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The effects of a 12-week different exercise programmes on physical anxiety and some physical parameters of women with osteoporosis

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Abstract

Study aim: The aim of this study was to determine the effects of 12 weeks of Pilates, coordination and strength exercise on the osteoporosis patient's social physical anxiety and physical parameters.
Methods: Three groups of patients practiced 12 weeks of exercises, 3 day/week, 60 minutes/day. Each group performed a different set of exercises. Those are Pilates, coordination and strength exercise. For each group before and after program the social physical anxiety index and physical parameters were measured.
Results: The paired sample T test shows that the Pilates and Coordination group has significant improvement regarding the participants' social physical anxiety. On the other hand the strength exercises have a bigger impact on the physical parameters of the patients.
Conclusion: The exercise programs improve the physical fitness capacity of the female patients with osteoporosis. Social physical anxiety decreases with increasing self-confidence, as patients feel their body muscles have become stronger.
Key words*: social physical anxiety, osteoporosis, exercise, Pilates*

Rezumat

Scopul studiului: Scopul acestui studiu a fost acela de a determina efectele a 12 săptămâni de Pilates, exerciţii de coordonare şi întărire a musculaturii asupra parametrilor fizici şi de anxietate socială a pacientului cu osteoporoză.
Metode: Trei grupuri de pacienţi au practicat exerciţii fizice timp de 12 săptămâni, programul de exerciţii aplicat fiind de 3 zile pe săptămână, 60 de minute/zi. Fiecare grup a executat un set diferit de exerciţii, acestea fiind Pilates, coordonare şi întărire musculară. Pentru fiecare grup s-a măsurat indicele de anxietate socială şi parametrii fizici înainte şi după efectuarea exerciţiilor.
Rezultate: Testul T pereche a arătat că grupul care a practicat Pilates şi cel de Coordonare au avut o îmbunătăţire semnificativă a statusului de anxietate socială. Pe de altă parte, exerciţiile de forţă au avut un impact mai mare asupra parametrilor fizici ai pacienţilor.
Concluzie: programele de exerciţii îmbunătăţesc capacitatea de efort a femeilor cu osteoporoză. Anxietatea fizică socială a scăzut odată cu creşterea încrederii în sine datorită faptului că pacienţii au simţit o îmbunătăţire a forţei musculare.
Cuvinte cheie*: anxietate socială fizică, osteoporoză, exerciţiu fizic, Pilates*

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1. Introduction

Osteoporosis is defined as a group of metabolic bone diseases which is characterized as a decrease in bone structure density. A decrease in bone density increases the risk of bone fractures by weakening the mechanical strength of the bones [1, 2]. These fractures can be important morbidity and mortality causes, and can result in loss of physical function which may lead to impoverishing economical welfare. The elderly population has increased with the longevity highlighting the importance of osteoporosis of which treatment costs stretches the budgets of national health services of all countries [3, 4, 5].

Peak bone mass and the pace of bone loss are important factors in calculating the bone mass. Peak bone mass is determined by genetic characteristics, mechanical pressure (exercise), nourishment, hormonal factors and environmental factors. When the peak bone mass is not high enough as a result of these factors, the osteoporosis risk increases with aging. The peak bone mass is reached by the age of 35 at the latest and the loss of bone begins in the following years [6, 7, 8]. The mechanical pressure as a result of physical activity and exercise contribute positively to the accumulation of peak bone mass and the preservation of the existing mass. Results of studies on animals show that mechanical pressure apart from normal physical activity increases the density of long bones. Contrary to this, long time immobilization leads to osteoporosis [9, 10]. Walking provides mechanical pressure on the spinal cord and the bone structure of the part of the body. Osteoporosis patients should prefer dynamic exercises instead of static exercises. In addition, these activities should be applied in order to increase their functional capacity (physical suitability). The recommended duration of the activity is 30-60 minutes [11, 12]. The elderly are particularly recommended longer exercise programs which aim to improve muscle strength and balance co-ordination [13, 14].

