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The Effect of Eight-Week Resistance Exercise Program on Static Balance in Sedentary Men Aged 20-40 Years

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Abstract

Resistance exercises are performed in order to improve muscle strength as well as to achieve balance recovery. For this reason, the aim of the study is to examine the effect of eight-week resistance exercise program on static balance in sedentary men aged 20-40 years. Between 20-40 years 45 sedentary male were separated exercise groups and control group. A resistance exercise program was applied for 3 days a week for 8 weeks. The first four weeks of the program is completed with 11 stations, with 3 sets/12 reps at 60% of 1 repeat maximum (RM) and 3 sets/12 reps at 70% of 1 RM in the second four weeks. A static balance test was performed on the right, left and double legs before and after 8 weeks. When the values of balance test and strength test were compared before and after training, there was a significant difference in EG in all parameters ($p<0.05$). A significant difference was found in the comparison of the balance test between the groups in favor of right leg and double leg EG ($p<0.05$). There is a significant difference in the strength test between the groups in favor of EG. As a result, it is possible to say that resistance exercise program applied for 8 weeks has a positive effect on static balance and strength.

Keywords: Static balance, resistance exercise, general strength, sedentary

Introduction

Balance is the ability to maintain body position against a gravitational force in a stationary position or in motion (Massion at al., 1998). Balance competence begins to develop in the pre-school period (3-6 / 7 years), reaches the maximum level in the youth (17-18 in females, 18-19 in males) and decreases with increasing age (Muratlı, 2007). Balance can be examined in two sub-headings as static balance and dynamic balance. Static balance is the ability to maintain different positions in a steady state without the need for any external force while maintaining the center of gravity and supporting surface width (Wolff et al., 1998). It is also defined as a balance automatically provided on a fixed support surface to protect the posture or body parts in the proper position (Nichols, Glenn, and Hutchinson, 1995). Static balance tests are performed by recording the time during which the body can be maintained in different positions while the support surface remains unchanged (Guyton et al., 2007).

The ability of the body to stand upright and maintain its position against gravity depends on 3 sensory systems. These are visual, vestibular (auditory) and proprioception (sensorial) systems. Balance is performed by functions of central nervous system. Information from various peripheral organs is prepared and assessed in the central nervous system and then balance is provided through some reflexes (Bressel et al., 2007).

Muscular force is the amount of force a person can develop during a single maximum contraction. Muscle strength is the maximum amount of work that occurs at a given unit time. Muscular force is defined as the muscle's ability to create force. Force exercises are used to improve athletic performance, improve the musculoskeletal system health, and correct disequilibrium in muscular force (Folland and Williams, 2007). The general force is the strength of all the muscles that the muscles exhibit in the same balance for each sporting event in a versatile way without a tendency towards a sports branch. In daily life, people use about 30% of muscular force. Resistance exercises are applied for specific purposes. Resistance exercises are also being applied to protect or improve the body form (Pollock et al., 2000) as well as to achieve balance, as well as protective, therapeutic, performance-enhancing purposes. Muscular force is important in terms of motor skills in terms of balance operation of the joints, efficient movement, and musculoskeletal injuries to reduce risk. Training intensity, training frequency, training method, ranking and application of training content, starting length of muscle, joint working angle, contralateral training effects and additional stress influence force development internally, while nutrition and seasons influence externally. Also; momentary states such as force, motivation, stress, hypnosis and daily rhythm are influential (Muratlı et al., 2007).

The positive effects of resistance exercises on muscular force have been shown in the literature (Häkkinen et al., 1998; Hortobaágyi and DeVita, 2000), and studies have shown that resistance exercises without balance exercises have a positive effect on balance (Heitkamp et al., 2001; Krebs et al, 1998; Lord et al., 1991). Motor skills training, including balance exercises, increase the sensitivity of the feedback tracts and improve the motion sensitivity of both agonist and antagonist muscles (Massion et al., 1998).

