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The effects of postural control to gender differences in children

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Abstract

The aim of this study was to compare the effects of gender differences on children's static balance parameters. A total number of 60 children (girls group N=30, boys group N=30) aged 9-11 who had been never involved in any sport activities before, took part in this study voluntarily. Anthropometric measurements (height, weight) and bilateral, unilateral static balance tests were conducted on the both groups. For statistical comparison of the students, t test was used.

When bilateral (EO, EC) and unilateral (left leg) static balance parameters of boys were compared to the balance parameters of girls, it was found statisticaly significant ($p<0.05$). No statistical differences were found for Romberg test (perimeter ratio, area ratio) and unilateral (right leg) static balance of the subjects between genders. ($p>0.05$).

It was stated that 1) boys spend more time outside than the girls and that's why their physical suitability was higher than the girls, 2) although they aren't involved in any sport professionally, they play team games like soccer, basketball more than girls. It can be concluded that physical activity increases muscle strength of boys and affect their balance performance positively.

Keywords: postural balance; boys; girls; static balance

Introduction

Postural balance can be described as a controlling center of gravity related to supporting area in order to prevent falling and ability to keep on that. Postural control is important for control of motor ability as well as getting it and basic need for the daily physical activities. It has been stated

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that postural control can change owing to many reasons. Injuries, pathologies, aging, difficulties of tasks, attainability of sensorial information etc. are some of those reasons (Chiari et al., 2002; Hyromallis, 2011; Shaperd, 2000). Postural control systems serve two main functions; 1) optional stabilization of walking, sitting and standing 2) providing automatic balance so that gravity center can take re-position fast from supporting area to the back in order to prevent falling (Shaperd, 2000).

Postural balance consists of the combination of visual, vestibular and somato-sensorial systems. Postural arrangement requires afferent information (knowledge) integration from the visual, vestibular and proprioceptive systems in the hierarchical and stereotypical patterns (Vuillerme et al., 2004; Paillard et al., 2006). Combination of those three systems develops in childhood (Sparto et al., 2006).

Children form their balances from visual knowledge till the age of 3 and from somato–sensorial knowledge till the age of 7-12. Because balance ability reaches about senior level at the age of 10 (Sparto et al., 2006), studies related to balance ability should be done in order to ensure improving this quality in childhood.

Children grow up consistently in this period and their coordination is disturbed consistently. It is because of the fact that injuries and falling are seen mostly in that age group (Hyromallis, 2011), and they keep balanced more while their leg strength increases (Matton et al., 2007; Kambas et al., 2004).

The use of platform stabilometer which is also called as static posturagrafi in order to evaluate the postural positions of individuals while standing is common. (Chiari et al., 2002; Winter, 1995; Geurts et al., 1993; Trop et al., 1984; Winter et al., 2003; www.tecnobdy.it, 2011). However, the studies about improving balance connected to age and gender related to children are limited (Hatziaki, 2002; Geldhof 2006; Nolan, 2005; Riach 1987) and there are different findings among the results of those limited studies (Nolan et al., 2005; Steindl et al., 2006).

The aim of this study was to compare the effects of gender differences of children on static balance parameters.

Methods

A total number of 60 children (girls group N=30, boys group N=30) aged 9-11 who have no neurological or vestibular visual diseases, lower extremity injuries and orthopedically problems and have never been involved in any sport activities before took part in this study voluntarily. The parents of children gave their consent to the experimental procedure as required by the Helsinki declaration (1964). Right leg of all the participants is dominant. This study was carried out in the biomechanic laboratory of Marmara University. The experiment was approved by the ethics commision of the Marmara Üniversitesi in İstanbul.

First of all, the anthropometric measurements of the subjects were taken. Prior to balance testing, participants were familiarized with the balance device and provided practice sessions on the testing procedures to decrease the change of a learning effect occuring during testing. The tests were conducted at the same times of the day (between 10.00 and 13.00) when the body was in rest, and measures were taken to prevent distraction due to environmental factors (noise, temperature). The measurements lasted 20 minutes for each child. The tests of whole group were completed within three days.

