The Effects of Aerobic Exercise on Balance and Strength Parameters in Sedentary Women

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ABSTRACT

The aim of this study was to investigate the effects of 8-week aerobic exercise and relative strength training on balance and strength parameters and the relationship between balance and strength in sedentary women. The participants between the ages of 30-55 residing in Sinop province were divided into experimental and control groups. The experimental group received 60-90 minutes of aerobic and strength training two days a week for 8 weeks while the control group did not receive any training program. Measurements were taken from the participants before and after the training period and the data obtained were compared between the experimental and control groups. Activforce 2 Manual Muscle Test measuring device was used for strength measurements and Togu Challenge measuring device was used for balance measurements. The data obtained were analyzed with SPSS 26.0 analysis program. As a result of the analysis, a significant difference was observed between the experimental and control groups in both balance and strength values ($p<0.05$); however; the relationship between balance and strength parameters was not statistically significant ($p>0.05$). In addition to these findings, it was observed that the relationship between right hip strength and left hip strength was positive and statistically significant. As a result, it can be stated that aerobic exercise has a positive effect on balance and strength, yet it does not create a significant relationship between balance and strength.

Keywords: Sedentary women, aerobic training, strength, balance, physical performance

1. Introduction

A sedentary lifestyle is the primary risk factor contributing to obesity (O'Donoghue et al., 2016; Dhuli et al., 2022; Cabo et al., 2024). In immobile individuals, it is believed that when they regularly add light exercises to their lives, they will significant health gains. The lack of physical activity, which is a fundamental element in ensuring individuals' physical, social, and mental development, is a significant public health issue (Yaribeygi et al., 2021;

Silva et al., 2024; Śliwicka et al., 2024). In order to create a healthy and peaceful society, it is necessary to lead an active lifestyle and make physical activity a way of life. There are numerous studies in the literature investigating the benefits of physical activity on body composition (Morales-Suárez-Varela et al., 2013; Idler et al., 2015), cardiovascular risk factors (Ekelund et al., 2007; Morales-Suárez-Varela et al., 2013; Castillo-Rodríguez et al., 2020) and physical fitness (Arriscado et al., 2014; Voss et al., 2014).

Through exercise, balance and skill development increase along with flexibility, thereby reducing the risks of falls and injuries. The impact of exercise on disease prevention and quality of life has been known for many years (Özenoğlu et al., 2016). According to one definition, exercise is a planned, voluntary physical activity aimed at improving one or more components of physical fitness (cardiovascular fitness, muscular strength, balance and endurance, flexibility, and body composition) through repetitive actions. In short, they are planned physical activities aimed at goals such as fitness, physical performance, weight control, or maintaining a healthy lifestyle (İşleyen, 2018). Aerobic exercise is defined as physical activity where the primary energy requirement is met with oxygen, and it can be performed at varying intensities from low to high, applying different principles of intensity and load (Yalman, 2016). In addition to this definition, aerobic exercise refers to prolonged activities lasting more than 10 minutes, where the majority of energy is supplied through aerobic energy metabolism (Kızılay, 2012). With aerobic exercises, more calories are expended and fat stores are reduced, while with strength training, the resting metabolic rate increases more and the strength of the respiratory muscles increases in parallel with the increase in strength. Additionally, regular moderate-intensity strength exercises lead to an increase in cardiac output due to the increase in the mass of myocardial tissue and contraction strength (Yaprak, 2004). As a result of the literature review, the positive effects of exercise on

women have been demonstrated by many studies (Biçer et al., 2009; Kurt et al., 2010; Sekendiz et al., 2010; Özenoğlu et al., 2016). In line with these explanations, the aim of the study was to investigate the effects of 8-week aerobic exercise and strength training with own body weight on balance and strength parameters and the relationship between balance and strength parameters in sedentary women.

2. Methods

2.1.Participants

The study was conducted with sedentary women aged 30-55 years, residing in Sinop province, and participating the study voluntarily. The study was conducted in Sinop province and 22 participants were divided into Experimental Group (EG n:11) and Control Group (CG n:11). The means and standard deviations of the parameters obtained from the participants before and after training are provided in Table 1.

Table 1: Descriptive Characteristics of The Participants

		n	X̄	SD
Age	EG	11	41.00	6.51
	CG		41.64	6.86
Body Height (cm)	EG	11	162.59	6.25
	CG		164.27	5.91
Body Weight (kg)	EG	11	77,44	11,86
	CG		76,14	16,75

n: Number of participants, X̄: Mean, SD: Standard deviation, EG: Experimental group, CG: Control group

2.2.Procedures

In the study, a control group experimental model involving repeated measurements was used as the method, and all participants were thoroughly informed about the study before it began.

