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DETERMINATION OF THE RELATIONSHIP BETWEEN CORE ENDURANCE AND SITTING BALANCE IN WHEELCHAIR BASKETBALL PLAYERS: A PILOT STUDY [1]

TEKERLEKLİ SANDALYE BASKETBOL SPORCULARININ CORE ENDURANSLARI İLE OTURMA DENGESİ ARASINDAKİ İLİŞKİNİN BELİRLENMESİ: PİLOT ÇALIŞMA

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Öz: Bu çalışma tekerlekli sandalye (TS) basketbol sporcularında coreenduransı ile oturma dengesi arasındaki ilişkiyi belirlemek amacıyla yapıldı. Çalışma; kriterlere uyan ve katılmayı gönüllü olarak kabul eden 16-26 yaş aralığında olan 9 erkek paralimpik basketbol sporcusunun katılımı ile gerçekleştirildi. Denge ölçümleri Human Body Equilibrium 360 (HUBER 360®) olarak adlandırılan elektronik cihaz ile yapıldı. Denge parametrelerinden, stabilite ve fonksiyonel uzanma testleri oturma pozisyonunda değerlendirildi. Stabilite testleri gözler açık ve kapalı olacak şekilde ölçüldü. Core endurans ölçümleri statik gövde fleksiyon endurans testi, statik gövde ekstansiyon endurans testi ve lateral köprü endurans testleri ile değerlendirildi. TS basketbol sporcularının stabilite testlerinden gözler açık ve kapalı olarak ölçülen merkez, uzunluk, alan ve hız değerleri ile statik gövde fleksiyon endurans testi, statik gövde ekstansiyon endurans testi ve lateral köprü endurans testi ölçüm sonuçları arasında istatistiksel olarak anlamlı bir ilişki bulunmazken(p>0,05) fonksiyonel uzanma ile sol lateral köprü ve sağ lateral köprü değerleri arasındaki istatistiksel olarak anlamlı bir ilişki bulundu (p<0.05).TS basketbol sporcularındacore enduransı oturma dengesi üzerinde önemli bir parametredir. TS basketbol sporcularında antrenman programlarında core endurans parametrelerini arttıracak egzersizler eklenmesi, sporcuların fonksiyonel oturma dengelerini pozitif yönde etkileyecektir. Bu bağlamda TS basketbol sporcularınıncoreenduransları ve fonksiyonellikleri arttırılarak müsabakalarda sporcuların performanslarınınarttırılabileceğini düşünmekteyiz.

Anahtar Kelimeler: Paralimpik Basketbol, Core Endurans, Denge

Abstract: This study was conducted to determine the relationship between core endurance and sitting balance in wheelchair (WC) basketball players. The study consisted of 9 male paralympic basketball players aged between 16-26, who complied with the criteria and voluntarily participated in the study. Equilibrium measurements were performed with electronic devices so-called the Human Body Equilibrium. Paremeters of balance, stability and functional reach test in the sitting position were evaluated. The stability tests were measured with eyes open and closed. Core endurance was measured by using the static trunk extensor endurance test, trunk flexor endurance test and side bridge endurance test. While there was no significant relation between side bridge, trunk extension, trunk fleksion tests and center, length, area and velocity values in the stability test which measured eyes open and closed, we found out a statistically significant relation between functional reach test and side bridge tests values. Core endurance is an important parameter on sitting balance in WC basketball players. Adding exercises which will improve core endurance parameters, will affect functional sitting balance of WC players positively. Consequently, we think that performance of WC athletes in competition can be improved by increasing functionality and core endurance.

Key Words: Paralympic Basketball, Core Endurance, Balance

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INTRODUCTION

Today, the most popular sport of disabled people is Wheelchair basketball (Yalcin, 2015:1).Wheelchair basketball is a fast paced, exciting sport that conforms to the same standards as its stand up counterpart. Unlike most sports for people with disabilities, wheelchair basketball is a team oriented activity that provides athletes with varying degrees and levels of disabilities to participate in an inclusive atmosphere based on a player classification system. (Brasile and et., 1996:114-117).

WC basketball classification system is used in a variety of performance and physiological criteria (Brasile, 1990:289-297). These criteria include trunk stabilization, sitting balance and body movement in the horizontal-frontal- sagittal plane (Santos, 2014: 77-80). The most important of these criteria is sitting balance in WC basketball players (Brasile et al., 1996:114-117). Good sitting stability control has a great importance. Sitting stability control directly affects the transfer performance during the game (Bolin et al., 2000: 425-434). Trunk muscle control is an important subsystem which contributes to postural control and balance (Westcott et al., 1997:629-625). Postural stability and balance is almost inseparable throughout all movements (Wade and Jones, 1997:619-628; Assaiant et al., 2005:263-272). Core stabilization plays an important role in maintaining the trunk of muscle control.