Balance; Static and dynamic balance measurements were made by using Prokin 5.0. (Prokin System 5.0 Pk-Manop-05-en-01 Begomo, Italy). After explaining the tests to the subjects, data were entered (height, weight, age) and the device was calibrated. The subjects were asked to look at the screen in front of them with 10 cm distance between their feet while their arms were at sides, and to keep them fixed at (0) point. After completion of each test, when the device was being re-calibrated, the subject was asked to sit down and rest. At the time of the measurements, no verbal feedback was given to the subjects other than what was necessary.

Static Standing balance

Static balance tests were performed for 30 seconds;

a- Bipedal static balance; Eyes open (EO) and eyes closed (EC). The data obtained were evaluated in terms of COPX (EO-COPX/EC-COPX), COPY (EO-COPY/EC-COPY), Forward/backward Standart Devination (EO-FBSD/ EC-FBSD), Medio-lateral Standart Devination (EO-MLSD/ EC-MLSD), Avarage Forward/backward velocity (EO-AFBV/ EC-AFBV) (mm/sec.), Avarage Medio-lateral velocity (EO-AMLV/ EC-AMLV) (mm/sec.), perimeter (EO-PE/ EC-PE) (mm), ellipse area (EO-EA/ EC-EA) (mm^2). Romberg test perimeter ratio (RTPR) and romberg test area ratio (RTAR). In case of a sequence the software will calculate the Romberg test too in two variables: perimeter ratio between closed eyes and opened eyes, and area ratio between closed eyes and opened eyes.

b- Unipedal static balance; static balance was measured respectively on right and left foot, eyes open and the values in terms of COPX (RF-COPX/LF-COPX), COPY (RF-COPY/LF-COPY), Forward/backward Standart Devination (RF-FBSD/ LF-FBSD), Medio-lateral

Standart Devination (RF-MLSD/ LF-MLSD), Avarage Forward/backward velocity (RF-AFBV/ LF-AFBV) (mm/sec.), Avarage Medio-lateral velocity (RF-AMLV/ LF-AMLV) (mm/sec.), perimeter (RF-PE/ LF-PE)(mm), ellipse area (RF-EA/ LF-EA) (mm²) were taken.

Statistical analysis

The descriptive characteristics of the variables were expressed as mean values, standard division, and range values per group. The statistical analysis of balance data was performed using a parametric technique with the Independent T test to compare the differences between boys and girls. The level of statistical significant was set p≤0,05.

Results

All data are presented as mean ± standard deviation. The characteristics of the study groups are presented in Table 1.

Table 1. Characteristics of boys and girls.

Variables	Boys group n=30	Girls group n=30
Age (year)	8.94±0.80	8.92±0.48
Height (cm)	134.27±4.85	133.88±5.01
Weight (kg)	32.16±5.86	36.08±10.22
Leg Height (cm)	63.78±4.64	61.63±4.39
BMI(kg/m^2)	17.78±2.82	19.94±4.89
Foot Length(cm)	21.09±1.11	21.16±1.43
Foot Width(cm)	7.87±0.50	7.51±0.47
CMI	52.52±2.52	54.05±2.53

BMI: body mass index
CMI: cormic index

The mean values and the comparison of the EO and EC static balance of the boys and girls are presented in Table 2 and Table 3.

Boys' static bilateral balance parameters were found to better than girls in eyes open and eyes closed conditions. Additionally, boys' EO and EC (EO-FBSD, EO-MLSD, EO-AFBV, EO-AMLV, EO-PE, EO-EA) parameters were significantly better than girls' parameters ($p<0.05$) (Table 2 and Table 3).

Table 2. Eyes open balance test scores for girls and boys.

