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INVESTIGATION OF THE RELATIONSHIP BETWEEN (SEMI-DYNAMIC AND DYNAMIC) BALANCE AND SOME ANTHROPOMETRIC INDICATORS OF 9-11 YEAR OLD GIRLS OF THE CITY OF YASUJ

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ABSTRACT

The purpose of this study was to investigate the relationship between the (semi-dynamic and dynamic) balance and some anthropometric indicators of 9 to 11 year old girls of the city of Yasuj. The subjects of the study consisted of 100 primary school girls (average height of 139.6 ± 10 cm and average weight of 34.7 ± 8.5 kg) of the city of Yasuj, who were selected in an available random way. In this study, the relationship between the (semi-dynamic and dynamic) balance and anthropometric indicators of ankle diameter, width of knee-thigh, hip width, foot arc circumference, leg circumference, height, knee circumference, thigh circumference, knee height to ground, foot length, leg length, thigh length and weight was evaluated. Using the Kolmogorov-Smirnov test, normality of data distribution was investigated. Mean and standard deviation was used to describe the data, while Pearson correlation coefficient was used for inferential statistics to investigate the relationship between balance and anthropometric indicators in various age groups. The results of the present study indicated that there was no meaningful relationship between anthropometric indicators and dynamic balance of heel-paw with closed eyes. However, there was a meaningful and positive relationship between anthropometric indicators of thigh length (p=0.02), leg length (p=0.04), foot length (p=0.04) at the level of

P≤0.05 and knee height to ground (p=0.00) and height (p=0.00) at the level of P≤0.01 with the semi-dynamic balance Y in the anterior direction. In the external posterior direction, there was a positive and meaningful relationship between anthropometric indicators of leg (p=0.01) at the level of P≤0.05 and knee height to ground (p=0.006) and height (p=0.003) at the level of P≤0.01 with balance. In addition, in the internal posterior direction, there was a positive and meaningful relationship between anthropometric indicators of thigh circumference (p=0.04), knee circumference (p=0.04) and height (p=0.03) at the level of P≤0.05 and foot arc circumference (p=0.00) at the level of P≤0.01 and the semi-dynamic balance Y. Based on the research finding, it can be concluded that anthropometric features play a role in creation of balance only if various sensori motor systems like sight, vestibular and proprioception systems are not impaired. Eliminating the sight agent, it was seen that there was no meaningful relationship between anthropometric features and balance.

Key Words: Balance, Anthropometric Indicators

INTRODUCTION

Human's motion begins with balance and ends with balance too. Most often, the motor system doesn't get involved in movement and its only function is to maintain the body condition. In fact, in order to keep an individual's balance, it works through a hierarchy of mechanisms (Farsi, 2006).

Balance is a typical motion reaction which is dependent on the integrity of the stimuli received from the sight system and sense of movement. Eyesight tells you in which relative condition to the environment your body rests. The sense of movement data of internal receptors of the body tells you in which relative condition your body organs and parts are. When you should keep your balance, the flood of sensory data should be integrated in the central nervous system and muscles should get active or remain in a calm or resting state (Hey Wood, 1993).

Scientists of kinesiology have concluded that the implementation level of balance movements is specific to the same movements. It means balance is not a general ability but it is a special type of capability. An individual may execute a balance action well, while they implement another action at an average level. For this reason, duration and process of the best balance development is related to a special balance work which is used for the special assessment and evaluation (the same reference).

Nowadays, scientists and experts of sports are looking for the relations between physical

characteristics and the degree of performance and motor skills of human. Through identification of physical features and characteristics, they are aiming at discovering limitations and advantages created by the features in human's performance. Attention to anatomic and physiological structure by finding and using the exact objective data which are basically obtained through scientific research and investigationcan be a good solution to the optimum selection of athletes by coaches (Behboodi, 2003).