In a study, the core stabilization is defined as connection between the pelvik floor, multifidius, transversus abdominus and diyafragma muscles and this structure is explained being effectively in stabilization of the trunk (Mclean, 2006).

Because of this, the aim of our study is to determine the relation between core endurance and sitting balance in WC basketboll players and the results of this study will guide us to improve athletic performance in WC basketboll players training programme.

METHOD

The study was conducted with the aim of determining the relation between core endurance and sitting balance in in WC basketboll players in the Ministry of Youth and Sports, Sports General Directorship, Department of Health Services Center of Athlete Training and Health Research in Ankara, Turkey. All the athletes who accepted to participate in the study were informed about the study purpose, the assessments included in the study and the benefits of the study and the study was based on volunteerism. The necessary permit and approval was obtained from the Ethics Committee of Ankara Yıldırım Beyazıt University to conduct the study [13/05 (348)].

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The incluation criteria of the study are not having any systemical problem, any healthy problem except their problems, any visually and earing problems and being cooperated to the test parameters, being able to do tests and being voluntary to participating to the study.

The disability types of the WC basketball players who participate to study are; poliomyelitis (n=4), spina bifida (n=1), spinal cord injury (n=2) and amputation (n=2).

Data Collecting Tools

Equilibrium Evoluation

Equilibrium measurements were performed with Human Body Equilibrium 360 (HUBER 360®). HUBER 360® is an electronic device with a screen used in dynamic and static balance measurement and training, including specific sensors which are sensitive to motion and providing visual feedback to the person. The evaluation that can done with HUBER 360® consists of seven basic parameters, including stability, standing on one leg, walking stability limitation (functional reach), mobility restriction, strength and coordination. And also stability test and stability limitation can done in standing and sitting position. We evaluated stability and stabilization limits in the sitting position due to players'disability and playing with wheelchair. Stability was assessed for 50 sec separately when their eyes were open and closed at sitting position. In this test, how well the individual maintained his position, getting away from the center (mm), the length (mm) drawn during center change and the area of place change (mm^2) and their velocity during these changes (mm/sec) were assessed. An individual sees an arrow and dot on the monitor during the assessment of stabilization limits. The dot represents the individual. Arrows appear on the monitor at the degrees 0-45-90-135-180-225-270-315 respectively on the coordinate system. The individual is asked to move the dot toward the arrow tip at a flat slope without disconnecting its contact with the ground and without the body rotation upon the warning sounds. This test represents doing the functional extension test in an electronic setting (© LPG Systems., 2015) and the results were recorded as square millimeters.

Core Endurance Evoluation

Core endurance of athletes; was measured by using static trunk extensor endurance test, trunk flexor endurance test and side bridge endurance test, the results were recorded in seconds.

Trunk Flexor Endurance Test

The WC Basketball Player sits at 60º with both hips and knees at 90º, arms folded across the chest with the hands placed on the opposite shoulder, and the toes scured by the pyhsiotherapist. The trunk flexor muscles endur-

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ance tested by timing how long the player can hold a position of seated trunk flexion up to inferior angulus of the scapulae (about 60º trunk flexion). Failure was ocur when the player falled back from 60º trunk flexion to the under inferior angulus of the scapulae (Bliss and Teeple, 2005: 179-185; Evans et al., 2005:447-55; Demoulinet al., 2005: 43-50).

Extensor Endurance Test

The WC Basketball Player is prone over the edge of couch at the point of Spina Iliaca Anterior Superior, with the pelvis, hips, and knees secured by the pyhsiotherapist. The upper limbs are held across the chest with the hans resting on the opposite shoulders. The trunk extansor muscles endurance tested by timing how long the player can hold a position of the upper body horizontally to floor. Failure was ocur when the player falled from horizontally to the fleksed position (Bliss and Teeple, 2005: 179-185; Evans et al., 2005:447-55; Demoulinet al., 2005: 43-50).

Right and Left Lateral BridgeTest

The WC Basketball Player's legs are extended as can and the top foot placed in front of the lower foot for support. Players support themselves on one elbow and their feet while lifting their hips off the floor to create a straight line over their body length. The uninvolved arm is held across the chest with the hand placed on the opposite shoulder. The lateral bridge test assesses the lateral core muscles. The lateral core muscles endurance tested by timing how long the player can hold a position of lifted hip and staright line postur. Failure was occur when the player loses the straigth postur and the hip fals toward the table (Bliss and Teeple, 2005: 179-185; Evans et al., 2005:447-55; Demoulinet al., 2005: 43-50).

