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Standing Broad Jump and Dynamic Balance on Hypermobiles That Participating in Physical Education Lessons

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Abstract : The aim of this study was to determine the differences and the correlation between standing broad jump and dynamic balance according to the hypermobility of 11-14 years of age children. A total of 240 children (mean age 12.81±1.25years) participated voluntarily. Beighton criteria were used for the evaluation of hypermobility syndrome and cut point was taken as 5. The dynamic balance ability measured with prokin tecnobody for bipedal and right-left feet for 30 sec. Standing Broad Jump test applied to determine the explosive leg strength. Mann Whitney U analysis and Spearman Correlation Coefficient used for statistical analysis since the distribution was not normal. In both genders, those with nonhypermobile achieved better dynamic balance results for right-left perimeter length. On the contrary, hypermobiles show better explosive leg strength results. The female participants have a more successful dynamic balance test results (p<.005). In contrast, the male participants have higher scores than females in standing broad jump results. The standing broad jump test mean values show that males are more successful than females no statistically significant difference observed when the leg length corrected. There was no correlation between hypermobility and other variables according to the results of correlation analysis. Hypermobile children that are more flexible than peers are advised to continue strength training.

Keywords: Hypermobility, Dynamic Balance, Standing Broad Jump.

INTRODUCTION

Hypermobility is a syndrome that is defined by the mobility of the joints more than the normal limits. The studies indicated a wide variation in the prevalence of joint hypermobility; its presence is influenced by age and gender. Hypermobility diminishes with age from childhood onward; is about three times more frequent in females than males and among children than adults (Beighton et.al., 1973; Demir et.al., 2019; Hakim and Grahame, 2003; Kesilmiş and Akın, 2018; Ortega et.al., 2010; Simmonds and Keer, 2007; Zurita et.al., 2009). Functional problems such as delayed motor development, limited physical capacity, joint (usually foot and knee) and daily life problems and sports activities such as running, cycling can be affected by hypermobility (Adib et.al, 2005; Beighton et.al., 1998). All these delays in motor development and excessive joint flexibility are the factors affecting the knee and ankle balance mechanism, force and proprioceptive input quality. Proprioceptive system plays a critical role in maintenance of joint stability, including sensation of both position and movements of joint, under

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dynamic conditions. Muscle and joint receptors are main sources for proprioception (Sharma, 1999). A clinical trial that aimed to improve proprioception was found to alleviate symptoms of patients with joint hypermobility syndrome. There was also seen an improvement in balance board performance and in quadriceps and hamstring strength (Ferrel et.al., 2004). Balance needed when performing a range of activities from the maintenance of static positions to complex dynamic movements and dynamic activities are crucial in the development of motoric abilities on childhood (Schubert-Hjalmarsson et.al., 2012). The balance control system makes great efforts to maintain the balance while being in motion during exercise (Rogind et.al., 2003). Maintaining the balance is provided as a result of correct adjustment of the body position to perform movements such as deceleration, re-acceleration or rotation in motion (Hatzitaki et.al., 2002). In order to achieve a successful performance in both everyday life and sport, the strength is as important as ensuring balance (Altay, 2001). Increased muscle strength can result in better stability of the joints, and this can increase the quality of life (Kemp et.al., 2010).

In literature, there are some studies that point out the balance and proprioception have improved with necessary treatment and training (Ferrel et al., 2004; Kesilmiş and Akın, 2018). In addition, there are studies indicating that training with hypermobile individuals, contribute to strength and balance, as well as decreasing pain by increasing quality of life (Ferrel et. al., 2004).

It is thought that understanding the effect of balance and strength components from motor skills can be helpful for the hypermobile participants to cope with the negative situations they may face. In light of this information, the necessity of investigating the balance and strength components of the basic motoric features in hypermobile children and comparing them with their non-hypermobile peers has emerged. Thus, the aim of this study was to evaluate the explosive leg strength and dynamic balance in 11-14 age group children according to the hypermobility syndrome.