Gholipoor (2013) investigated the balance ability and its relation with some anthropometric features of 7 to 10 year old boys of the city of Yasuj. In the study, the average body mass index of the subjects was respectively equal to 14.99, 16.05, 16.62 and 17.5 for the four groups of 7, 8, 9 and 10 years of age, which were among normal people group and not among people with a high body mass index; hence not leading to unbalance in the subjects. Therefore no relation was found between body mass index and stationary balance. Perhaps, had the body mass index of the study subjects had a wider scope and breadth the resulting outcomes would have changed.

Gaeini et al., (2010) determined the relationship between somatic features (height, weight, fat percentage, body mass index, lower limb size and bust size), physiological features (aerobic power, anaerobic power, agility and flexibility, speed and balance) and body composition of elite man taekwondo athletes with their success level. The success of taekwondo athletes was reported based on their success in national, Asian and international games. The findings showed that there is a meaningful relationship between balance, flexibility of waist area and anaerobic power with the success level of elite taekwondo athletes. On the other hand, there was no meaningful relationship between age, weight, height, lower limb size, aerobic power, speed, agility and forward flexibility with success.

In an investigation of the relationship between some anthropometric features and balance at various levels of hardship, a study conducted on 102 students of Islamic Azad University of Mashhad (including 50 boys and 52 girls) by Hosseini (2008). According to his obtained results, a meaningful relationship could only be found between metatarsus size, the width of the heel and the width of the paw with balance when standing normally on both legs. However, no meaningful relation was found between other features and balance. Furthermore, for other

types of standing (legs in one direction or standing on one leg), no relationship was found between anthropometric features and stationary balance (P>0.05).

Nadja Schott (2007) assessed 466 children of kindergartens and primary schools of the Rhine region in four age groups of 4 to 5 year olds, 6 to 7 year olds, 8 to 9 year olds and 10 to 12 year olds using two balance tests of standing on one leg and heel-paw walking. The analysis of the results showed that the age related factors were meaningful and significant in all measurements. Moreover, it was determined after the test that the 10 to 12 year old age group was better than the 4 to 7 year old group in all stationary balance tests. Having analyzed all the dynamic conditions, it became clear that there was a meaningful difference between all age groups.

During a study conducted on children aged 2 to 8 as a three age groups of 2 to 3 year olds, 4 to 5 year olds and 7 to 8 year olds in comparison with adults and by the use of analysis of the data related to relocation of their center of pressure on the Force Plate station, Austad, H. and A. L. Van Der Meer (2007) concluded that growth and development of dynamic balance control in younger children (2 to 5 years old) was disturbed by applying less pressure (in a

range of basic support), while a higher level of pressure and touch of hand pushing was needed to disturb it in older children and adults (P<0.05). Thus, dynamic balance control gets better and is stabilized with the age.

Hue et al., (2007) conducted a study called "Body weight is a strong predictor of postural stability" on 59 men with the body mass index between 17.4 to 63.8 kg/cm^2 using the energy meter plate both with open eyes and closes eyes. The results indicated that reduction of balance stability has a strong relationship with the increase of the body weight.

Suttanon (2006) investigated the relation of the balance performance of healthy Thai children aged 7 to 10 and 11 to 15. In the study, 100 healthy Thai children of two groups of 7 to 10 and 11 to 15 year olds were evaluated using the Clinical Test of Sensory Interaction on Balance (CTSIB) and determination of the relationship between the balance performance and individual features (age, weight, height and BMI). The results indicated a significant reduction in the balance performance during the impaired vision in the 7 to 10 age group in comparison with the 11 to 15 year olds groups. The strategies of ankle and thigh were normally more used for maintaining balance in both

groups. However, the 7 to 10 years old group used more of walking strategy, indicating posture instability for balance control in difficult conditions and sensory changes of the 11 to 15 year olds group. In addition, a meaningful relationship was obtained between performance and individual features, especially age (age, height, weight, BMI of heel and paw standing with closed eyes), ($P \leq 0.5$).

