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Effects of Gymnastics on Static and Dynamic Balance in Children (Bingol Province Sample)

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Abstract

This study was performed out to examine the effects of gymnastic exercises on dynamic and static balance in children. A total of 31 volunteer children attending primary school in Bingöl, 9 male experimental groups (MEG) and 8 male control groups (MCG) and 7 female experimental groups (FEG) and 7 female control groups (FKG), participated in the study. For the MEG who participated in our study, the age was found to be 7.60 ± 1.51 years, the heigth was 127.30 ± 10.90 cm, the body weight was 25.60 ± 5.41 kg and the BMI was 15.74 ± 0.99 kg/m^2; for the MCG who participated in our study, the age was 7.25 ± 1.26 years, the heigth was 125.80 ± 9.70 cm, the body weight was 26.51 ± 4.73 kg and the BMI was 17.72 ± 0.66 kg/m^2. For the FEG who participated in our study, the age was found to be 7.25 ± 1.26 years, the heigth was 122.63 ± 4.21 cm, the body weight was 26.51 ± 5.38 kg and the BMI was 17.72 ± 0.66 kg/m^2; for the FCG who participated in our study, the age was 7.75 ± 1.25 years, the heigth was 123.50 ± 4.30 cm, the body weight was 26.75 ± 5.52 kg and the BMI was 17.55 ± 0.62 kg/m^2. While basic gymnastics training was applied to boys and girls experimental groups for 8 weeks, 3 days a week, control groups continued their classroom training and were not included in any physical activities. Star balance test for dynamic balance measurement and flamingo balance test for static balance measurement were applied before and after gymnastics training. Analysis of the data obtained SPSS package program was used. The normality of the distributions of the variables and the homogeneity of the variances were determined by Mauchly Sphericity and Levene Tests. Analyzes between the groups, within the group and the effect of training were made with multiple measures analysis of variance (MANOVA) in repeated measurements. Post Hoc comparisons in significant values were determined by Bonferroni Test. The degree of significance ($p < 0.05$) was accepted. According to the star balance test values applied before and after exercise, test*group interaction was observed in MEG in both the right foot and left foot Anterior, Anteromedial, Medial, Postoremedial, Posterior, Posterolateral, Lateral, Anterolateral values. It has been determined that this interaction is caused by intra-group development in MGE ($p < 0.05$). While anterior, anteromedial, medial, postoremedial, posterior, and anterolateral test*group interaction is observed for the right foot star balance test in girls, this interaction is due to intragroup development in the FEG ($p < 0.05$). Although the result did not express statistical significance in the posterolateral and lateral direction values, the results of the FEG in both values were determined to be higher than the values of the FCG. According to the results of the left foot star balance test in girls, Anterior, Anteromedial, Postoremedial, Posterior, Lateral, Anterolateral values are observed in the test*group interaction, this interaction is due to intragroup developments in the FEG ($p < 0.05$). Although there was no significant difference in the values of the medial and posterolateral sides, it was found that the measurements of FEG in both direction values were higher than the results of the FCG. According to the flamingo balance test values, which is the other balance test applied in our research, according to MEG in MCG in both right foot and left foot tests; a significant increase was statistically observed in the FEG compared to the FCG ($p<0.05$).

As a result, it is possible to say that the 8-week gymnastic exercises applied in our research improve both static and dynamic balance in children. It can be explained by balance is an important component in all movements of gymnastics.

Keywords: Bingöl, gymnastics, flamingo test, star test, dynamic balance, static balance

1. Introduction

The nervous system, balance, agility and coordination develop as children age. In addition, mental and skill abilities of reaction time develop in a certain rate in primary school children (Kula, 2018). Primary education period is also among the most important age range of physical development in children. In addition to the physical and physiological development of children, social behavior develops in this period (Gülüm, 2008). Gymnastics is very important for this age group to gain running, balance and jumping skills. Balance is needed in many sports branches as well as balance is needed to do our work efficiently in daily life and to prevent accidents (Gündüz, 1998). Having different importance for all ages, balance is the key to movements (Cecel et al., 2007). Balance plays an important role in being successful in sports (Altay, 2001). Balance or postural control; It is statically defined as the ability to maintain the support base in the smallest movement and to do a job dynamically in a fixed position (Winter, Patla, & Frank, 1990; Bandy & Sanders, 2007; Heyward & Gibson, 2018; Yaprak et al., 2019). Static and dynamic balance is dealt in two ways. Both balances are important in performing all activities. Static balance is when the person is standing still reacting against the gravity center within the existing support base. Dynamic balance is keeping the balance while the support base or center of gravity moves during movement (Ackland, Elliott, & Bloomfield, 2009; Bandy & Sanders, 2007; Dewey & Tupper, 2004; Yaprak et al., 2019). Balance is a multidimensional process that includes; peripheral nervous system (PNS), central nervous system (CNS), muscle strength and muscle strength, joint range of motion (ROM), flexibility, visual, vestibular and proprioceptive system (Dewey & Tupper, 2004; Heyward & Gibson, 2018). Muscle tonus and muscle strength affect balance among internal factors (Heyward & Gibson, 2018). Blackburn et al. (2000) states that force contributes to balance by producing muscle tension, which improves neuromuscular control by increasing proprioceptor sensitivity to strain and decreasing the electromechanical delay in the stress reflex. It is defined as a complex motor ability that includes control of balance, planning flexible movement patterns, and integration of sensory inputs as well as implementation (Hrysomallis, 2011). For a coordinated movement of the body as a whole takes place in direct proportion to the balance skill (Taşkın et al., 2015).