		M (SD)	t	df	P
EO-COPX	boys girls	-5.60(12.70) -.12(14.057)	-0.133	53	0,895
EO-COPY	boys girls	-22.20(17.012) -17.07(20.328)	-1.06	58	0,293
EO-FBSD	boys girls	7.60(1.54) 10.60(6.75)	-2.373	58	0,021*
EO-MLSD	boys girls	4.67(3.28) 6.97(3.51)	-2.618	58	0,011*
EO-AFBV	boys girls	17.83(3.46) 25.23(11.12)	-3.478	58	0,001*
EO-AMLV	boys girls	10.23(5.98) 17.20(12.55)	-2.743	58	0,008*
EO-PE	boys girls	626.90(174.59) 945.63(394.103)	-4.050	58	0,000*
EO-EA	boys girls	700.20(577.186) 1391.43(1207.99)	-2.828	58	0,006*

p<0.05* and p<0.01** respectively significant differences between the groups.

Table 3. Eyes closed balance test scores for girls and boys.

		M (SD)	t	df	P
EC-COPX	boys girls	-9,93 (11,832) -.6,50 (15,095)	-0.98	58	0,331
EC-COPY	boys girls	-21,47 (17,051) -15,13 (26,814)	-1.09	58	0,279
EC-FBSD	boys girls	9,10 (1,845) 11,57 (5,722)	-2.34	58	0,028*
EC-MLSD	boys girls	4,40(1,850) 6,10(5,033)	-1.73	58	0,088
EC-AFBV	boys girls	24,67(5,909) 32,37(17,214)	-2.317	58	0,024*
EC-AMLV	boys girls	11,03(2,953) 17,30(14,206)	-2.366	58	0,021*
EC-PE	boys girls	788,03(156,365) 1097,03(530,706)	-3.059	58	0,003*
EC-EA	boys girls	744,17(463,171) 1615,97(2002,421)	-2.323	58	0,024*

p<0.05* and p<0.01** respectively significant differences between the groups.

Table 4. Romberg test scores for boys and girls.

		M (SD)	t	df	P
RTPR	boys girls	129,17(25,041) 120,17(34,807)	1,150	58	0,255
RTAR	boys girls	129,50(56,121) 130,17(106,285)	-,030	58	0,976

p<0.05* and p<0.01** respectively significant differences between the groups.

There was no significant differences (p>0.05) romberg test parameters between boys and girls (Table 4).

In table 5 unilateral (right leg) static balance parameters have been shown.

Table 5. Right leg static balance test scores for girls and boys.

		M (SD)	t	df	P
RF-COPX	boys	-4,47(8,460)	-3,623	58	0,001**
	girls	5,03(11,604)			
RF-COPY	boys	8,47(14,848)	1,967	58	0,054
	girls	0,93(14,814)			
RF-FBSD	boys	11,13(4,455)	-1,901	58	0,062
	girls	13,30(4,372)			
RF-MLSD	boys	7,57(2,079)	-1,775	58	0,081
	girls	8,67(2,682)			
RF-AFBV	boys	53,23(23,103)	-1,797	58	0,078
	girls	63,67(21,859)			
RF-AMLV	boys	38,93(13,567)	-1,745	58	0,086
	girls	44,73(12,134)			
RF-PE	boys	1879,30(705,512)	-1,850	58	0,069
	girls	2199,73(633,931)			
RF-EA	boys	1697,07(1157,630)	-1,786	58	0,079
	girls	2279,23(1359,118)			

p<0.05* and p<0.01** respectively significant differences between the groups.

There was no statistical difference (p > 0.05) in unilateral static balance (right leg) between the boys and the girls. (Table 5). Unilateral static balance parameters (left leg) have been shown Table 6.

Table 6. Left leg static balance test scores for girls and boys.

