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The Effect of Static Balance Exercises on Reaction Time in Sedentary Female Students

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Abstract

The purpose of this study is to analyze the effect of 8 week static balance exercises on reaction time. 38 sedentary female students voluntarily participated in the study. The volunteers were selected randomly and were separated into 2 groups as the experiment group (n=19) and the control group (n=19). While the experiment group participated in static balance exercises in their physical education lessons for 8 weeks, the control group only participated in the physical education lessons. The visual and auditory reaction times of the samples were carried out with the Newtest 1000 device as pre-test and post-test. The data were evaluated with the SPSS 20.0 statistical software program and since there was no normal distribution, the wilcoxon signed rank test which is one of the non-parametrical tests was carried out and the significance level was determined as $p<0.05$. The age average of the volunteers (n=38), was determined as 15.8±1,50 years, height averages as 160,3±5,48 cm and body weight averages as 53,33±7,50 kg. As a result of the statistical analysis, it was found that there was no significant differences in either of the groups between the pre-rest and post-test visual and auditory reactions ($p>0.05$). As a result, it was determined that 8 week balance tests did not affect the visual and auditory reaction times of the female students.

Keywords: reaction time, balance, physical education lesson

1. Introduction

Individuals' reaction times occur through the central nervous system and muscles as a result of the interaction between appropriate components and various factors (Eren et al., 2017). In physiological terms, reaction time takes place as a result of five stages as a stimulant taking place in the receptor level, spreading of the stimulant to the central nervous system, production of the effector signal through the stimulant's being carried by neurological paths, the signal's being carried from the central nervous system to the muscles and the contraction of the muscles to produce mechanical activity as a result of the stimulus (Bompa 1990). Reaction time is defined as the time between giving the stimulus to the individual and the individual's voluntary reaction to the stimulus (Açıkada, 1990; Çankaya, 2014). Reaction time changes from person to person and situation to situation. In general, the reaction time being long is an indication that the individual gives less attention to the stimulant (Fox et al., 1999).

Reaction time is extremely important in our daily lives. The measurements obtained from the simple reaction time tests give information about a person's neurological and cognitive functionality in a given activity (Okkesim and Coşkun 2015). Reaction time is an important criterion in sports due to being a part of sportive components which include muscle-nerve performance and hand-eye coordination and it has been determined that reaction time can be developed through regular exercise (Çolakoğlu et al., 1993).

Sports being done regularly improves the development of circulatory, respiratory and muscle systems in adolescent individuals and increases physical capacity. While exercises done at early ages provide protection against various diseases such as cancer, diabetes, obesity and cardiovascular diseases, they also help to develop motor characteristics. A positive development takes place in the perception and reaction times of adolescents who exercise (Sevim, 2002). Therefore, it is important that the balance skill of individuals (Aksu, 1994) which is defined as a determinant factor in the development of other motor systems to be studied together with its relation to reaction time.

Balance is the foundation of all movements (Brown and Ferrigno, 2005). Balance is needed to protect the body position

during a movement, speeding up and slowing down and during sudden place and direction changes. Balance is necessary in the performance of a number of motor duties (Malina, 1999). Balance is separated into two as static balance and dynamic balance. Static balance is the skill of keeping the body's balance in a certain place or position, whereas dynamic balance is the skill of keeping the body's balance while moving (Muratlı 1997, Hazar and Taşmektepligil 2008).

Balance starts developing in the pre-school period and reaches its top level at age 17-18 in girls and decreases as they get older (Muratlı, 2003). Our study was planned to analyze the effects of 8 week static balance exercises on the reaction time of girls who are at their top level in terms of balance development.

2. Method

38 sedentary female students with an age average of 15.8±1,50 who are receiving education at the İstanbul Stock Exchange Vocational and Technical Anatolian high-school in Osmangazi, Bursa volunteered to participate in our study. The students were chosen randomly and separated into two groups as the experiment (n=19) and control group (n=19). While the experiment group participated in static balance exercises in their physical education lessons for 8 weeks, the control group only participated in the physical education lessons. The volunteers' height, weight and visual and auditory reaction times were measured. They were warned about not taking any stimulant medicine, not consuming caffeine and not doing any exhausting activities prior to 24 hours of measuring the reaction times.