METHOD

Participants

One hundred and twenty females and 120 males participated voluntarily in this study with the mean age of 12.81±1.25 year. Before the study, ethical permission was obtained from Mersin University Social and Human Sciences Ethics Committee (30201175-659). In addition, the participants informed about the research and all participants signed the volunteer consent form, which was prepared according to the Helsinki criteria. All of the participants were attending a regular school program and two-hour physical education lessons per week and additionally they live in Mersin-Turkey. All measurements were taken by the researchers.

Hypermobility Measurements

Beighton criteria were used to determine hypermobility and cut point was taken as 5. Beighton criteria include thumbs, 5th metacarpals, elbow and knee joints and spine flexibility. For each joint flexibility, the participant receives 1 point and is recorded on the measurement form. In this study, 0-4 points accepted as nonhipermobil and 5-9 points accepted as hypermobile (Beighton et.al., 1973).

Dynamic Balance Measurements

Dynamic balance performance was determined using Prokin Tecno Body (PK200WL, Italy). The device works simultaneously with the computer and participant tries to keep the balance center within the circle displayed on the participant's computer screen using the instrument-specific software. “Easy” tape used from four different tapes. The test starts after the participant reaches the balance device and stabilizes it. The test starts after the participants step on the balance device and stabilize themselves. At the end of 30 seconds, the balance device measures and gives the perimeter length. Two measurements perform for each participant's bipedal, right foot and left foot, and the best result is recorded in the measurement form.

Standing Broad Jump Measurements

For standing broad jump performance; at the starting point, the legs are open at the shoulder width and the knees are ready in the slightly twisted position. After the participant jumped with the command, the distance from the foot heel to the starting point is recorded in cm. In order to determine the explosive leg strength, the corrected leg length was used which is formulated by multiplying the skipped distance by the section of the leg length by 100 (Gribble and Hertel, 2003).

Leg Length Measurements

For leg length measurements, the participants lied on the examination table and the right leg lengths in the supine position were determined by measuring the distance between the anterior superior and the medial malleolus in the spina iliaca. Leg length measurements were repeated twice and the mean of two measurements were used for statistical analysis (Gurney, 2002).

Statistical Analysis

Spearman correlation coefficient was used in this study since descriptive statistics and distribution were not normal. Also, Mann Whitney U analysis used to see hypermobility and gender differences.

RESULTS

It was showed that the rate of hypermobility of male participants was 10,67%, and 15,59% of female (Table I). In both genders, nonhypermobile participants achieved better dynamic balance results for right-left perimeter length. On the contrary, hypermobiles show better explosive leg strength results (Table II). The perimeter length of the female participants for bipedal dynamic balance scores is lower than the male participants and this indicates that female participants have a more successful dynamic balance test result. In contrast, the male participants have higher scores than females in standing broad jump results. While the standing broad jump test mean values show that males are more successful than females in Table I, no statistically significant difference was observed when the leg length was corrected as shown in Table II, and in this way, the gender-based physical feature difference was eliminated.

Table I. Descriptive statistics of participants according to gender and hypermobility

Gender	Hypermobility	Variables	N	Mean	Std. Deviation
Male	**Hypermobile**	Standing Broad Jump	11	127,12	19,97
		Explosive Leg Strength	11	156,06	26,66
		Bipedal Dynamic Balance	11	478,41	199,27
		Right Dynamic Balance	11	227,43	84,57
		Left Dynamic Balance	11	252,58	130,58
	Nonhypermobile	Standing Broad Jump	103	124,20	27,03
		Explosive Leg Strength	103	139,67	30,46
		Bipedal Dynamic Balance	103	476,63	138,28
		Right Dynamic Balance	103	194,87	84,38
		Left Dynamic Balance	103	193,18	71,28
Female	**Hypermobile**	Standing Broad Jump	17	120,18	19,66
		Explosive Leg Strength	17	157,65	53,67
		Bipedal Dynamic Balance	17	410,71	109,73
		Right Dynamic Balance	17	181,45	57,24