Analysis of Data

All the data obtained from the measurements of athletes' core endurance and balance were analyzed with statistical software package "SPSS (Statistical Package for Social Sciences Inc., Chicago, IL, USA) For Windows Release15.0" The data verified with the Kolmogorov-Smirnov test is normally distributed. The correlation between core endurance tests and sitting balance was done by Pearson correlation test. The statistical significance was set at $p < 0.05$ (Sümbüloğlu, 1994:152-155).

RESULTS

A total of 13 basketball players were invited to the study but 4 of these athletes were disqualified because they could not complete some tests due to their disabilities. So 9 WC basketball players aged between 23-40 years were included in the study. The mean age of players included in the study was 29.8 ± 6.64

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years, weight 73.61 ± 10.15 kg, height 1.78 ± 0.06 meter and body mass index values 23:18 ± 2.95 kg / m^2 were recorded (Table 1).

Table 1. Demografik Characteristics of the Wheelchair Basketboll Players

BMI: Body Mass Index

	Mean	Standar Deviation
Age (year)	29,88	6,64
Height (cm)	178,22	6,18
Weight (kg)	73,61	10,15
BMI (kg/m^2)	23,18	2,95

***p<0.05, r=Pearson Correlation**

The relationships between the stability tests and core endurance tests of the athletes along with p and r values are shown in Table 2. It was found out that there was no statistically significant relationship between the length, area and velocity values measured by the stability tests when the athletes' eyes were closed and open and the results of the flexor endurance test and static body extensor test (p>0,05), there were significant correlations found (p<0,05) between the functional extension measurements made by the stability tests of the athletes and the results of left lateral ligament and right lateral ligament tests. Moreover, the balance value results and the core endurance test results of the athletes showed significant correlation among themselves (p<0,05) (Table 2).

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Variables		Fleksor Endurance Test (sec)		Extansor EnduranceTest (sec)		Left Lateral Bridge Test (sec)		Right Lateral Bridge Test (sec)	
		r	p	r	p	r	p	r	p
Eyes Opened Stability Test	Area (mm^2)	-0,094	0,809	0,119	0,760	0,229	0,553	0,364	0,336
	Length (mm)	-0,132	0,735	-0,291	0,448	-0,052	0,894	0,227	0,558
	Speed (mm/sec)	-0,132	0,735	-0,291	0,448	-0,052	0,895	0,227	0,557
Eyes Closed Stability Test	Area (mm^2)	0,461	0,211	0,367	0,331	-0,012	0,975	-0,114	0,771
	Length (mm)	0,280	0,466	-0,038	0,923	-0,080	0,837	0,068	0,862
	Speed (mm/sec)	0,280	0,466	-0,038	0,923	-0,081	0,837	0,068	0,862
Stabilization Limitation (mm^2)		0,434	0,243	0,524	0,147	0,748	0,021*	0,711	0,032*

***:p<0.05**

DISCUSSION

The aim of our study was to investigate the relationship between the core endurance and sitting balance of TS basketball players. As a result of our study, there was no significant relationship found between the static balance performance of the athletes and the measurement results of the lateral ligament test, static extensor test and flexor endurance test, and there was a significant relationship determined betweeen the functional extension test results of the athletes and the measurements of right and left lateral ligament test. This illustrated the importance of the force of spinal muscles and abdominal muscles not to distort the sitting balance during the functional extension movement. This information supported the literature and showed the relationship between the body balance and core stability that is defined as the simultaneous contraction of the external and internal oblique abdominal muscles and spinal muscles by right and left lateral ligament tests.

Recently conducted studies focused on core stability, force and endurance of body muscles and body balance because the core is the center of body movements, effective on achieving the body balance and the funda-