		M (SD)	t	df	P
LF-COPX	boys	-10,30(6,215)	,052	58	0,959
	girls	-10,40(8,613)			
LF-COPY	boys	0,63(15,812)	,166	58	0,869
	girls	-0,17(21,078)			
LF-FBSD	boys	11,80(3,836)	-2,953	58	0,005*
	girls	14,87(4,200)			
LF-MLSD	boys	7,77(2,528)	-2,462	58	0,017*
	girls	9,43(2,712)			
LF-AFBV	boys	53,23(23,283)	-2,556	58	0,013*
	girls	68,63(23,384)			
LF-AMLV	boys	39,37(14,880)	-1,898	58	0,063
	girls	47,37(17,649)			
LF-PE	boys	1881,27(742,339)	-2,277	58	0,027*
	girls	2319,80(749,577)			
LF-EA	boys	1817,70(1220,578)	-2,963	58	0,004*
	girls	2777,77(1288,671)			

p<0.05* and p<0.01** respectively significant differences between the groups.

Boys (LF-FBSD, LF-MLSD, LF-AFBV, LF-AMLV, LF-PE, LF-EA) parameters were significantly ($p<0.05$) better than girls parameters (table 6).

Discussion

The main finding of this study was that EO and EC bilateral static balance of boys, aged nine and who haven't been involved in sports regularly, was significantly better than the girls. There was no significant difference between the values of bilateral SB romberg test of the boys and the girls. It has been found that unilateral static balance (left leg) parameters of the boys were statistically significant while there wasn't any significant difference unilateral static balance (right leg) of the boys and the girls. Those results have shown that bilateral and unilateral balances of boys were better than the girls.

Boys have a more active life than the girls in our country (Saygın et al., 2006; Arabacı, 2009). They play games on the streets more and therefore they complete the physical activity necessity for their progress. It can be said that static balance (EO-EC- Left foot) of the boys is better than the girls because they do more physical activities. Soccer is also a very popular sport branch in our country and boys play soccer on the streets in early ages with their friends (Ergen, 2004; Arabacı, 2009).

All the participants in our study kick the ball with their right legs. It is thought that unilateral (left leg) static balance parameters of the boys are better than the girls because they do more physical activities. Especially physical activities like soccer strengthen lower extremity muscles and increase unilateral and bilateral balance performance (Paillard et al., 2006; Heitkamp et al., 2001; Tveter and Holm, 2010).

Even if childreen are in the same age and gender groups, their maturation levels differ (Sparta et al., 2006) Also each children develop at different rates and thus differences in balance due to the maturation differences of boys and girls (Ricotti et al., 2011; Kirshenbaum et al., 2001; Assaiante et al., 2005;Nolan et al., 2005). Balance of boys and the girls aged 9-16 has been studied. They have found that medilateral sway velocity and path lenght parameters (static balance) of the girls aged 9-10 were beter than the boys and there wasn't any significant difference between the other parameters. The findings of this study differ from our study.

According to our results, there weren't any significant differences romberg test parameters between boys and girls. Steindl et al., (2006), Hirabayashi and Iwasaki (1995) have found similar results in their studies (Steindl et al., 2006; Hirabayashi and Iwasaki, 1995.

The complex system of standing stability supported various compensatory mechanism raises the question of how sensory organization develops in children adolescents when considering each sensory component in relation to age and sex. Girls showed a greater rate of improvement in stabilty until the age of 11-12 years. They thought that boys of 10 years seemed to be less attentive than girls (Olivier et al., 2008).

It has been stated that not only central nervous should improve for the improvement of postural control but also some functions like discretion should be developed. (Steindl et al., 2006). On the contrary of this study, we found that boys have better static balance than girls.

Conclusions

As a result, in the literature it has been stated that 1) boys spend more time outside than the girls and that's why their physical activity levels were higher than the girls. 2) Although they aren't involved in any sport professionally, they play team games like soccer, basketball more than girls (Arabacı, 2009).

It can be said that muscle strength of the boys who are involved in more physical activity increases, which affects their balance performance positively. The results of the study can be an important source for the sport scientists who make studies about children. In addition, we think that educators who are interested in improvement of children and training them should develop exercise programmes in order to increase balance and physical suitability for especially girls and therefore they can decrease the number of potential falling risks which are particular to the sport brach they perform.

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