Measurements of both balance and strength were taken from the participants before and after an 8-week aerobic exercise program aimed at the objectives of the study. This way, the effects of aerobic exercise on balance and strength, as well as the relationship between them, were examined. A group of female participants aged between 30 and 55 in the experimental group underwent an exercise program prepared by the researcher for 8 weeks, with sessions held 2 days a week, lasting 60 to 90 minutes each day. Each training session is designed to include warm-up, stretching, main training, cool-down, and stretching. The main training period consisted of 30-45 minutes of aerobic exercise and 20-25 minutes of strength training with own body weight. As part of the exercise program, the participants were engaged in an aerobic exercise regimen that included varying tempo workouts with increasing intensity from low to high. For the strength training program, they performed a range of bodyweight exercises on mats, progressing from easy to difficult variations. While the exercise programs were prepared in different intensities and scopes from day to day and week to week, the control group was not trained in any way and it was assumed that they did not do sports during the 8-week training period. The exercise program is provided in Table 2.

Table 2: Exercise Program

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Exercise Duration (min)	60	60	65	70	75	80	85	90
Exercise Intensity (%)	60-65	60-65	65-70	65-70	70-75	70-75	75-80	75-80
Exercise Frequency (days)	2	2	2	2	2	2	2	2

2.3.Data Collection

For the purposes of the study, the personal information of the participants was obtained through the “Personal Information Form” prepared by the researcher.

Strength measurements: The strength values of the participants were measured with the Activforce 2 Manual Muscle Test meter (Activforce 2, San Diego, California, USA). In the literature, the device used for measuring muscle strength and range of motion in joints such as the neck (Sharmin et al., 2024), shoulder, (Karagiannopoulos et al., 2022) and hip (Mihajlov et al., 2023; Mihajlov et al., 2024) is required to have a measurement accuracy of ±1%. This allows for the assessment of eccentric muscle strength in each extremity, as well as the maximum strength required to overcome isometric contraction by applying strength to the participant with the device during measurement, and the measurement of joint range of motion. During the strength measurements, the participants were seated and the knee joint was measured at a 90-degree angle, with the whole foot in a fixed position on the ground, preventing any strength from the hands. During the measurement, the device was fixed and only the strength exerted by the desired muscle group was measured. Strength tests were applied twice and the averages of the results were evaluated.

Balance measurement: The participants' balance was measured using a dynamic balance meter (Togu Challenge Disc2.0, Prien am Chiemsee, Rosenheim, Germany). The device can transmit data wirelessly and is used to assess body stability, coordination, and balance. When the score scale is examined, the best score is given as 1 and the lowest score is given as 5 in the score table between 1-5. The participants stepped on the measuring device without shoes and tried to keep the point in the circle fixed in the center for 20 seconds in addition to the 10-second preparation time with both feet. The participants performed the balance test twice and their best scores were evaluated (Mor et al. 2022).

2.4.Data Analysis

The analysis of the data obtained was made through the SPSS 26.0 program, the normality distribution of the data was examined through the Shapiro-Wilk test and it was determined that all data showed a normal distribution. The comparison of the data between groups was analyzed by Independent Sample T Test and the correlation analysis was analyzed by Pearson correlation analysis.

3. Results

Table 3: Comparison of Balance and Strength Parameters Between Groups T-Test

			Pre-training			
		n	**X̄**	**SD**	**X̄-F**	**Sig.**
Balance	EG	11	3.16	.80	.13	.75
	CG	11	3.03	1.11		
				Post-training		
Balance	EG	11	2.50	.81	-.96	**.02***
	CG	11	3.46	1.00		
Strength Measurements						
				Pre-training		
RIGHT HIP	EG	11	19.33	5.84	-2.59	.27
	CG	11	21.92	4.89		
LEFT HIP	EG	11	20.09	6.11	-1.83	.38
	CG	11	21.92	3.04		
				Post-training		
RIGHT HIP	EG	11	26.78	6.87	6.62	**.01***
	CG	11	20.16	4.05		
LEFT HIP	EG	11	27.13	7.31	7.28	**.01***
	CG	11	19.85	4.33		

*n: Number of participants, X̄: Mean, SD: Standard deviation, X̄-F: Mean differences, EG: Experimental group, CG: Control group, *: p>0.05*

Table 4: Correlation Analysis of Balance and Strength

				Pre-training	
Groups			**Balance**	**RIGHT HIP**	**LEFT HIP**
		r	1	-.177	-.197
	Balance	p		.60	.56
		n	11	11	11
		r	-.177	1	.982**
EG	**RIGHT HIP**	p	.60		**.00**
		n	11	11	11
		r	-.197	.982**	1
	LEFT HIP	p	.56	**.00**	
		n	11	11	11
		r	1	-.106	-.381
	Balance	p		.75	.24
		n	11	11	11
		r	-.106	1	.857**
CG	**RIGHT HIP**	p	.75		**.00**
		n	11	11	11
		r	-.381	.857**	1
	LEFT HIP	p	.24	**.00**	
		n	11	11	11
				Post-training	
		r	1	-.543	-.478
	Balance	p		.08	.13
		n	11	11	11
		r	-.543	1	.956**
EG	**RIGHT HIP**	p	.08		**.00**
		n	11	11	11
		r	-.478	.956**	1
	LEFT HIP	p	.13	**.00**	
		n	11	11	11
		r	1	.024	-.183
CG	**Balance**	p		.94	.59
		n	11	11	11

	r	.024	1	.884**
RIGHT HIP	p	.94		**.00**
	n	11	11	11
	r	-.183	.884**	1
LEFT HIP	p	.59	**.00**	
	n	11	11	11