Tests related to balance assessment started being conducted many years ago and have developed much until now (Guskiewicz, 1999; Nordahl et al., 2000; Wilkins et al., 2004). In 1851, Romberg found a method of measurement with a stabilizer to clinically assess the static balance (Goldie et al., 1990). This test and its improved versions are currently being used both in balance assessments and in the treatment of some neuromuscular disorders. In recent years, computerized balance systems have been developed that allow balance evaluations to be

improved (Paterno et al., 2004). This new generation of balance devices is more accurate and provides data that can be measured objectively. They consist mainly of a movable platform supported centrally by a small pivot. The stabilization level of the platform can be adjusted for different difficulties. The distance from the recommended position to the center of the platform is measured during each recording. Three balance scores, total balance score, anteroposterior balance score and right-left balance score, are obtained from the sum of these distances (Arnold and Schmitz, 1998).

Materials and Methods

Participants

45 healthy sedentary men between 20-40 years of age living in Manisa province participated in the study. Participants were invited to the workshop via face-to-face interviews. Individuals voluntarily participating in the study have been taken to work after they have read the information form in which they have detailed information about the work and signed the voluntary consent declaration. Participants who did not exercise regularly in the last 6 months, who had muscle and joint problems, and who used alcohol and tobacco-like substance were not included in the study.

Training Protocol

Between 20-40 years 45 sedentary male were separated exercise groups (EG, n = 23) and control group (CG, n = 22). A resistance exercise program was applied for 3 days a week for 8 weeks. Before starting the 8-week program, the participants in the exercise group were trained about right grip, correct breathing and weight lifting with the right technique for 1 week with low weights. In order to determine the exercise loads to be applied to the participant before the exercise, 1 RM loads were estimated using the 10 repeated maximum (RM) method and the loads to be applied to the participants were determined. Studies were conducted for 8 weeks, 3 days a week, in accordance with the recommendations of the American College of Sports Medicine for health and fitness purposes (Medicine, 2013). Participants worked the exercise program under the supervision of sports instructors. Participants in the EG (3 sets in 60% of the estimated 1 RM, 12 replicates) working at weights determined during the first 4 weeks of the resistance training program were again subjected to strength measurement to determine the new weights to be applied when they reached the 4th week of the program. Each participant's new estimated 1 RM level (3 sets in 70%, 12 repeats) was determined and new weights were calculated and processed into training cards. Participants performed the exercise program for approximately 50-60 minutes at 11 stations. These stations; chest press, seated row, shoulder press, knee flexion, knee extension, biceps curl, triceps press, crunch, hyperextension. The strength test was performed after a full rest 48 hours after the exercise. Resistance training was performed between 08:30 and 10:30 in the morning. During the resistance training program, before and after the exercises, the participant applies 10 min warming, 5 min stretching, 5 min active cooling.

Tests and Measurements

The length of all participants was measured with Seca 769 (Hamburg, Germany) before starting work. Body composition and body mass index (BMI) were measured using a Tanita 300 MA (Japan) with a sensitivity of 0.5 kg that works with a bioelectrical impedance analyzer. Resistance exercises were performed at Manisa Celal Bayar University, Faculty of Sports Sciences, Sports Center for Health, balance measurements and body composition

measurements were performed in the performance laboratory. For the purpose of increasing participation in the study, those who want to exercise are included in the exercise group and those who do not want to exercise are included in the control group. We measured the static balance on the right-left-double leg using Korebalance (USA) 8 weeks before and after. The static test was performed on the right leg, left leg and posture positions on both legs, respectively. During one-leg static tests, the other leg is 60-90 degrees in flexion. Participants were not allowed to touch the platform. The participant was asked to stay stable by trying to maintain the balance to the front, back, right, left at the fixed point on the screen during the test. The test times were 30 seconds and the rest intervals were 10 seconds and the scores were recorded.