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mental component of the kinetic chain. The studies showed that the inadequacy of core muscles can affect individual performance and enable injury formation (Petrofsky et al, 2005: 423). In this context, the body balance is very important for movement and performance for TS athletes. There are studies in the literature including various measurement techniques for postural balance assessment of disabled individuals (Mason et al., 2012;126-34; Yildirim et al, 2010;55-61; Patatoukas et al, 2011:40-46; . Mockova et al, 2006:211-217; Valent et al, 2009:1051-160). In a study conducted on amputee soccer players, static balance was assessed by SPORKAT 2000 device only when their eyes were open (Aytar et al, 2012:332-338), and in another study, modified functional extension test, bilateral extension and lateral extension tests were used (Özünlü et al, 2012:44-50). We used different balance device in our study. We assessed both static and dynamic balances of our athletes in the sitting position when their eyes were open and closed. We could not find a study in the literature scrutinizing the relationship between core endurance and sitting balance of TS basketball players. However, there are various studies in the literature investigating the relationship between lower extremity and upper extremity muscular force and core endurance. One of these is the study investigating the relationship between lower extemity static balance performance and core stabilization on 40 individuals who exercised. In this study, core stabilization was assessed by Sorensen test, prone plank test, abdominal exhaustion test and Sahrmann's core stabilization test. Static balance was assessed by Flamingo balance test at both the right side and left side. As a result of this study, a significant relationship was found between static balance performance and Sorensen test, Prone Plank test and Sahrmann's core stabilization test. It was concluded as a result of the study that lower extremity static balance performances of individuals who had strong core stabilization were better (Aggarwal et al., 2012:11-16). In a study supporting this study, the relationship between the endurance of the body muscles and static balance was investigated on healthy 50 male students, and static balance was assessed by Flamingo balance test, and the endurance of the body muscles was assessed by static body extensor endurance test, flexor endurance test and lateral ligament test. As a result of the study, a positive relationship was found between static balance and the endurance of the body muscles (Barati et al, 2013:289). We could not find a relationship between static balance and core endurance in our study. We think that this result stems from the measurement made in sitting position because the individuals included in the study were TS-using athletes and due to their disabled profiles, low number of participants and sensitive measurement

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of the device. Moreover, in a study assessing the relationship between core stabilization, balance and muscular force of ampute soccer players, static balance was assessed when the athletes were standing up on their healthy lower extemity without a prothesis and when their eyes were open. As a result of this study, it was found out that the balance had no relationship between core stabilization and force (Aytar et al, 2012:332-338). We could not find a relationship between stability tests when their eyes were open and closed and core endurance tests. It is stated in the literature that there are only a few research investigating the body balance of paralympic athletes (Aytar et al, 2012:332-338). We determined during our research that the literature was not full adequately on this issue. We think that our study will contribute to the literature on this issue. In a study investigating the effect of the body muscles on mobility and balance in 70 elderly people, the body extension force and endurance, the body flexion force and endurance, Berg balance scale and the balance was assessed by Flamingo balance test. In this study, a significant relationship between balance and body muscles was found (Suri et al, 2009:916-924). In another study, the relationship between static and dynamic balance and the force of core muscles was investigated on 32 autistic children; and static and dynamic balances were assessed by Flamingo balance test and Walking Heel To Toe Test respectively. Core muscle force was assessed by the stabilizer by measuring dominant and non-dominant leg maximum isometric hip external rotation and maximum isometric hip abduction force. In this study, a relationship between dynamic balance and core was found and there was no significant relationship between static balance and core (Salar et al, 2014: 33-42). As similar to this study, in a study investigating the relationship between static and dynamic balance and core endurance on 100 basketball players, static balance was assessed by Flamingo balance test, and dynamic balance was assessed by Y Balance test. Core endurances were assessed by Prone plank test, flexion endurance test and Sonersan test. In this study, a strong relationship was found betweeen dynamic balance and core endurance, and there was no significant relationship found between static balance and core endurance (Saki et al, 2015:33-41). The results of these two studies support our study results. In addition to these studies; the relationship between core stabilization and athlete performance was investigated in a study conducted on male and female athletes attending a university, and it was found that the athletes who had a strong core stabilization had better athletic performance (Sharnock et al., 2011:63). These results supported the literature and showed the importance level of core endurance parameter for ensuring body balance.

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In our study we hypothesized that core endurance affects sitting balance positively and core endurance is an important parameter for improving the performance of WC basketball players. We observed that there was a relation between the functional reach and side bridge test. These results showed us how much trunk balance which is even important in classification of WC basketball player is related to core stability, and reminded us not to forget to add the exercises which will improve core stability to training programme. Nevertheless, the training programs of the athletes whose core muscles don't function due to their disabilities must be planned. In this context, 4 athlete tests were not included in the study because they could not do core endurance tests especially. The limitation of our study was the low number of the individuals who participated in our study. Studies are needed by increasing the individual number to investigate and compare the relationship between upper and lower extremity muscular force and functionality.

The suggestion of this study; core endurance is an important parameter on sitting balance in WC basketball players and this should be taken into account when planning training programmes.

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