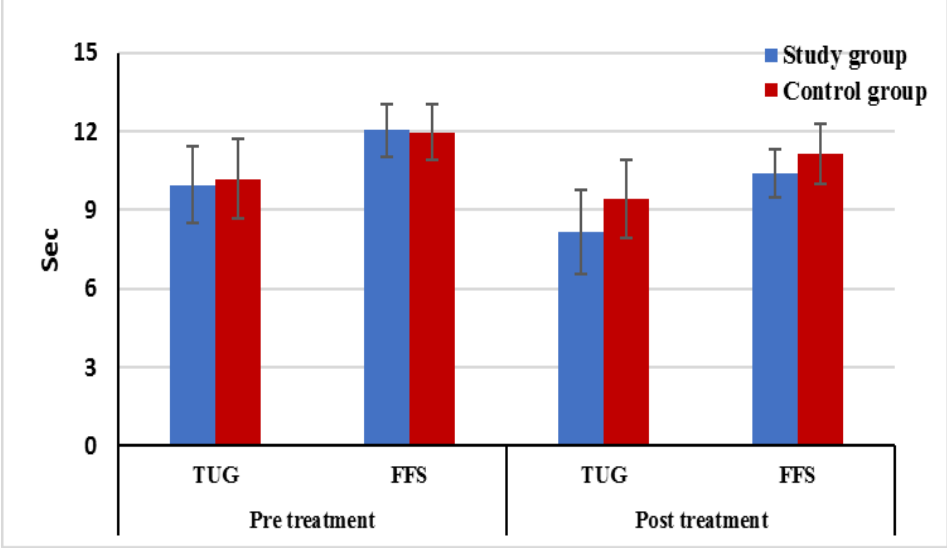

Figure (1): Mean values of TUG and FSS of study and control groups' pre and post treatment.

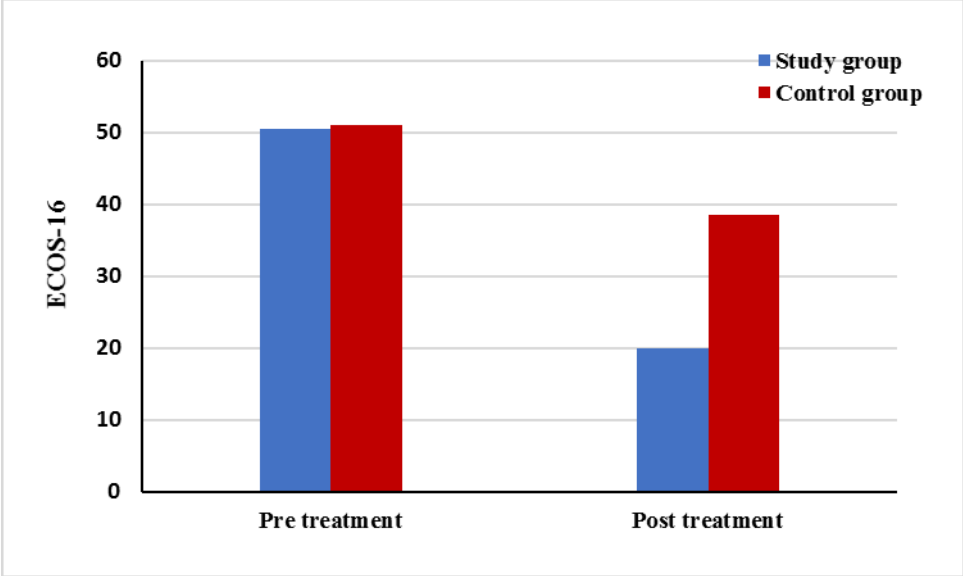

Figure (2): Median values of ECOS-16 of study and control groups' pre and post treatment.

Discussion

The long-term effects of the noticed bone reduction after bariatric surgery stay in dispute. It really is clear that many of the bariatric strategies were associated with calcium mineral and vitamin supplements D deficiencies, which resulted in case reviews of histologically established osteomalacia, osteoporosis, osteitis fibrosa cystica, and brown tumors after bariatric surgery [16]. Several longitudinal studies have reported that bone markers continue to be increased [17] and bone reduction may continue into the second and third years after

surgery[18]. In the same way, the large modifications in body structure after bariatric surgery are combined with changes in estradiol and adipocytic hormones (leptin, adiponectin, visfatin, resistin) [19].

There are data to suggest that many of these hormones may have direct effects on bone homoeostasis [20]. Finally, increased energy expenditure has been recorded after bariatric surgery [21], as well as metabolic changes such as metabolic acidosis [22]. Several hormonal and metabolic results maydonateto the observed changes in bone after bariatric surgery.

Falls, which often take place because of balance disorder, result in fractures at the sites typically associated with osteoporosis. Rizolli et al. [23] examined the studies publicized between 1985 and 2009 and recommended that the balance between bone durability and disposition to falls that result in a fractureis a combination of bone disease and central nervous system disorders. A balance disorder is usually a cause of falls and fractures in people who have osteoporosis. The postural imbalance is a significant risk factor for falls. Nguyen et al. [24] discovered that bone mineral density, postural sway and quadriceps strength were the key indicators of falls. Many studies reported that physical activities and sports improved upon postural performance [25,26]. Ageing and inactive life cause diminution of muscle mass (sarcopenia) and strength. Sports and being physically active might prevent or postpone these changes. Increased physical activity relates to better muscle power, reaction time, balance and coordination and each one of these help to prevent falls and fall-related fractures [27].