	Left Dynamic Balance	17	175,68	60,30
Nonhypermobile	Standing Broad Jump	109	107,97	18,04
	Explosive Leg Strength	109	161,46	87,68
	Bipedal Dynamic Balance	109	419,90	129,24
	Right Dynamic Balance	109	156,25	58,60
	Left Dynamic Balance	109	162,53	68,21

Table II. Dynamic balance and strength differences according to hypermobility

Variable		**N**	**Mean**	**Std. Deviation**	**Standard Error**	**Mann Whitney U**	**p**
Standing Broad Jump (cm)	Hypermobile	28	124,39	19,78	345.213	2.343	.070
	Nonhypermobile	212	115,86	24,20			
Explosive Leg Strength	Hypermobile	28	156,68	38,58	345.273	2.193	.025*
	Nonhypermobile	212	150,87	67,10			
Bipedal Perimeter Length (cm)	Hypermobile	28	451,81	170,66	345.275	2.933	.919
	Nonhypermobile	212	447,46	136,38			
Right Foot Perimeter Length (cm)	Hypermobile	28	209,37	77,30	345.275	2.153	.018*
	Nonhypermobile	212	175,01	74,66			
Left Foot Perimeter Length (cm)	Hypermobile	28	222,37	113,64	345.275	2.254	.039*
	Nonhypermobile	212	177,42	71,23			

*p<.05

Table III. Dynamic balance and strength differences according to gender

Variable	**Gender**	**N**	**Mean**	**Std. Deviation**	**Mean Rank**	**Standard Error**	**Mann Whitney U**	**p**
Standing Broad Jump (cm)	Male	120	124.62	26.09	146.23	537.677	4.112.50	.000**
	Female	120	109.09	18.44	94.77			
Explosive Leg Strength	Male	120	141.99	30.39	127.92	537.771	6.309	.098
	Female	120	161.11	84.98	113.08			
Bipedal Perimeter Length (cm)	Male	120	476.88	147.41	135.43	537.773	5.408	.001**
	Female	120	419.06	127.19	105.57			
Right Foot Perimeter Length (cm)	Male	120	199.48	84.82	138.13	537.773	5.084	.000**
	Female	120	158.56	58.69	102.87			
Left Foot Perimeter Length (cm)	Male	120	201.59	84.15	137.3	537.773	5.183	.000**
	Female	120	163.74	67.40	103.7			

**p<.005

Table IV. Correlations according to hypermobility and gender

Gender		**Standing Broad Jump**	**Bipedal Dynamic Balance**	**Right LegDynamic Balance**	**Left Leg Dynamic Balance**
Hypermobile Male	Standing Broad Jump	1.000			
	Bipedal Dynamic Balance	-.098	1.000		
	Right Leg Dynamic Balance	.027	.344	1.000	
	Left Leg Dynamic Balance	.090	**.570****	**.558****	1.000

	Female	Standing Broad Jump	1.000			
		Bipedal Dynamic Balance	.112	1.000		
		Right Leg Dynamic Balance	-.049	**.450****	1.000	
		Left Leg Dynamic Balance	-.014	**.319***	**.453****	1.000
Nonhypermobile	Male	Standing Broad Jump	1.000			
		Bipedal Dynamic Balance	-.026	1.000		
		Right Leg Dynamic Balance	.057	**.482****	1.000	
		Left Leg Dynamic Balance	.100	**.352****	**.482****	1.000
	Female	Standing Broad Jump	1.000			
		Bipedal Dynamic Balance	.009	1.000		
		Right Leg Dynamic Balance	-.042	**.540****	1.000	
		Left Leg Dynamic Balance	-.043	**.693****	**.529****	1.000

*p<.05. **p<.005

CONCLUSIONS

Balance and strength are needed when performing a range of activities from maintenance of static positions to complex dynamic activities and are the necessary components in daily life. The importance of these components is often ignored. There are some studies suggesting that the important factors in our mechanism of balance stabilization are the flexibility of the knee joint and ankle (Akın et.al., 2017; Kesilmiş et.al., 2017). In our study, hypermobile group showed lower performance in right and left foot dynamic balance score than nonhipermobile peers. According to gender, female participants were more balanced than males in dynamic balance skills. In spite of the statistical differences observed at the beginning in the long jump skill, the gender differences eliminated when the leg length was taken into consideration.