After the volunteers were informed about the content, purpose and application of the study, their consent about volunteering to participate in the study and the other required approvals were taken. It was determined that there were no students among the volunteers who had visual and auditory handicaps and that they did not have any other handicaps which were formed in the recent times or have had a surgery which could influence the measurements.

2.1 Measures

The body weights of the students were measured with an electronical scale with a sensitivity of 0.1 kg and their heights were measured with a digital stadiometer with a sensitivity of 0.01 cm.

2.1.1 Reaction Time Measurement

The visual and auditory reaction time measurements were carried out with the Newtest 1000 device. In the application part of the study, the participants were lined side by side and asked to put their palms on a table with their fingers in the closed position. They were asked to leave a fixed distance of 30 cm between the table and themselves. Their hands were placed 10 cm. in front of the Newtest device's reaction indicators and they were asked not to move their other hand. They were given3 light and 3 sound signals for the measurement of the reaction to sound of the right hand, reaction to sound of the left hand, reaction to light of the right hand and reaction to light of the left hand and the best reaction time values were recorded by the researcher on the form developed by her in milliseconds.

2.2 The Static Balance Exercise Program

The static balance exercise group (n=19) was given a static balance exercise program for 8 weeks in their physical education lessons, which consisted of 2 sets of 10 movements for each session; these movements were required to be performed with eyes open for the first four weeks and eyes closed in the second four weeks and the movements' duration started with 5 second and reached 12 seconds at the end of 8 weeks. The increase in load was achieved through the increase in the duration of the movements and the change in the muscle groups involved in the movements. The principle of full rest was applied between the movements and the rest time between the sets was determined as 1 minute.

Static Balance Exercises: Standing on one leg (right, left), tree position (right, left), standing on one leg in the relief position (right, left), raising the leg 90 degrees to the front in the standing straight position (right, left), sailplane position (right, left), side balance (right, left), bending forwards with one leg on top of the other leg (right, left), forward movement (right, left), side movement (right, left), backward movement (right, left) (Erdoğan et al., 2017).

2.3 Analysis of Data

The data were analyzed with the SPSS 20.0 statistical software program. Since the distribution of the data was not normal, the Wilcoxon Signed rank test which is one of the non-parametrical tests was done the statistical significance level was determined as $p<0.05$.

3. Results

In the study in which the reaction times of the experiment group and the control group were determined, the findings are presented in the tables below.

Table 1. Comparison of the Experiment Group's Visual Reaction Pre-test and Post-test Values

Right Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	14	8.00	42.00	2.22	.07
Positive Rank	3	2.00	4.00		
Equal	2				
Left Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	15	7.00	38.00	1.19	.09
Positive Rank	2	3.00	5.00		
Equal	2				

It was found that there is no significant difference between the experiment group participants' reaction to light of the right hand and left hand values' pre-test and post-test results ($p>0.05$). It was seen that there was an increase in the values of 14 participants, a decrease in the values of 3 participants and no change in the values of 2 participants in the right hand reactions. It was seen that there was an increase in the values of 15 participants, a decrease in the values of 2 participants and no change in the values of 2 participants in the left hand reactions.

Table 2. Comparison of the Control Group's Visual Reaction Pre-test and Post-test Values

Right Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	13	9.00	49.00	3.17	.06
Positive Rank	2	3.00	4.00		
Equal	4				
Left Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	16	11.00	53.00	3.67	.08
Positive Rank	1	2.00	2.00		
Equal	2				

It was found that there was no significant difference between the control group participants' reaction to light of the right hand and left hand values' pre-test and post-test results ($p>0.05$). In the right hand reactions of the control group participants, it was seen that there was an increase in the values of 13 students, a decrease in the values of 2 students and no change in the values of 4 students. It was seen that there was an increase in the values of 16 participants, a decrease in the values of 1 participant and no change in the values of 2 participants in the control group in the left hand reactions.