The results of this pilot study suggest that aerobic exercise program may have a role in improving postural balance and quality of life in osteoporotic women post bariatric surgery. All the patients involved in the study have been continued the study until the end of it. None refused or withdrawn. The physical characteristics of the patients showed that there is no significant difference between both groups($P > 0.05$) as observed in a table (1). Treadmill walking is a general aerobic weight-bearing exercise, and the stepping exercises employed in this study were regarded as a high-impact exercise with the specified strain on the femoral neck. Exercise programs used in our study were 50 minutes long, three times per week, with a combination of treadmill walking and stepping exercises that are popular and feasible for the general population.

There was no significant difference between both groups: “group 1 (study group) received submaximal aerobic exercises program (graded treadmill walking and stepping exercises), in addition to their routine medical treatment for osteoporosis and group 2 (control group) received the routine medical treatment for osteoporosis only” in timed up and go test (TUG), four square step test (FSS), and ECOS-16pre-treatment ($p > 0.05$). Comparison between study and control groups post-treatment revealed a significant decrease in TUG and FSS of study group compared with that of a control group ($p < 0.05$). Also, there was a significant decrease in ECOS-16of study group post-treatment compared with that of acontrol group ($p = 0.0001$) (Table 4, 5) and (figure1, 2).That could prove group (1) showed better improvement than group (2).

We found that a 12-week submaximal aerobic exercise program (graded treadmill walking and stepping exercises)provides a significant improvement in balance and quality of life in osteoporotic women post bariatric surgery provides a significant improvement in balance and quality of life in osteoporotic women post bariatric surgery and this comes in agree with:

Corresponding to Gillespie et al. [28] supervised group exercise lowered the rate of falls by 22% and the threat off alling by 17% in adults aged ≥60 years. Furthermore, the group-based multi-component exercise was effective among both unselected and high-risk elderly adults. Individually approved exercise programs at home reduced the fall rate and risk of falling by 34% and 23% respectively. Tai chi exercise was examined separately and proved a 37% decrease in fall rate and 35% decrease in the chance of falling.

De Kam, et al. [29] demonstrated that regular weight-bearing activities coupled withresistance exercises are useful for bone durability and improve lower extremity muscle power. The inclusion of balance exercises in training to boost balance and prevent falls is likewise important.

Madureira et al. [30] assessedthe result of balance exercises on the static and dynamic balance, ability to move, and the rate of falls in patients with osteoporosis. After a year of regular physical exercise (once weekly assisted by way of a physical therapist, and three times a week alone at homerelating to a recognized training curriculum), the writers observed improved upon static and dynamic balance and a reduced number of falls compared with controls who did not practice.

Pfeifer et al. [31] proved that a systematic review of 28 exercise interventions in people with low BMD concluded that exercise can reduce falls, fall-related fractures and many risk factors for falls in this group.

Shigematsu et al. [32] reported a 3 month-aerobic exercise program of dancing increased balance, flexibility and avoidance of falls in older women. We reinforced these reviews and |proved that submaximal aerobic exercise (12 weeks, 3 classes weekly) program significantly improved postural balance and quality of life in premenopausal women post bariatric surgery.

Carter et al. [27,33] demonstrated that an exercise program prolonged for 20 weeks, looking to develop posture, gait, balance, coordination, hip and trunk stabilization in osteoporotic women improved the effectiveness of knee extension, which can be an unbiased factor of dynamic balance and falls. However, in another research by the same writers 10-weeks exercise program did not significantly modify the effectiveness of knee extension, and the static and dynamic balances in osteoporotic women and it were stressed that the length of the exercise program might be inadequate to improve the fall-risk profile in women with osteoporosis [33].

Heinonen et al. [34] reported that plyometric exercise programs (jumping, step, etc.) for 1. 5 years increased bone mineral density of lower extremity and axial skeleton that was bearing weight and also improved the muscle power and dynamic balance in premenopausal women. High-velocity activities in plyometric exercises are thought to boost the speed of body movements and reflex time and therefore improve balance, coordination, reaction time, motor skills and muscle power.

Alternatively, Mills [35] showed that 8 week-duration low-intensity aerobic exercise improved the balance by 22% in the older people. Incongruous results extracted from different studies might possibly occur from the distinctions in the sort, duration, intensity and occurrence of the exercises.

Limitations

A whole lot of work become exerted with each affected person to lessen impact of practical errors inherent within the study. This examine converted into constrained using the next factors: physical and mental situation of the affected person through length of remedy, viable human mistake in application of measurement or therapeutic types of procedures , assistance of the affected person, affected person lifestyles fashion and practising physical games, and variability among patients and their response consequences of recovery.

Conclusion

In summary, our study proven that a 12-week program of submaximal aerobic exercise led to significant improvements in postural balance ratings and quality of life in osteoporotic women post bariatric surgery in comparison to the control group.

To conclude, this study implies that the balance abilities and quality of life of premenopausal women with osteoporosis post bariatric surgery implemented submaximal aerobic exercise program were not the same as that of premenopausal women with only medical treatment, quite simply, aerobic exercise program provide balance changes modification. A 12 week-submaximal aerobic exercise training program provided significant improvements in postural balance and quality of life in our premenopausal osteoporotic women.

Future Recommendations

More comprehensive studies assigning the effectiveness of aerobic exercise on postural balance and quality of life in osteoporotic women post bariatric surgery are needed with a more substantial sample as well as fora longer time of treatment.

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