In a study, using the test of standing two feet on a platform with open and closed eyes and measurement of relocation of pressure center, Nolan et al., (2005) studied 60 children (30 girls and 30 boys) as three age groups (respectively with an average of 9 years and 11 months, 12 years and 11 months and 15 years and 11 months) aiming at differences of age and sex in balance. The obtained results indicated that the development related to age was seen in the oscillation occurred for the boys because some height control situations develop slowly after nine to ten years. On the age related changes, there was some delay in the ability of height control development.

Rival et al., (2004) carried out a study aiming at investigation of the balance adjustment and stabilization period of children aged 6-8-10 years. 30 participants were assessed while standing on the platform with closed eyes. 10 adult subjects were also selected as the reference group. They analyzed the time and rate of changes in the stationary balance and displacement from the center of pressure from time to time (every two seconds). The results showed that A) Displacement time of the center of pressure decreased with the increase of age to 8 years, while linear speed of center of pressure displacement showed a reduction from 6 to 10 years of age. B) Both parameters (time and speed of center of pressure displacement) decreased and stabilized over time for all age groups and the optimum maintenance processes of the desirable posture begins at least from the age of six.

In a study called "Relationship between anthropometric factors and balance actions of the body in postural balance", conducted by Kejonen et al., (2003)on 100 people randomly including 50 men and 50 women, the fundamental anthropometric features of measurement consisted of height, weight, distance between two feet, legs size and the widest part of paw and heel when standing on one foot with open or closed eyes. The investigations showed that the anthropometric factor is not responsible for the changes in the balance actions of the body when standing.

In a study conducted by Streepey and Angulo-Kinzler (2002) on three age groups of below than 6, 10 to 11 years and adults, measurement of the primary situation, rotation and amplitude of center of pressure was investigated on the Force Plate station. The results showed that: 1) the amount of backrest pressure in balance control is more sensitive to the age related changes. 2) Balance control is related to age as well as difficulty of doing assignments.

In all sport fields, especially basic ages and sporting talent finding which has a very high importance for sports skills training, having a balance is of a very high value, specifically for those fields needing the stationary and dynamic balance. Thus, necessity requires that we achieve fresh tips by the exact examination of balance indicators and the

relation with some anthropometric features of children aged 9 to 11.

THE RESEARCH METHOD

The statistical population of the present study consisted of 9 to 11 year old girls of Yasuj. 100 people of the population were selected in an available random manner as the statistical sample of the study. Using the Kolmogorov-Smirnov test, normality of data distribution was investigated in this study. Then, mean and standard deviation was used to describe the data in descriptive statistics. In order to analyze the relationship between anthropometric indicators and balance tests, Pearson correlation coefficient was used for inferential statistics at the two levels of ($p \leq 0.01$) and ($p \leq 0.05$).

In this study, the following tests were used for balance measurement:

Table 1

Test		Parameter	
anterior	**Y (adjusted star)**	semi-dynamic	balance
internal posterior			
external posterior			
heel-paw with closed eyes (tendon)		dynamic	

THE RESEARCH FINDINGS

The descriptive statistics related to anthropometric indicators and balance was calculated in tables 2, 3 and 4. In addition, the inferential statistics related to correlation coefficient of anthropometric indicators was calculated by the dynamic balance test of

heel-paw with closed eyes (tendon) and the Y semi-dynamic balance test in table 5 and 6.

As it is specified in table 5, there is a meaningful and positive relationship between anthropometric indicators of thigh length (p=0.02), leg length (p=0.04), foot length (p=0.04) at the level of P≤0.05 and knee height to ground (p=0.00) and height

(p=0.00) at the level of P≤0.01 with the semi-dynamic balance Y in the anterior direction. In the external posterior direction, there is a positive and meaningful relationship between anthropometric indicators of leg (p=0.01) at the level of P≤0.05 and knee height to ground (p=0.006) and height (p=0.003) at the level of P≤0.01 with balance. In addition, in the internal posterior direction, there is a positive and meaningful relationship between anthropometric indicators of thigh circumference (p=0.04), knee circumference (p=0.04) and height (p=0.03) at the level of P≤0.05 and foot arc circumference (p=0.00) at the level of P≤0.01 with the semi-dynamic balance Y.