In the course of osteoporosis, the physical changes may, in time, lead to psychological problems. Debilitating physical change may diminish the quality of self-care and daily activities [15, 16, 17, 18, 19]. This may have a limiting effect on the individuals' taking part in social activities, adopting hobbies and going out to visit people and places. As a result, individuals may experience social isolation, depression and anxiety [20, 21]. Sleep disorders, loss of appetite, tiredness, social maladjustment and fear of death can also be added to the list of consequences of physical debilitation [22]. While exercise helps increase muscle mass and strength, improving both the width of joint opening and body balance, reducing the number of falls in osteoporosis helps individuals get rid of debilitating effects of physical weakness, and it also helps them regain mobility. All these will decrease the number of falls in osteoporosis. It is important how individuals perceive their body as well as how it is perceived by others. They are motivated to make an impression on others but some are more worried about how they look. For this reason, those who think they fail to make a good impression on others may experience anxiety [23]. This type of anxiety is referred to as Social Physical Anxiety (SPA) in the literature [24].

Although this can play an important role in many people's lives, it has not received the amount of attention it deserves in the literature. Such studies that aim to investigate the effect of strength balance co-ordination and Pilates exercises on female patients with osteoporosis that experience social physical anxiety, as well as other physical parameters have not been carried out to the best of our knowledge. The aim of this study is to investigate the effects of a 12-week strength balance co-ordination and Pilates exercise program on elderly females with osteoporosis regarding the social and physical anxiety and physical parameters.

2. Methods

2.1 Participants

One hundred women (age range 45 - 65 years) who were diagnosed with postmenopausal osteoporosis without any history of fractures were evaluated. Patients who were on drugs that lead to secondary osteoporosis (antiepileptics, steroids, lithium, heparin and thyroid hormones), those with a systemic disease, those with a systemic condition limiting their ability to perform physical exercises, and those who were not willing to participate in an exercise program were excluded from the study. The remaining 55 patients gave consent to participating in the study. The subjects were 55 female patients with osteoporosis, who were receiving medical treatment in the medical school of Uludağ University. They had not menstruated during the past year and were 55-69 years of age. They were divided into three groups. The first group performed strength exercises (SE) (n=12, Xage=59.5±5.9 years), the second group balance and co-ordination exercise (n=12, Xage= 60.5± 4.5 years), and the third group performed Pilates exercise (n=31, Xage= 58.61±5.6 years). The information about these groups and the type of exercise each one did is presented in the table I.

The participants were briefed about the procedures prior to the exercise sessions. All participants were volunteers. They were informed about the experiment. They were also presented the Helsinki

Act and provided with information related to ethical issues [25].

Table I. Distribution of subjects for each exercise group

Group	Type of exercise	Number of participants	Average age (years)
Group 1	Strength exercise	12	59.5±5.9
Group 2	Balance and coordination	12	60.5±4.5
Group 3	Pilates	31	58.61±5.6

2.2. The Exercise Procedure

The participants attended a 60 minute exercise program three days a week (Monday, Wednesday, and Friday) for a 12-week period. All three groups had the same warm-up schedule. Warm-up exercises lasted 5-10 mins and included stretching exercises such as hamstring stretching, gluteus maximus and stretching of the hip flexors, triceps surae muscle stretching, para spinal stretching.

2.2.1. Strength Exercise Program

This protocol included the following exercises: Quadriceps isometric exercises, strengthening exercises- upper extremities muscles (5-10 times), Strengthening exercises- abdominal muscles, back extensors (5 times), Progressive and resistive exercises, Lower extremities- Quadriceps hamstring, Gluteus Maximus Gluteus Medium and Cooling exercises.

2.2.2. Balance and Co-ordination Program

This program consisted of the following phases: reciprocal lower extremities exercise (10 times eyes closed), bending over (10 times), slow sitting and standing up on a high chair, reciprocal feet exercises, modified phomberg exercises (standing up eyes closed balancing) on a hard floor and on a soft floor, balancing on one foot for 30 seconds (on each foot) eyes open and eyes closed, exercise on the balance board, bending forward and bending backward on one leg with eyes open, standing and walking on heels and on the toes, standing and walking on tandem position, walking on a floor with hurdles and without hurdles and mini squad exercise.