Regular sports activities are very important for a healthy physical and mental development during childhood (Kürkçü & Gökhan, 2011). Sport activities can be defined as the aim of teams or individual athletes to dominate each other. In athletic competitions, it is very important for athletes to achieve high performance in terms of physiological and motoric features (Göral, Saygın, & Babayiğit, 2012; Türkeri et al., 2019). In addition to some athletic skills, the sports they do for the development of cognitive, perceptual and motoric elements are important in order to create, develop and maintain performance in children. Two of these are balance and reaction properties. Conditioning features, which are the important components of sporting performance, are the effects of balance and reaction speed that directly affect. Knowing this level makes important contributions to the planning of the training. It is very important for the athletes to maintain the position of the body in terms of ensuring and maintaining the efficiency of all the movements they perform in the competition or training. For the protection of the position depends on the sufficient balance feature. Balance is a system that adjusts our stance so as to prevent falling by ensuring the adaptation in the environment where the perception of width, height and depth (Baysal, Gündüz, & Bayazıt, 2006; Türkeri et al., 2019). In this frame, this study was conducted to examine the effects of gymnastic exercises on dynamic and static balance in children.

2. Method

2.1 Study Group

A total of 31 volunteered children, aged 7 to 10 years old, attending primary school in Bingöl, 9 male experimental groups (MEG) and 8 male control groups (MCG) and 7 female experimental groups (FEG) and 7 female control groups (FKG), participated in the study.

2.2 Research Design

While basic gymnastics training was applied to boys and girls experimental groups for 8 weeks, 3 days a week, control groups continued their classroom training and were not included in any physical activities. After warm-up program, basic gymnastic training program (Table 1) was applied for 8 weeks, 3 days a week. The study was conducted in accordance with the Helsinki Declaration Principles and a voluntary approval form was filled and signed by the parents of the participants.In the study, the distribution of the descriptive characteristics of the participants (age, height and weight, Body Mass Index—BMI) were determined.In the study, it was investigated that there was a significant difference between the static and dynamic balance performance characteristics of the groups and the recorded values.

Table 1. Gymnastic training plan

Applied Actions	Times	Applied Actions	Times
Tilt forward and backward	2	One leg hand over in the sponge pool study	2
Tilt forward and back stretched leg	2	Double leg hand overrun exercise in sponge pool	2
Tumble leg forward and back	2	Tumble on sponge	2
Scissor work	2	Handstand on the wall Studies	2
Forward perpendicular tumble	4	Circle work on the line	2
Perpendicular pirouette	2	Cartwheel on the balance board	2
Perpendicular press	2	Spagat	2
Circle	4	Eagle studies	4
Cartwheel	4	Bridge studies	4
Head handstand	4		

2.3 Instruments for Data Collection

2.3.1 Anthropometric Measurements

Length Measurement: Length measurements have been made with stadiometer with a sensitivity of 0.1 cm by making the subjects stop at a right angle on their bare feet, body weight is evenly distributed over the two feet, heels adjacent and in contact with the ground, after a deep breath while the arms are hanging freely from shoulder to side, bringing the ruler at the top of the head compressing the hair in a sufficient amount (Tamer, 2000).

Body Weight Measurement: It was made with Seca brand weighting instrument. During body weight measurement of subjects, they were wanted to be bare feet and having their tracksuits on while their body in the vertical position and body weight has been recorded in kg (Tamer, 2000).

Body Mass Index: BMI values of the participants were obtained by dividing their weight by the square of their height (Günay et al., 2006).

2.3.2 Balance Tests

Star balance test for dynamic balance measurement and flamingo balance test for static balance measurement were applied.

Static Balance Measurement: Static balance measurements of the subjects participating in the study were measured with Flamingo balance tool.