Table 3. Comparison of the Experiment Group's Auditory Reaction Pre-test and Post-test Values

Right Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	15	5.00	27.00	3.28	.09
Positive Rank	2	2.00	4.00		
Equal	2				
Left Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	16	8.00	36.00	1.56	.06
Positive Rank	1	4.00	7.00		
Equal	2				

According to the table 3, it was seen that there was no significant difference between the pre-test and post-test results of the experiment group participants' reaction to sound of the right hand and left hand values ($p>0.05$). It was determined that there was an increase in the values of 15 participants, a decrease in the values of 2 participants and no change in the values of 2 participants in the right hand reactions in the experiment group. It was determined that there was an increase in the values of 16 participants, a decrease in the values of 1 participant and no change in the values of 2 participants in the left hand reactions in the experiment group.

Table 4. Comparison of the Control Group's Auditory Reaction Pre-test and Post-test Values

Right Hand El	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	15	7.00	39.00	2.29	.12
Positive Rank	2	2.00	4.00		
Equal	2				
Left Hand	n	Mean Rank	Sum of Ranks	z	p
Negative Rank	14	8.00	46.00	3.43	.24
Positive Rank	2	2.00	5.00		
Equal	3				

It was found that there was no significant difference between the pre-test and post-test results of the control group participants' reaction to sound of the right hand and left hand values ($p>0.05$).It was seen that there was an increase in the values of 15 participants, a decrease in the values of 2 participants and no change in the values of 2 participants in the right hand reactions of the control group. It was seen that there was an increase in the values of 14 participants, a decrease in the values of 2 participants and no change in the values of 3 participants in the left hand reactions of the control group.

4. Discussion

It was determined in our study that the 8 week balance exercises did not create a significant difference in reaction times. When the literature is reviewed, it can be seen that there are studies which show that regular exercises positively affect reaction time (Bompa 1998).

Çankaya et al. (2014), in their study in which they analyzed the effects of special exercises which develop balance in 11 year old male children on reaction times and body mass index, have shown that 8 week special exercise program which develops balance improved the reaction times of athletes and sedentary groups. Arslan (2014) stated that 12 week exercises given to male children aged 8-11 improved their reaction time and that these movements which are required in daily life in terms of life quality will help them do these in purposeful manner and have great contributions on their success in sports. Öl çüc ü et al. (2010) have given 12 week movement training with balls and without balls to children aged 10-12 who were tennis players (n=60) and have shown that there was significant difference in the sound and light reaction times in the pre-test and post-test values of the group which was given movement training with balls ($p>0.01$). Yıldırım et al. (2010), in their study in which they analyzed the effects of physical fitness exercises in youth with intellectual disabilities on reaction times, have determined that there were significant improvements in the reaction times of the experiment group which was given a physical fitness program for 12 weeks according to the results of the pre-test and post-test ($p<0.05$). The results indicated that reaction time can be improved with an exercise program in youth with intellectual disabilities.

İri et al. (2017), in their study in which they analyzed the effects of physical activity on the eye-hand coordination and reaction time in children aged 11-14, have determined that although there was no significant difference between the physical activity levels and simple reaction times, male children have a better reaction time compared to female children and that physical activity has effects on reaction time. Can (2007), in his study in which he compared the reaction times of male tennis players, table tennis players and sedentary children in the 10-12 age group, has determined a statistically significant difference between tennis players, table tennis players and sedentary children in terms of reaction time.

As a result, it is indicated in many studies that exercise positively affects reaction time. However, the fact that there is a limited number of studies set with similar parameters which analyzed the effects of balance exercises on reaction time like our study has limited our study. In Çankaya et al. (2014)'s study set in a similar manner, different results were obtained compared to our study. This difference might have resulted due to the fact that female children participated in our study and male children participated in Çankaya et al.'s study, due to the age difference of the groups or that athlete groups were used in their study. According to these results, it is not possible to state the effects of 8 week static balance exercises on reaction time in a definite manner. In new studies to be conducted in this area, implementation of programs consisting of balance exercises along with different exercise protocols for both female and male children together in different age groups might contribute to obtaining healthier results.

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