2.2.3. Pilates Exercises

The exercise program follows the basic principles of the Pilates method. Resistance bands and 26 cm Pilates balls were used as supportive equipment. Our protocol comprised of 9 modules: postural education, search for neutral position, sitting exercise, antalgic exercises, stretching exercises, proprioceptive improvement exercises and breathing training.

The main purpose of the final part was not only for cooling down but also for relaxing and increasing brain body awareness.

2.3 Data Collection

A social physical anxiety test was given to all participants in all three groups prior to and following the exercise program. In order to determine levels of social physical anxiety Hart et al 'Social Physical Anxiety Inventory' (SPAI) [24] was used. The inventory includes 12 items with a point Likert scale, beginning with entirely false to entirely true. The reliability and validity of this inventory have been calculated for the Turkish population by Mülazımoğlu and Aşcı [26]. For our participants the reliability of the test was calculated as (pre-test) 0.826 and (post-test) 0.786. In order to measure the height of the participants the Sport Expert anthropometry set (MEDAN 100) was used.

By using Tanita BC 418 composition analyzer, weight, body mass index (BMI), metabolic rate (BMR), body fat ratio (fat mass), fat free mass (ffm), body water ratio (tbw), fat in internal organs (Visceral) and waist / hip ratio were calculated. The equipment works based on Bio Impedance principles by sending 50 KHz electric impulses to 5 different points in the body, analyzing the amount of fat ratio, fat free mass and muscle weight in the arms and legs. The equipment can be recalibrated. It can weigh up to 200 kg with a 100 gr sensitivity.

2.3.1. Waist and Hip Measurement

The measurement of waist was performed with a nonflexible measuring tape without expanding the end of the tape while the individual is standing up with the arms resting on the sides and the abdomen relaxed [13]. The measurement of the hip circumference was performed by a person standing on the side of the participant from the highest point of buttocks [27] without exerting any pressure on the measuring tape and by keeping it parallel to the ground. During this time, the participant was wearing a swimming suit or any other comfortable outfit and keeping her feet and arms on the sides.

2.4 Statistical Analysis

The data has been analyzed using SPSS 17 for Windows. The pre-test and post-test values of each group were compared and contrasted by using the Paired Samples T test. The significant p value was <0.05. One way variance analysis was used in order to find out if there was any meaningful difference between groups.

3. Results

The female participants were divided into three groups. The first group included 31 women with an average age of 55.61 and performed the Pilates program. The second group included 12 women with an average age of 55-83 and performed the Balance Co-ordination Exercise Program. The third group included 12 women with an average age of 60.33 who performed strengthening exercises.

These groups attended a 3-month program, 3 days a week, with 60 minutes of exercise for each session. These programs were conducted by the authors**.** The difference between the before and after measurements were calculated using the t-test. The results are presented in Table II.

Table II shows that there has been a significant difference between the measurements of height and hip before and after the Pilates program ($p<0.05$). No statistically significant difference was found between the measurements of other parameters before and after Pilates program ($p>0.05$). Measurements of Basal Metabolic Ratio (BMR), fat free mass (ffm), total body water (tbw), waist and hip circumference before and after the balance and co-ordination exercise program have been found to be statistically significant ($p<0.05$). There was no significant difference between other parameters measured before and after this program. Measurements of fat free body mass (ffm), total body water (tbw), waist and hip circumference before and after the strength exercise program have been proven to be significant ($p<0.05$). There was no significant difference between other parameters measured before and after this program.