Statistical Analysis

Statistical analysis was performed with SPSS 23.00 statistical package program. Normal distribution suitable for the data was assessed by the Shapiro-Wilk test. The mean and standard deviation of the data showing normal distribution and the median (25-75 percentile) of the data without normal distribution were expressed. Paired-t-test was used for pre-posttest comparison in normal distribution data whereas Unpaired-t-test was used for comparison of groups. The Wilcoxon signed rank test was used in the pre-post test comparison of the data with no normal distribution, whereas the Mann Whitney-U test was used to compare the groups. For statistical significance, $p < 0.05$ was accepted.

Results

A total of 45 participants' data were used in the statistical analysis of the study. Table 1 shows the minimum, maximum, mean and standard deviation of the descriptive parameters of the participants.

Table1. General characteristics of participants at baseline.

Parameters	**EG (n=23)**		**CG (n=22)**	
	Min-Max	Mean±SD	Min-Max	Mean±SD
Age (yr)	20-40	26.43±7.64	20-40	25.36±5.63
Height (cm)	168-194	181.04±7.55	166-190	177.86±7.73
Body weight (kg)	62.80-92.60	77.41±8.10	53.20-97.20	73.86±12.25
BMI (kg/m^2)	19.40-35.10	25.01±4.66	17.20-32.00	23.48±3.47

EG= exercise group; CG= control group

When the balance test of the groups and the before and after the training values of physical parameters were compared; there was a difference of $p < 0.05$ in EG in right leg and double leg values. It was determined that there was a difference on behalf of EG, as a positive effect between EG and CG in the comparison of differences happened between groups in training ($p<0.05$) (Table 2).

Table2. Changes in physical and balance characteristics of subjects following the intervention

Parameters	n	Pre-test	Post-test	p
Body weight (kg)				
EG	23	77.41±8.10	76.75±7.79	.129
CG	22	73.86±12.25	74.05±11.95	.484
BMI (kg/m^2)				
EG	23	23.90 (21.20-28.20)	23.36±2.82	.134
CG	22	22.80(21.52-24.32)	23.34±2.91	.574
Left leg				
EG	23	1427(1021-2488)	1300(1100-2500)	.025*
CG	22	2347.63±939.70	2279(1558.75-2842.25)	.865
Right leg				
EG	23	1160(1011-1865)	1036(927-1300)**	.000*
CG	22	1314(1010.25-2061.25)	1372.52(1002-2251.25)	.390
Double leg				
EG	23	912(808-1590)	851(701-1011)**	.002*
CG	22	1415(1014.75-2263.75)	1375(1107.50-2023)	.590

*p<0.05 change from baseline; **p<0.05 between EG and CG

When the before training and after training strength values of groups were compared; there was a significant difference at p<0.05 level of EG in chest press, stead row, shoulder press, knee flexion, knee extension, biceps curl, triceps press, crunch, and hyperextension. In comparison between groups, it was determined that there was a difference on behalf of EG as a positive effect of the training (p<0.05) (Table 3).

Table3. Changes in the strength for the EG and CG following 8 weeks of resistance training period

Parameters	n	Pre-test	Post-test	p
Chest press (kg)				
EG	23	40(35-45)	60(55-60)**	.000*
CG	22	43.40±7.13	44.81±8.09	.248
Stead Row (kg)				
EG	23	40(35-45)	60(50-60)**	.000*
CG	22	37.27±6.31	39.13±7.54	.318
Shoulder Press (kg)				
EG	23	20(15-20)	25(25-35)**	.000*
CG	22	15(15-20)	20(15-25)	.398
Knee Flexion (kg)				
EG	23	39.13±44.68	50.65±7.87**	.000*
CG	22	40(35-45)	40(38.75-45)	.491
Knee Extension (kg)				
EG	23	40(35-45)	55(45-55)**	.000*
CG	22	35(35-40)	35(35-40)	.495
Biceps Curl (kg)				
EG	23	10(7-15)	20(15-20)	.000*
CG	22	15(10-20)	17.5(15-20)	.318
Triceps Press (kg)				
EG	23	15(15-20)	30(20-35)**	.000*
CG	22	15(10-15)	15(15-20)	.485
Crunch (kg)				
EG	23	20(15-25)	35(30-45)**	.000*
CG	22	15(10-25)	17(15.25)	.365
Hyperextension (kg)				
EG	23	20(15-25)	35(25-35)**	.000*
CG	22	20(15-25)	22.5(18.75-30)	.487