Flamingo Balance Test: On the standard balance board used for the test, the number of losing balance was recorded for 60 seconds with eyes open, following the standard measurement method. Between the tryouts, two minutes of rest were given (Tsigilis, Douda, & Tokmakidis, 2002).

Dynamic Balance Measurement: Dynamic balance measurements of the subjects participating in the study were measured with the Star balance test.

Star Balance Test (Star Excurcion Balance Test—SEBT): It is placed at an angle of 45 degrees on the flat ground, and the distance of reaching with a single leg on the 8 pieces of 150 cm tape measure is determined in the order determined without disturbing the hands and waist. While the left foot was on the ground, the participant reached to the points in a clockwise sequence with his right foot, while his right foot was on the ground, he stretched in the opposite direction with his left foot and returned to the starting point after each stretch. Before the application, 180 seconds to recognize the test, 120 seconds for inter-application rest, and 5 seconds for both feet to stand between each stretch were given to subjects (Kinzey & Armstrong, 1998).

2.4 Statistics and Data Analysis

The data obtained from the pre- and post-training measurements of gymnasts were analyzed in the IBM SPSS 22 statistical program. Descriptive statistics are categorized according to all gymnasts and groups. The pre- and post-test distributions of the variables were examined according to groups, the normality of the distributions and the homogeneity of the variance were determined by the Mauchly's Sphericity Test and the Levene Test. Analysis of intergroup, intra group and the effect of training was carried out with multiple analysis of variance (MANOVA) in repeated measurements. Bonferroni test was used for Post Hoc comparisons; the significance level was accepted as 0.05.

3. Results

Table 2. Identifying characteristics of male participants

Variances	n	Group	Average	S.D
Age (year)	9	MEG	7.60	1.51
	7	MCG	7.25	1.26
Height (cm)	9	MEG	127.30	10.90
	7	MCG	125.80	9.70
BW (kg)	9	MEG	25.60	5.41
	7	MCG	26.51	4.73
BMI (kg/m^2)	9	MEG	15.74	0.99
	7	MCG	17.72	0.66

Note. BMI: Body Mass Index, BW: Body Weight.

For the MEG who participated in our study, the age was found to be 7.60 ± 1.51 years, the heigth was 127.30 ± 10.90 cm, the body weight was 25.60 ± 5.41 kg and the BMI was 15.74 ± 0.99 kg/m^2; for the MCG who participated in our study, the age was 7.25 ± 1.26 years, the heigth was 125.80 ± 9.70 cm, the body weight was 26.51 ± 4.73 kg and the BMI was 17.72 ± 0.66 kg/m^2 (Table 2).

Table 3. Identifying characteristics of female participants

Variances	n	Group	Average	S.D
Age (year)	9	FEG	7.25	1.26
	7	FCG	7.75	1.25
Height (cm)	9	FEG	122.63	4.21
	7	FCG	123.50	4.30
BW (kg)	9	FEG	26.51	5.38
	7	FCG	26.75	5.52
BMI (kg/m^2)	9	FEG	17.72	0.66
	7	FCG	17.55	0.62

Note. BMI: Body Mass Index, BW: Body Weight.

For the FEG who participated in our study, the age was found to be 7.25 ± 1.26 years, the heigth was 122.63 ± 4.21 cm, the body weight was 26.51 ± 5.38 kg and the BMI was 17.72 ± 0.66 kg/m^2; for the FCG who participated in our study, the age was 7.75 ± 1.25 years, the heigth was 123.50 ± 4.30 cm, the body weight was 26.75 ± 5.52 kg and the BMI was 17.55 ± 0.62 kg/m^2 (Table 3).

Table 4. Examination of right foot star balance test pre-test and post-test values of male participants