Table II. Values measured before and after exercise program

		Pilates				Balance & Coordination				Strength			
		mean	std. dev.	t.	p	mean	std. dev.	t.	p	mean	std. dev.	t.	p
SPAI	B	31,71	10,45	1,262	0,217	27,17	11,53	0,763	0,461	28,75	10,36	0,085	0,934
	A	29,84	8,61			25,75	11,72			28,58	9,2		
Height	B	154,65	7,05	-2,145	0,040*	156,33	5,66	0,692	0,504	156,5	4,83	-1,629	0,131
	A	156,32	7,49			156,5	5,55			157,08	4,83		
Weight	B	67,56	10,42	-0,754	0,457	66,63	10,44	1,241	0,24	59,41	10,34	0,799	0,441
	A	67,65	10,3			63,47	11,27			59,08	9,84		
BMI	B	28,34	4,94	1,555	0,13	27,3	4,81	1,218	0,249	24,24	4,01	1,489	0,165
	A	28,16	4,94			26,09	5,26			23,9	3,66		
BMR	B	5,407,39	547,87	-0,73	0,471	5,503,67	501,03	3,608	0,004*	5,354,25	338,2	3,8	0,003*
	A	5,426,29	510,58			5,370,08	439,58			5,200,00	318,66		
fat mass	B	25,52	7,06	1,383	0,177	20,99	9,32	-1,548	0,15	18,73	5,09	-3,854	0,003*
	A	24,71	7,21			23,59	7,92			20,14	4,52		
ffm	B	42,15	6,68	-0,964	0,343	43,81	3,91	3,524	0,005*	43,18	2,8	4,165	0,002*
	A	42,89	4,02			42,47	3,28			41,52	2,79		
tbw	B	30,41	5,27	-0,155	0,878	32,09	2,86	3,562	0,004*	31,34	2,04	3,27	0,007*
	A	30,44	5,24			31,1	2,4			30,4	2,05		
visceral	B	8,77	2,63	-0,273	0,787	7,83	2,79	-1,393	0,191	7	1,81	-1,773	0,104
	A	8,81	2,52			8,08	2,94			7,33	1,44		
Waist	B	87,71	11,52	-0,245	0,808	90,83	13,31	3,218	0,008*	82,83	8,01	3,694	0,004*
	A	87,97	10,74			86,83	9,98			80,5	6,78		
Hip	B	107,81	7,77	2,135	0,041	109,58	12,78	2,61	0,024*	103,75	6,76	2,318	0,041*
	A	105,74	9,06			107	12,4			101,08	5,42		
Waist/Hip	B	0,81	0,08	-1,268	0,214	0,83	0,06	1,376	0,196	0,8	0,05	0,155	0,879
	A	0,84	0,11			0,81	0,05			0,8	0,06		

3.1. The Pilates Program Group

Table III shows the correlation analysis for the variables measured before and after the programs for each group. There has been a positive but at medium level of correlation between Social Physical Anxiety (SPA) and waist/ hip ratio difference. A positive relationship has been found between all other variables apart from Social Physical Anxiety (SPA) and waist/ hip ratio.

Table III. The correlation analysis for variables measured before and after the program for each group

Before and after the program	Pilates	Balance &Co-ordination	Strength
SPAI	0,640**	0,847**	0,765**
Height	0,972**	0,989**	0,967**
Weight	0,998**	0,672*	0,991**
Body Mass Index (BMI)	0,991**	0,770**	0,984**
Basal Metabolic Ratio (BMR)	0,965**	0,971**	0,910**
Body fat ratio (Fat mass)	0,897**	0,784**	0,972**
Fat free body mass (ffm)	0,790**	0,947**	0,878**
Total body water (tbw)	0,984**	0,947**	0,881**
Fat ratio in internal organs(visceral)	0,968**	0,978**	0,945**
Waist circumference	0,863**	0,972**	0,970**
Hip circumference	0,806**	0,963**	0,808**
Waist /Hip	0,523	0,753	0,986

*p<0.05 **p<0.01

3.2. Balance and Coordination Program Group

Except for the values obtained for weight, a high level positive correlation was obtained between all variables measured before and after the program. For all variables positive correlations have been observed.

3.3. Strength Program Group

A positive correlation was obtained for all measured variables for the participants included in this program. In other words, the measurement values before the beginning of the program correlated directly and positively with the measured values at the end of the program (if the first one increased, so did the second). In the same manner, if the values measured before the beginning of the program decreased, the final values also decreased.