Similar to this study, which did not show any correlation between dynamic balance variables and hypermobility, a study reported that there was no correlation between open eyes dynamic balance and hypermobility (Çelenay and Kaya, 2017). In another study on nineteen hypermobile children without sports history, the dynamic balances during walking were measured and the lateral body stability decreased in walking conditions (Falkerslev et.al., 2013). Similarly, in this study although there is no correlation between dynamic balance and hypermobility, the mean values of double-right-left foot dynamic balance of hypermobile participants were higher than non-hypermobile participants. In another study conducted on hypermobile subjects and reported that hypermobile individuals in activities of daily life have a higher rate of strength development in the knee extensors and a higher mediolateral sway than controls (Mebes et.al., 2008). In addition, in a study to describe the correlation between hypermobility and balance of hypermobile children and reported that balance decreased in children with HMS compared with healthy controls. These findings found on sedentary differentiated on athletes (Schubert-Hjalmarsson et.al., 2012). In the study of Ambegaonkar et. al. (2016), lower extremity hypermobility and balance were positively related, and specifically, the lower extremity hypermobile dancers had better balance than the non-hypermobile dancers (Ambegonkaret. Al., 2016). This differentiation on athletes may have eliminated the disadvantages of hypermobility with the effect of special strength training.

Jul-Kristensen et al. (2012) reported that decreased isokinetic strength was observed in children with general and knee hypermobility. In contrast, Jensen et al. (2013) reported that there was no decrease in maximum isometric knee strength on hypermobile children.

Şahin et. al. (2008) reported that the knee extensor muscle strength was significantly lower in the hypermobile group compared with the healthy controls. They also found decreased strength in the flexor muscle groups and concluded that exercises targeted at increasing both the strength and the balance of extensor and flexor muscle groups should be applied for hypermobiles. The loss of soft-tissue strength is accompanied by unstable joints with laxity, loss of proprioception and pain-related inactivity (Maillard and Murray, 2003). Hypermobility syndrome has been implicated in ankle sprains, anterior cruciate ligament injury, shoulder instability. Therefore, gaining strength is important in hypermobiles. Joint laxity and hypermobility have an effect on orthopedic injuries and disease, and orthopedic surgeons should be aware of these conditions. Joint laxity and hypermobility have an effect on orthopedic injuries and disease and recognition of these syndromes can help direct and modify patient care (Wolf et.al., 2011).

The movement of the normal knee joint provides the balance ability, while the flexibility above the normal creates difficulty in maintaining the balance. As in our study Wolf et. al. (2011) reported that hypermobile children that are more flexible than peers are advised to continue strength training. Improving general and sport- specific fitness as well as muscle strength and proprioception in this population may reduce the risk of injury, as well. Muscle strength and joint proprioception deficits in hypermobiles may lead to an increased incidence of musculoskeletal injuries (Finsterbush and Pogrund, 1982). Although exercise is not likely to diminish ligamentous laxity of hypermobiles, general and therapeutic exercises have been widely recommended as primary interventions for this condition (Hall et.al., 1995; Russek, 1999). Thus, it may be appropriate to focus on improving general fitness, muscle strength, proprioception, and balance in asymptomatic, uninjured persons with hypermobility (Ferrel et.al., 2004). Studies in this age of growth, the corrected leg length, body length, and spam should be evaluated by taking into consideration. Otherwise, as this study shows, measurement data can be misleading. The limitation of this study was that the participants were not participating any sports activities except PE Lessons. For future studies, it is recommended to compare with peers who participate sports.

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