Variances	n	Grup	Pre-Test X ± SS	Post-Test X ± SS	Intragroup Change (%)	Test*Group F	p
Anterior (cm)	9	MEG	61.35 ± 4.69	64.83 ± 3.31	**3.48 (5.67%)***	**5.828**	**0.042***
	7	MCG	60.20 ± 5.17	61.23 ± 4.94	1.03 (1.71%)		
Anteromedial (cm)	9	MEG	62.81 ± 5.11	66.40 ± 3.97	**3.59 (5.71%)***	**16.516**	**0.004***
	7	MCG	62.65 ± 4.03	63.00 ± 3.74	0.35 (0.55%)		
Medial (cm)	9	MEG	59.47 ± 5.85	62.61 ± 4.32	**3.14 (5.27%)***	**12.033**	**0.008***
	7	MCG	58.63 ± 5.89	59.20 ± 5.84	0.57 (0.97%)		
Postoremedial (cm)	9	MEG	47.43 ± 7.16	50.56 ± 3.85	**3.13 (6.59%)***	**9.031**	**0.017***
	7	MCG	48.25 ± 7.38	48.45 ± 7.36	0.20 (0.41%)		
Posterior (cm)	9	MEG	56.43 ± 6.34	61.05 ± 5.34	**4.62 (8.18%)***	**25.806**	**0.001***
	7	MCG	56.25 ± 6.57	56.87 ± 6.68	0.62 (1.10%)		
Posterolateral (cm)	9	MEG	55.39 ± 5.27	58.84 ± 5.38	**3.45 (6.22%)***	**22.222**	**0.002***
	7	MCG	56.06 ± 5.52	56.46 ± 5.58	0.40 (0.71%)		
Lateral (cm)	9	MEG	61.63 ± 6.26	63.46 ± 6.09	**1.83 (2.96%)***	**19.600**	**0.002***
	7	MCG	61.10 ± 6.67	61.40 ± 6.26	0.30 (0.49%)		
Anterolateral (cm)	9	MEG	57.63 ± 4.72	59.43 ± 4.66	**1.80 (3.12%)***	**14.400**	**0.005***
	7	MCG	57.22 ± 3.96	57.89 ± 4.20	0.67 (1.17%)		

Note. *$p < 0.05$.

In Table 4, the measurement results showing the right foot star balance performances of male participants are compared in terms of intergroup, intragroup and group*test relationships. The test*group relationship in all parameters is significant for the right foot star balance performance measurements of the subjects. The reason for this meaningful relationship will be tried to be answered by comparing the pre-test and post-test measurement results within the group. While a 5.67% statistically significant increase was observed in the right foot anterior measurement of MEG ($p < 0.05$) and 1.71% increase in MCG was not statistically significant ($p > 0.05$). While a statistically significant increase of 5.71% in MEG was observed in the right foot anteromedial value ($p < 0.05$); Although there is an increase of 0.55% in MCG, this increase is not statistically significant ($p > 0.05$). While the 5.27% price increase in MEG was statistically significant in the right foot medial measurement ($p < 0.05$); Although there is an increase of 0.97% in MCG, this increase is not statistically significant ($p > 0.05$). While 6.59% statistically significant increase in MEG was observed in the right foot postoremedial measurement ($p < 0.05$); The 0.41% increase in MCG is not statistically significant ($p > 0.05$). While a statistically significant increase in MEG of 8.18% was observed in the posterior measurement of the right foot ($p < 0.05$); and although there is 1.10% increase in MCG, this increase is not statistically significant ($p > 0.05$). While a statistically significant increase in MEG of 6.22% was observed in posterolateral measurement of the right foot ($p < 0.05$); Although there is a 0.71% increase in MCG, this increase is not statistically significant ($p > 0.05$). While a statistically significant increase in MEG of 2.96% was observed in the right foot lateral value ($p < 0.05$); Although there is a 0.49% increase in MCG, this increase is not statistically significant ($p > 0.05$). A statistically significant increase of 3.12% in MEG was observed in the right foot anterolateral measurement ($p < 0.05$); Although there is an increase of 1.17% in MCG, this increase is not statistically significant ($p > 0.05$). While test*group interaction is observed in Anterior, Anteromedial, Medial, Postoremedial, Posterior, Posterolateral, Lateral, Anterolateral values, this interaction results from intragroup development in MEG.

Table 5. Examination of right foot star balance test pre-test and post-test values of female participants

Variances	n	Grup	Pre-Test X ± SS	Post-Test X ± SS	Intragroup Change (%)	Test*Group F	p
Anterior (cm)	7	FEG	59.50 ± 2.08	62.20 ± 2.25	**2.70 (4.53%)***	**25.485**	**0.002***
	7	FCG	60.25 ± 1.70	61.20 ± 2.32	0.95 (1.57%)		
Anteromedial (cm)	7	FEG	61.25 ± 2.21	64.37 ± 2.05	**3.12 (5.09%)***	**18.615**	**0.005***
	7	FCG	62.00 ± 1.82	62.35 ± 1.37	0.35 (0.56%)		
Medial (cm)	7	FEG	59.50 ± 2.08	62.25 ± 2.17	**2.75 (4.62%)***	**34.714**	**0.001***
	7	FCG	60.25 ± 1.70	60.75 ± 1.70	0.50 (0.82%)		
Postoremedial	7	FEG	45.25 ± 3.40	48.25 ± 3.40	**3.00 (6.62%)***	**24.000**	**0.003***
(cm)	7	FCG	46.75 ± 3.63	47.75 ± 3.04	1.00 (2.13%)		
Posterior (cm)	7	FEG	54.75 ± 3.59	56.87 ± 3.52	**2.12 (3.87%)***	**32.000**	**0.001***
	7	FCG	54.00 ± 4.08	55.12 ± 3.96	1.12 (2.07%)		
Posterolateral (cm)	7	FEG	53.25 ± 3.95	55.12 ± 3.61	**1.87 (3.51%)***	2.842	0.143
	7	FCG	53.75 ± 3.95	54.87 ± 3.83	1.12 (2.08%)		
Lateral (cm)	7	FEG	61.25 ± 2.50	63.50 ± 3.31	**2.25 (3.67%)***	1.744	0.235
	7	FCG	60.25 ± 3.30	61.25 ± 2.98	1.00 (1.65%)		
Anterolateral (cm)	7	FEG	56.50 ± 1.29	58.62 ± 1.25	**2.12 (3.75%)***	**13.636**	**0.010***
	7	FCG	55.75 ± 1.70	56.62 ± 1.10	0.87 (1.56%)		