4. Discussion

There have been various studies carried out in order to investigate the effect of exercise on the osteoporosis treatment. However, the relevant literature lacks research investigating the effects of strength, balance-coordination and Pilates exercises on the social physical anxiety levels and some physiological parameters of the female osteoporosis patient. The results of the present study show that there is a meaningful difference between height and hip circumference measured for each subject before and after performing the Pilates and balance-coordination program ($p<0.05$). The increase in height may have mainly resulted from the stretching and elongation exercises performed during the program. This may have improved the participants' posture and led to higher values for height measurements. Therefore, the difference in height at the beginning and at the end of the program can be attributed to participants' adaptation to a correct posture.

In a study carried out by Altıntaç [28], suitability tests were performed by the women over 30 who attended a Pilates reformer and Pilates floor exercise program 3 times a week for 8 weeks. In this study, it was observed that the average weight, body mass index, body fat percentage, body fat index, fat free, waist and hip and waist/ hip ratio measurements of these women decreased. In the same way, an increase has been observed for the following values: flexibility of leg muscles and joints together, balance, leg and torso muscle maximal force and endurance of muscles in legs, torso and biceps. Besides, the vital capacity of the lungs has also been improved. Therefore, participants were able to run longer distances and for a longer time, in the process being measured also the indirect aerobic capacity. As a consequence their maximum VO2 (oxygen capacity) increased [29].

In the present study, the Social Physical Anxiety scores of the participants after attending the Pilates and balance- coordination programs has been found lower but not statistically significant. Pilates, balance and co-ordination exercises can make the body look fitter as such exercises apply strong isometric muscle force. This causes improvement in the physical appearance, which results in low social physical anxiety in return [30]. Pilates exercises have been found to negatively influence the possibility of falls, as well as to increase muscle strength, dynamic balance and muscle flexibility. As a result, Pilates exercises can lower anxiety and improve the quality of life [30].

In a study carried out by Korkmaz, it has been found that Fibromyalgia patients who attended a 12-week Pilates exercise program for three days a week presented a positive response in regard to their SPA

[31]. According to the relevant literature, those individuals who exercise and have better physical performance are expected to have lower anxiety levels in comparison to those who do not exercise at all [32, 33, 34]. In a study investigating the effect of exercising on spare time satisfaction and social physical anxiety of the adults, Gökçe et al, found that those individuals who did not exercise had significantly higher social physical anxiety levels in comparison to those who exercised [35].

The present study has found a significant difference between values of basal metabolism rate (BMR), fat free mass (ffm), total body water (tbw), waist and hip circumference measured before and after the exercise program for the participants in the balance-coordination and strength exercise groups ($p< 0.05$). In a study on a group of middle aged women (40-66 years old), Dixie et al [36] defined the physical characteristics as follows: body mass ratio 26.0 kg/m2, weight 70.2 kg, body fat ratio % 34.9. A significant correlation has been found between the measurements of basal metabolism rate, fat free body mass, total body water for the women who attended the balance- coordination exercise program and strength exercise program. Similarly, Amano et al [37] reported that a group of obese male and female participants had a lower body fat index as a result of attending an aerobic program. The body fat rates were 29.6±1.3% before the program and 26.6 ±1.3% after the program; Wimberly et al. [38] found that women who do not exercise had 10% more body fat in comparison to those who exercise. In a study investigating the effects of walking and step-aerobic exercises on obese women and on their physical parameters, Akdur et al. reported a statistically significant difference in the body fat percentage of the participants [39]. Nindl et al. [40] applied a combination of resistance and aerobic programs to 31 healthy female participants for 6 months 5 days a week. They determined a 10% decrease in the fat mass of the participants at the end of the program. The findings of these studies support the findings of the present study.

5. Conclusion

In conclusion, Pilates, strength and balance and co-ordination exercise programs improve the physical fitness capacity of the female patients with osteoporosis aged between 50 and 69. While Pilates exercises and balance and co-ordination strengthen the body muscles, they also increase the unity of muscle and skeleton system and maintain the joint stabilization as they improve spinal mobility. Social Physical Anxiety decreases with increasing self-confidence as patients feel their body muscles have become stronger and that their body posture has improved. Strength exercises are particularly important because the muscles mass lost with aging can be replaced as a result. In sum, it has been found that Pilates, balance and co-ordination, and strength exercise programs performed 3 times a week for 12 weeks can decrease social physical anxiety and weight gain.

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