*n: Number of participants, EG: Experimental group, CG: Control group, r: Pearson correlation, *: p<0.05, **:p<0,01*

4. Discussion

The aim of this study was to investigate the effects of 8-week aerobic exercise and relative strength training on balance and strength parameters and the relationship between balance and strength in sedentary women. For this purpose, 22 sedentary women who voluntarily participated in the study were divided into EG (n:11) and CG (n:11) and the data obtained before and after the 8-week training period were compared.

When the data of the experimental group were analyzed, it was found that the average age of the participants was 41±6.51 years and their body height was 162.59±6.25 cm. It was concluded that the difference between the Pre-training and Post-training means of the balance test values of the experimental group was -0.66, the average difference of the Right Hip was 7.45 and the average difference of the Left Hip was 7.04. It was observed that there was a positive development in both balance and strength values of the experimental group and this difference obtained before and after the training period was statistically significant. When the data of the control group were analyzed, it was concluded that there was a negative change in balance and strength data at the end of the 8-week period and this change was statistically significant. It is known that exercise has positive effects on humans such as increased muscle strength and balance (Haskell et al., 2009) and that physical inactivity can cause

musculoskeletal problems, especially in women (Bento et al., 2012). When the data belonging to the control group is examined, the negative developments in parameters such as balance and strength due to inactivity support these explanations. In the comparison made between groups, it was observed that there was a statistically significant difference between the experimental group and the control group as a result of 8 weeks of aerobic and strength training. These results show that aerobic exercises have a positive effect on balance and strength parameters. In the correlation analysis, it was observed that the relationship between balance and strength parameters was not statistically significant both before and after training, but there was a significant positive relationship between right and left hip in both groups.

In their study, Tortop et al. (2010) examined the effects of a 12-week step-aerobic exercise program on certain physical fitness parameters among university students and concluded that there was no statistically significant difference in leg strength values. Aktaş and Aslan (2023) examined the effects of 6-week aerobic-based exercises in sedentary women in their study and stated that it had a positive effect on leg strength. Zhang et al. (2024) reported an improvement in dynamic balance values as a result of 24-week aerobic exercises conducted with a sedentary group with older age and the difference obtained in this improvement was statistically significant. McCurdy and Langford (2006) conducted a study with 17 males (21.7±1.8 years) and 25 women (21.9±1.3 years) and aimed to compare the balance performance between dominant and non-dominant leg by determining the relationship between squat strength and static balance measurements. As a result of the study, they concluded that the relationship between balance and strength parameters was not statistically significant and stated that the differences in static balance performance cannot be determined by the dominant leg. Muehlbauer et al. (2012) examined the relationship between static and dynamic postural control variables and isometric and dynamic muscle strength in a middle-

aged group and concluded that there was no statistically significant relationship between balance and strength. Muehlbauer et al. (2012) examined the relationship between lower extremity muscle strength and balance in a study conducted with an older age group and concluded that there was no statistically significant relationship between balance and strength. Wang et al. (2016) examined the relationship between proprioception muscle strength and balance in their study. In a study conducted with female participants with an average age of 22.2±2.8 years, it was concluded that there is a significant relationship between quadriceps muscle strength and dynamic and static balance. Additionally, it was noted that there are differences in correlation between proprioception, strength perception, quadriceps strength, quadriceps/hamstring ratio, and balance at different knee angles. Wilson et al. (2018) examined the relationship between isometric hip strength and Y Balance Test and concluded that the relationship between Y Balance Test and hip strength was significant. In addition to this conclusion, the linear regression analysis indicated that hip abduction is a determining parameter for Y balance performance, and when an individual scores below expectations in the Y balance test, attention should be given to hip abduction strength.

5. Conclusion and Recommendation

It was concluded that moderate-paced aerobic exercises and relative strength training had positive effects on balance and strength parameters in sedentary women, but there was no statistically significant relationship between balance and strength. As a result of the study, it was requested to reduce the balance data (best score 1, lowest score 5) and increase the strength data. Although the desired change was seen in the experimental group after exercise, the exact opposite result occurred in the control group. Based on the results obtained, it can be

stated that exercise has positive effects on physical performance parameters in sedentary women.

Ethics Committee Approval: Ethical approval was received for this research from Sinop University Human Research Ethics Committee (10.04.2023 and 2023/45-87).

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Conflict of Interest: The authors have no conflicts of interest to declare.

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