Note. *$p < 0.05$.

In Table 5, the measurement results showing the right foot star balance performances of female participants are compared in terms of intergroup, intragroup and group*test relationships. In the right foot anterior measurement, a statistically significant increase of 4.53% in FEG was observed ($p < 0.05$); An increase of 1.57% in FCG does not show statistical significance ($p > 0.05$). While statistically significant increase was observed in the right foot anteromedial value at 5.09% in FEG ($p < 0.05$); Although there is an increase of 0.56% in FCG, this increase is not statistically significant ($p > 0.05$). While a statistically significant increase in FEG was found by 4.62% in the right foot medial measurement ($p < 0.05$); The 0.82% increase in FCG is not significant ($p > 0.05$). While a statistically significant increase was observed in FEG in the right foot posto-medial measurement with 6.62% ($p < 0.05$); 2.13% increase in FCG does not show statistical significance ($p > 0.05$). In the posterior measurement of the right foot, there was a statistically significant increase in FEG by 3.87% ($p < 0.05$); and although there is an increase of 2.07% in FCG, this increase is not statistically significant ($p > 0.05$). In the posterolateral measurement of the right foot, 3.51% statistically significant increase was observed in FEG ($p < 0.05$); 2.08% increase in FCG is not statistically significant ($p > 0.05$). While a statistically significant increase was observed in the FEG of the right foot lateral at 3.67% (p < 0.05); In FCG, the increase of 1.65% is not statistically significant (p > 0.05). In the right foot anterolateral measurement, there was a statistically significant increase of 3.75% in FEG (p < 0.05); although there is an increase of 1.56% in FCG, this increase is not statistically significant (p > 0.05). While test*group interaction is observed in Anterior, Anteromedial, Medial, Postoremedial, Posterior, Anterolateral values, this interaction results from intra-group developments in FEG. Although the result did not show statistical significance in the posterolateral and lateral direction values, the results of FEG in both values were determined to be higher than the values of FCG.

Table 6. Examination of left foot star balance test pre-test and post-test values of male participants

Variances	n	Grup	Pre-Test X ± SS	Post-Test X ± SS	Intragroup Change (%)	Test*Group F	p
Anterior (cm)	9	MEG	59.65 ± 4.27	63.13 ± 3.31	**3.48 (5.83%)***	**9.561**	**0.015***
	7	MCG	59.45 ± 3.91	60.13 ± 3.93	0.68 (1.14%)		
Anteromedial (cm)	9	MEG	61.21 ± 5.44	64.88 ± 4.72	**3.67 (5.99%)***	**8.471**	**0.020***
	7	MCG	61.85 ± 5.80	62.63 ± 5.41	0.78 (1.26%)		
Medial (cm)	9	MEG	58.67 ± 5.54	61.65 ± 4.53	**2.98 (5.08%)***	**18.778**	**0.003***
	7	MCG	58.41 ± 5.07	58.88 ± 4.65	0.47 (0.80%)		
Postoremedial (cm)	9	MEG	46.83 ± 7.56	48.86 ± 7.59	**2.03 (4.33%)***	**12.250**	**0.008***
	7	MCG	47.40 ± 7.76	48.00 ± 8.19	0.60 (1.26%)		
Posterior (cm)	9	MEG	54.65 ± 7.02	56.13 ± 6.61	**1.48 (2.70%)***	**14.222**	**0.005***
	7	MCG	54.20 ± 6.70	54.43 ± 6.18	0.23 (0.42%)		
Posterolateral (cm)	9	MEG	53.61 ± 5.17	56.42 ± 4.44	**2.81 (5.24%)***	**7.364**	**0.027***
	7	MCG	54.65 ± 5.59	55.67 ± 5.89	1.02 (1.86%)		
Lateral (cm)	9	MEG	61.67 ± 6.65	63.14 ± 6.04	**1.47 (2.38%)***	0.495	0.502
	7	MCG	61.21 ± 5.63	61.60 ± 5.54	0.39 (0.63%)		
Anterolateral (cm)	9	MEG	57.27 ± 5.11	59.65 ± 5.07	**2.38 (4.15%)***	**27.000**	**0.001***
	7	MCG	56.64 ± 2.06	57.20 ± 5.35	0.56 (0.98%)		

Note. *p < 0.05.