*p<0.05 change from baseline; **p<0.05 between EG and CG

Discussion and Conclusion

Exercise is an activity that should be in daily life. When the human body is in motion, accommodating hinges on the balance due to the changing center of gravity. Weak individuals in terms of balance are often affected by external effects and by the conditions of the movements of the human body, so they often lose their balance. In addition to this, falling causes injury risk. In this regard, the relationship between balance and sport gains importance.

The general belief is that balance skills develop after regular exercises Rodrigues et al. (2010), 27 elderly women were applied pilates exercise and positive effect on static balance was reported(de Siqueira Rodrigues, Cader, Torres, de Oliveira, and Dantas, 2010). Türkeri (2015), reported that regular exercises applied for 12 weeks increased static balance values. Eylen (2017), reported that there was a significant difference in double leg general static balance, right leg general static balance in the experimental group and general static balance

scores of double feet in control group after 8 weeks of different strength training (Eylen A, 2017). In our study, it is possible to say that resistance exercises have a positive effect on the static balance, similar to the literature information.

It is known that resistance exercises increase muscle strength, muscular power, and muscle mass and so increase life quality of people and prevent sarcopenia (Seguin and Nelson, 2003). In the study conducted by Flynn and his friends(1999) and done with sedentary individuals, it was determined that resistance exercises applied in 3 times of a week during 10 weeks increased muscle strength and also there was not a significant difference in body composition parameters (Flynn et al., 1999). With the study of Maeda and his friends, resistance exercises were applied to sedentary individuals 2 times a week for 12 weeks. Similarly, while there were not significant differences in body composition; there was an increase in the maximal strength of the participants (Maeda et al., 2006). Maddazolla and Snow (2000) applied resistance exercise in females and males between age of 50-60 in their study. The first group exercising moderately intensive exercise was applied for 24 weeks (3 days a week, about 75 minutes, 13 exercises, 40% of 1 TM in the first 3 weeks), 50% of 1TM at 3-6 weeks, and in 7-24 weeks they were applied incrementally, with 3 sets consisting of 10-13 repeats in 60% of 1TM. The second group doing high-intensity training was applied 3 days a week during 24 weeks; in the first 6 weeks 10 repetitions in 70% of 1TM, between 7-10 weeks 6 repetitions in 80% of 1TM, and in last weeks 2-4 repetitions with 3 sets in 90% of 1TM. After the exercises, they observed an increase about %37.62 in muscle strength and fat-free body mass in both genders (female: %3,1, male: %4,1) (Maddalozzo and Snow, 2000). Fenicchia and his friends (2004), observed significant reductions in body weight, body fat percentage, fat weight, fat free body mass, and BMI of the participants in the training program that was applied to the secretaries with Type 2 Diabetes in 3 times a week during almost 50 minutes (8 exercise, %80 in 3TM, 3 set, 12 repeat and 1,5 minute rest) (Fenicchia et al., 2004). Moreover, Wycherley and his friends (2010) applied resistance exercises on obese female and male patients with type 2 diabetes in 3 times a week, %70-85 of 60 ITM, 8-10 repeat in their study. With this program applied in a similar way, there was an increase in BMI, maximal strength of the participants while body weight and fat ratios decreased (Wycherley et al., 2010). In this study, it was also reported that the eight-week resistance exercises increased the maximal strength of the participants.

As a result, it is possible to say that resistance training program applied for 8 weeks has a positive effect on balance and strength in sedentary individuals.

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Conflict of Interest

The authors have not declared any conflicts of interest.

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