According to table (6), there is no meaningful relationship between any of anthropometric indicators and the test of paw-heel walking with closed eyes.

Table (2): mean and standard deviation related to the anthropometric data

9-11 years		11 years		10 years		9 years		Index	
standard deviation	mean	standard deviation	mean	standard deviation	mean	standard deviation	mean	Group	
4.2	42.8	4.2	44.4	3.48	43.4	4.0	40.5	rump knee size	
6.69	35.53	5.13	40.55	5.43	33.20	6.4	32.6	thigh size	
5.55	29.02	4.85	32.27	3.85	29.76	5.2	24.9	leg size	
2.98	21.32	4.07	23.59	1.35	21.09	2.1	19.2	foot length	
4.64	41.48	4.01	43.52	3.12	42.93	4.5	37.9	knee height to ground	
5.43	27.37	3.73	27.11	6.69	29.03	5.2	25.9	hip width	
1.77	8.58	1.97	9.12	1.12	7.70	1.8	8.9	knee-thigh width	
0.82	5.98	0.83	6.20	0.91	5.93	0.6	5.8	ankle diameter	
6.72	39.31	6.23	41.32	6.7	41.12	5.6	35.4	thigh circumference	
3.51	30.41	3.54	31.79	3.19	31.12	2.7	28.2	knee circumference	
4.20	27.49	4.39	29.39	3.76	27.96	2.7	25.2	leg circumference	
2.26	20.60	2.39	20.99	1.62	21.13	1.7	19.6	foot arc circumference	
10.0	139.6	9.7	145.6	8.42	141.5	5.8	131.5	height (cm)	
8.5	34.7	9.0	38.4	8.52	36.3	4.6	29.3	weight (kg)	

Table (3): Inferential statistics related to semi-dynamic balance (Y)

9-11 years			11 years			10 years			9 years			Group / index		semi-dynamic blance- Y test (cm)
internal posterior	external posterior	anterior	internal posterior	external posterior	anterior	internal posterior	external posterior	anterior	internal posterior	external posterior	anterior	direction		
45.71	29.50	59.10	47.39	50.99	60.95	51.82	47.80	57.76	37.88	52.05	58.55	mean		
17.50	19.21	18.31	16.57	21.32	16.53	15.04	17.99	18.44	18.27	18.42	20.24	standard deviation		

Table (4): Inferential statistics related to dynamic balance of heel-paw with closed eyes (tendon)

9 years		10 years		11 years		9-11 years		Index
standard deviation	mean	standard deviation	mean	standard deviation	mean	standard deviation	mean	Group
4.69	5 0.44	4.25	5 0.58	5.48	5 0.30	4.40	5 0.42	dynamic-tendon

Table (5): Pearson correlation coefficient (dynamic balance Y with anthropometric indicators)

ankle diameter	knee-thigh width	hip width	foot arc circumference	leg circumference	height	knee circumference	thigh circumference	knee height to ground	foot length	leg length	thigh length	Index / Pearson	
-0.095	-0.152	-0.048	0.127	0.188	0.350 **	0.122	0.148	0.383 **	0.205 *	0.205 *	0.229 *	coefficient	anterior Y
0.348	0.132	0.636	0.207	0.061	0.000	0.227	0.142	0.000	0.041	0.041	0.022	meaning level	
100	100	100	100	100	100	100	100	100	100	100	100	number	
0.029	0.132	0.046	0.065	0.105	0.297 **	0.163	0.184	0.274 **	0.129	0.253 *	0.122	coefficient	external posterior Y
0.775	0.191	0.653	0.524	0.296	0.003	0.105	0.066	0.006	0.200	0.011	0.228	meaning level	
100	100	100	100	100	100	100	100	100	100	100	100	number	
-0.080	-0.007	0.108	0.360 **	0.096	0.216 *	0.197 *	0.204 *	0.150	-0.01	0.069	0.014	coefficient	internal posterior Y
0.427	0.941	0286	0.000	0.340	0.031	0.049	0.042	0.137	0.891	0.495	0.892	meaning level	
100	100	100	100	100	100	100	100	100	100	100	100	number	