In Table 6, the measurement results showing the left foot star balance performances of male participants are compared in terms of intergroup, intragroup and group*test relationships. Test*group relationship is significant in all parameters except for lateral direction measurement results in left foot star balance performance measurements of subjects. The source of the meaningful relationship in the measurements will be examined by looking at the changes in the groups. While a statistically significant increase in MEG was observed as 5.83% in the left foot anterior measurement (p < 0.05); 1.14% increase in MCG is not statistically significant (p > 0.05). While a statistically significant increase of 5.99% was observed in the left foot anteromedial MEG (p < 0.05); 1.26% increase in MCG is not significant (p > 0.05). While a statistically significant increase in MEG was 5.08% in left foot medial measurement (p < 0.05); In MCG, the increase of 0.80% is not significant (p > 0.05). While a statistically significant increase of 4.33% in MEG was observed in the left foot postoremedial measurement (p < 0.05); 1.26% increase in MCG is not statistically significant (p > 0.05). In the posterior measurement of the left foot, there was a statistically significant increase in MEG by 2.70% (p < 0.05); An increase of 0.42% in MCG is not statistically significant (p > 0.05). There was a statistically meaningful increase observed in the left foot posterolateral measurement MEG group by 5.24% (p < 0.05); In the MCG group, 1.86% was not statistically significant (p > 0.05). While a statistically significant increase was observed in the left foot lateral value in MEG by 2.38% (p < 0.05); The 0.63% increase in MCG is not significant (p > 0.05). In the left foot anterolateral measurement, there was a statistically significant increase of 4.15% in MEG (p < 0.05); 0.98% increase in MCG is not significant (p > 0.05). While test*group interaction is observed in Anterior, Anteromedial, Medial, Postoremedial, Posterior, Postorelateral, Lateral, Anterolateral values, this interaction results from intra-group developments in MEG.

Table 7. Examination of left foot star balance test pre-test and post-test values of female participants

Variances	n	Grup	Pre-Test X ± SS	Post-Test X ± SS	Intragroup Change (%)	Test*Group F	p
Anterior (cm)	7	FEG	59.00 ± 2.94	61.12 ± 3.01	**2.12 (3.59%)***	**32.000**	**0.001***
	7	FCG	58.25 ± 2.50	59.37 ± 2.28	1.12 (1.92%)		
Anteromedial	7	FEG	60.12 ± 2.71	62.37 ± 2.35	**2.25 (3.74%)***	**15.783**	**0.007***
(cm)	7	FCG	60.75 ± 2.62	61.62 ± 2.49	0.87 (1.43%)		
Medial (cm)	7	FEG	59.00 ± 2.94	61.25 ± 2.87	**2.25 (3.81%)***	0.429	0.537
	7	FCG	59.50 ± 3.10	61.00 ± 2.70	**1.50 (2.52%)***		
Postoremedial	7	FEG	45.25 ± 4.78	47.62 ± 5.18	**2.37 (5.23%)***	**15.474**	**0.008***
(cm)	7	FCG	45.75 ± 4.64	46.37 ± 4.64	0.62 (1.35%)		
Posterior (cm)	7	FEG	52.75 ± 3.59	55.12 ± 4.00	**2.37 (4.49%)***	**21.429**	**0.004***
	7	FCG	52.25 ± 3.59	53.37 ± 4.02	1.12 (2.14%)		
Posterolateral	7	FEG	53.25 ± 3.94	55.12 ± 3.61	**1.87 (3.51%)***	2.842	0.143
(cm)	7	FCG	53.75 ± 3.59	54.87 ± 3.83	1.12 (2.08%)		
Lateral (cm)	7	FEG	61.25 ± 4.27	63.62 ± 3.81	**2.37 (3.86%)***	**10.000**	**0.020***
	7	FCG	61.50 ± 4.20	62.62 ± 3.94	1.12 (1.82%)		
Anterolateral	7	FEG	56.25 ± 2.06	59.37 ± 2.68	**3.12 (5.54%)***	**34.909**	**0.001***
(cm)	7	FCG	56.00 ± 2.06	57.12 ± 2.59	1.12 (2.00%)		

Note. *p < 0.05.

In Table 7, the measurement results showing the left foot star balance performances of female participants are compared in terms of intergroup, intragroup and group*test relationships. Test*group relationship is significant in all parameters except Medial and Posterolateral direction measurement results in the left foot star balance performance measurements of the subjects. The source of the meaningful relationship in the measurements will be examined by looking at the changes in the groups. While there was a statistically significant increase of 3.59% in FEG in the left foot anterior measurement ($p < 0.05$); 1.92% increase in FCG is not statistically significant ($p > 0.05$). While 3.74% statistically significant increase was observed in the left foot anteromedial FEG ($p < 0.05$); 1.43% increase in FCG is not significant ($p > 0.05$). A statistically significant increase was observed in the left foot medial measurement with a rate of 3.81% in FEG and 2.52% in FCG ($p < 0.05$). While a statistically significant increase of 5.23% was observed in the left foot posto-medial measurement ($p < 0.05$); 1.35% increase in FCG is not statistically significant ($p > 0.05$). In the left foot posterior measurement, there was a statistically significant increase of 4.49% in FEG ($p < 0.05$); In FCG, the increase of 2.14% is not significant ($p > 0.05$). In the left foot posterolateral measurement, while there was a statistically significant increase of 3.51% in FEG ($p < 0.05$); In FCG, an increase of 2.08% is not significant ($p > 0.05$). While a statistically significant increase was observed in the left foot lateral value in FEG at a rate of 3.86% ($p < 0.05$); 1.82% increase in FCG is not statistically significant ($p > 0.05$). In the left foot anterolateral measurement, there was a statistically significant increase of 5.54% in FEG ($p < 0.05$); In FCG, an increase of 2.00% is not significant ($p > 0.05$). While test*group interaction is observed in Anterior, Anteromedial, Postoremedial, Posterior, Lateral, Anterolateral values, this interaction is due to intra-group developments in FEG. Although there is no test*group interaction in the medial and posterolateral side values, it is seen that the measurements of FEG in both direction values are higher than the results of the FCG.

Table 8. Examination of flamingo test pre-test and post-test values of male participants

Variances	n	Grup	Pre-Test X ± SS	Post-Test X ± SS	Intragroup Change (%)	Test*Group F	p
Right Foot (piece)	9	MEG	11.40 ± 0.89	9.20 ± 1.78	**2.20 (19.28%)***	**5.400**	**0.049***
	7	MCG	10.80 ± 1.30	10.40 ± 1.14	0.40 (3.70%)*		
Left Foot (piece)	9	MEG	12.60 ± 1.14	10.80 ± 0.83	**1.80 (14.28%)***	**9.800**	**0.014***
	7	MCG	12.00 ± 0.95	11.60 ± 1.29	0.40 (3.33%)*		

Note. *p < 0.05.

In Table 8, measurement results showing the balance performances of male participants are compared in terms of intergroup, intragroup and group*test relationships. In the flamingo balance performance measurements of the subjects, the test*group relationship is significant in all parameters. When the source of the meaningful relationship in the measurements was examined, while a statistically significant increase was observed in the right foot flamingo balance test measurement at 19.28% of the MEG ($p < 0.05$); 3.70% increase in MCG is not statistically significant ($p > 0.05$). In addition, in the left foot flamingo balance test measurement, a statistically significant increase was observed in MEG at a rate of 14.28% ($p < 0.05$); 3.33% increase in MCG is not statistically significant ($p > 0.05$). While the Flamingo Test pre-test and post-test values of male participants, MEG and MCG, test*group interaction is observed in the right foot and left foot values, this interaction results from the intra-group developments in the MEG.

Table 9. Flamingo test pre-test and post-test values of female participants

Variances	n	Grup	Pre-Test X ± SS	Post-Test X ± SS	Intragroup Change (%)	Test*Group F	p
Right Foot (piece)	7	FEG	11.00 ± 2.00	9.00 ± 1.41	**2.00 (18.18%)***	**9.000**	**0.024***
	7	FCG	11.50 ± 1.73	11.00 ± 1.41	0.5 (4.34%)		
Left Foot (piece)	7	FEG	12.75 ± 0.95	10.25 ± 0.95	**2.50 (19.60%)***	**12.000**	**0.013***
	7	FCG	12.50 ± 1.00	12.00 ± 0.81	0.50 (4.00%)		

Note. *p<0.05.

In Table 9, measurement results showing the equilibrium performance of female participants are compared in terms of intergroup, intragroup and group*test relationships. In the flamingo balance performance measurements of the subjects, the test*group relationship is significant in all parameters. When the source of the meaningful relationship in the measurements was examined, while a statistically significant increase was observed in the right foot flamingo balance test measurement at 18.18% of the FEG ($p < 0.05$); 4.34% increase in FCG is not statistically significant ($p > 0.05$). In addition, in the left foot flamingo balance test measurement, a statistically significant increase was observed in FEG at a rate of 19.60% ($p < 0.05$); 4.00% increase in FCG does not show statistical significance ($p > 0.05$). While the Flamingo Test pre-test and post-test values of male participants, FEG and FCG, test*group interaction is observed in the right foot and left foot values, this interaction results from the intra-group developments in the FEG.