Sign (*) indicates meaning of the relation at the level of P≤0.05
Sign (**) indicates meaning of the relation at the level of P≤0.01

Table (6): Pearson correlation coefficient (paw-heel walking with closed eyes with anthropometric indicators)

ankle diameter	knee-thigh width	hip width	foot arc circumference	leg circumference	height	knee circumference	thigh circumference	knee height to ground	foot length	leg length	thigh length	Index / Pearson	
0.087	0.070	0.081	-0.010	-0.020	0.149	0.026	0.067	0.160	-0.014	-0.029	0.118	coefficient	heel-paw closed eyes
0.389	0.488	0.424	0.922	0.846	0.139	0.796	0.508	0.111	0.891	0.778	0.244	meaning level	
100	100	100	100	100	100	100	100	100	100	100	100	number	

DISCUSSION AND CONCLUSION

The statistical population of the present study consisted of 9 to 11 year old girls of Yasuj. 100 people of the population were selected in an available random manner as the statistical sample of the study. Using the Kolmogorov-Smirnov test, normality of data distribution was investigated in this study. Then, mean and standard deviation was used to describe the data in descriptive statistics. In order to analyze the relationship between anthropometric indicators and balance tests, Pearson correlation coefficient was used for inferential statistics ($p \leq 0.05$).

The results of the study indicated that there is a meaningful and positive relationship between anthropometric indicators of thigh length ($p=0.02$), leg length ($p=0.04$), foot length ($p=0.04$) at the level of $P \leq 0.05$ and knee height to ground ($p=0.00$) and height ($p=0.00$) at the level of $P \leq 0.01$ with the semi-dynamic balance Y in the anterior direction. In the external posterior direction, there is a positive and meaningful relationship between anthropometric indicators of leg ($p=0.01$) at the level of $P \leq 0.05$ and knee height to ground ($p=0.006$) and height ($p=0.003$) at the level of $P \leq 0.01$ with balance. In addition, in the internal posterior direction, there is a positive and meaningful relationship between anthropometric indicators of thigh circumference ($p=0.04$), knee circumference ($p=0.04$) and height ($p=0.03$) at the level of $P \leq 0.05$ and foot arc circumference ($p=0.00$) at the level of $P \leq 0.01$ and the semi-dynamic balance Y. There is no meaningful relationship between any of anthropometric indicators and the test of paw-heel walking with closed eyes.

One of the factors affecting balance is the vision system (Redfern and Forman, 2001). In 1994, he clearly showed in his research that there is a strong relationship between visual impairment and balance disorder. In other words, vision incompatibilities can have strong effects on balance. According to the research findings, it can be concluded that in addition to anthropometric features, other factors play a role in balance creation. Existence of numerous factors for maintenance of balance is one of the reasons why no relationship was seen between anthropometric features and dynamic balance of healthy children with closed eyes. Anthropometric features play a role in creation of balance only if various sensorimotor systems like sight, vestibular system and proprioception are not impaired. Eliminating the sight agent, it was seen that there was no meaningful relationship between anthropometric features and balance. For instance, use of various

sensorimotor systems like sight, vestibular system and proprioception can help a healthy person with the balance maintenance in spite of any changes in anthropometric features and having good muscular power in knee and metatarsus muscles is one of the effective factors on keeping balance in healthy people (Katayama et al., 2004).

This study was aligned with the results of the studies of Gholipoor (2013), Redfern and Forman, (2001), Bronstein et al., (1986), Held et al., (1975).

SUGGESTIONS OF THE STUDY

Schools teachers, especially primary schools, are recommended to pay attention to balance exercises in physical education lesson planning based on the differences in balance.

Schools teachers are recommended to pay attention to children's balance reinforcement to improve sports activities.

Investigation of the relationship between anthropometric features and balance using more standard tests of stationary and dynamic balance

Investigation of the relationship between anthropometric features and balance in various ages (children, adults, seniors)

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