4. Discussion and Conclusion

For athletes; to practice their movements at the desired level, the desired posture stance and balance must be ensured (McNeal & Sands, 2003). It would be wrong to think that balance is only necessary for sports. Balance is also an important part of sports performance, and it plays an active role in walking, sitting or even sleeping when we think about health-related physical fitness. Today, with the rapid increase of technology's share in our lives, while new developments make our lives easier, on the other hand, they drag people towards a more still life style. Children are also among the individuals affected by this immobile living environment. Movement is important for the healthy growth and development of children. Medium-level exercises are known to increase children's motor strength, such as endurance, strength, flexibility and balance, and have a positive effect on growth and improvement (Günay et al., 2018).

In this study, the effect of gymnastic exercise on balance in children aged 7–10 was examined. According to the values of star balance test applied before and after the exercise, a statistically significant increase was observed in both MEG and FEG ($p < 0.05$). In our study, a significant increase was statistically observed in both experiment groups (MEG and FEG) in both right foot and left foot tests according to the other balance test flamingo balance test values ($p < 0.05$).

When the literature is analyzed, it is reported that arm and leg movements are more successfully incorporated into sportive performance thanks to resistance and endurance training and increasing the strength of the muscles (Willardson, 2014) and strength training has an effect to increase balance performance (Scott, 2008). Sekendiz et al. (2010) stated in their study that as a result of the 8-week core training program they applied to sedentary women, the increase in strength in the lower limbs, back and abdominal muscles caused significant improvements in the balance feature. In another study, it is reported that strength training for 6-week leg muscles applied to young male athletes increases the leg strength of athletes, and improvements occur in the dynamic and static balance of athletes at the end of the study (Mohammadi et al., 2012). In another study, Young et al. (2010), in their studies on young male athletes, they report that increased strength with the strength exercises improves the dynamic and static balance.

In order to develop balance skills, emphasis should be placed on balance-related activities as much as possible (Gökmen, 2013). Aggarwal et al. (2010) reported that core stability and balance training had a positive effect on balance feature in their research on amateur male athletes. Kılınç et al. (2018) reported that theraband studies played an important role in developing static and dynamic balance in their studies examining the effect of swimming exercise and theraband studies on dynamic and static balance in children between the ages of 7–12. Harput et al. (2016) performed pliometric training along with volleyball training in 34 adolescent female volleyball players. They concluded that the balance characteristics of the subjects examined with the star balance test increased. Emery et al. (2005) reported an improvement in static balance and dynamic balance values after 6 weeks of Wobble board training on healthy adolescents.

There are studies in the literature that reported that balance performance improved positively due to the sports activity performed. Aydın et al. (2002), in their work with young gymnast women, they state that the gymnastist, whose eyes are open and closed, compare their ability to stand on one leg balance on a semi-hard ground, have better performance. Erkmen et al. (2007) report that the highest value is; among gymnasts and footballers and the lowest value is belonging to; basketball players in their studies where they examine the balance performances of athletes dealing with different sports branches. Davlin (2004), in his study comparing the dynamic balances of elite women and men athletes doing gymnastics, swimming, football and individual sports branches, reported that the balance results of both women and men athletes in the gymnastics branch were higher than those in other branches.

Bressel (2007) determined in his research that the dynamic and static balances of footballers, basketball players and gymnasts; there was no significantly statistical difference in the values of gymnasts and footballers, yet basketball players had lower dynamic balance scores than these two branch athletes. It is a known fact that physical activities improve children's motor abilities (Haga, 2008). Alpkaya (2013) found a statistically significant increase in all parameters including balance in girl subject group children whose average age was 7.56 years, as a result of the study in which basic gymnastics training integrated into physical education lessons examined the effect of selected motor skills. According to this information, balance performance can be expressed as a feature that can be improved by direct balance studies or branch-specific training that requires balance. In addition, it can be said that balance performance improves positively thanks to sportive activity.

It is observed that regular gymnastic exercises performed in our study caused an increase in the strength of the lower limb muscles, as well as the research results we obtained due to the large number of exercises requiring to restore the balance lost during gymnastics exercises, and literature survey considered; gymnastics exercises made a positive contribution to the dynamic and static balance development of children.

As a result; it can be said that the 8-week gymnastic exercises applied in our study improve both static and dynamic balances of children.

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