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THE EFFECTS OF 8 WEEKS CORE TRAINING ON DYNAMIC BALANCE OF ELITE LEVEL BADMINTON PLAYERS

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Abstract:

Background: Core training is effective training for sports which require high level balance ability. Badminton needs good shaped balance ability for front side or back side on the court.

Aim: Purpose of this study was to examine effects of core training on dynamic balance ability of high level Badminton players.

Material and Methods: Experimental design, specifically randomized pretest- posttest control group, was used for this study. Matching participants was also applied for decreasing learning effect and pretest treatment interaction effect. Forty (22 male and 18 female) national Badminton players were recruited for this study. They were divided randomly two groups. Twenty of them were experimental group and other 20 of them were control group. Age of participants were 16-24 years (M= 18.98, SD= 1.92). Star excursion balance test was used in order to measure dynamic balance of participants. Mixed ANOVA was applied for statistical analysis.

Result: Results showed that eight weeks core training increased dynamic balance ability of experimental group, not for control group participants.

Conclusion: Core training has an effect on dynamic balance in high level badminton players and it should be used for improving balance ability of badminton players.

Keywords: performance sport, balance test, training effect

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1. Introduction

Movements are highly related with center of gravity which allows changing body position (Akuthota & Nadler, 2004; Clark, Fater, & Reuteman, 2000). Center of gravity is surrounded by muscles that affect stability of body during activity in sports. These muscles are generally called as core muscles which maintain postural endurance and stability while body positions change suddenly. Core muscles include abdominals (rectus abdominus, internal and external oblique), hip (sartorius, gluteus maximus) and back (trapezius, latissimus dorsi) muscles (Handzel, 2003).They allow transferring actions from lower to upper or upper to lower extremities.

Maintaining postural position during movement requires core stability which has been defined as muscular capacity and motor control of lumbopelvic-hip contraction (Norris, 2001). Core stability is divided three sub-systems; a) passive, b) active and c) neural systems. These systems work together in order to maintain stability of body. If one of them does not work, others will not be able to fulfill their tasks sufficiently (Panjabi, 1992).

Core stability is a dynamic concept that continually changes to meet postural adjustments or external loads accepted by the body. From sport performance perspective, greater core stability provides a foundation for greater force production in the upper and lower extremities. Studies showed that core stability can be improved with well-designed core muscle strength training (Samson, & Sandrey, 2007; Tse, Mcmanus, & Masters, 2005).

Core training is effective and useful training for increasing strength of muscles (King, 2000; Samson, & Sandrey, 2007). Studies examined effects of core training on elite and novice players (Sato & Mokha, 2009). For example, Tse and his colleagues (2005) studied on 45 college rowers and applied 8 weeks core training. Findings of this study showed that training improved core endurance of participants. Moreover, studies in literature indicated that core training was effective on preventing or rehabilitating sport injuries. Aluko, De Souza and Peacock (2013) investigated low back pain rehabilitation of 33 participants. Back pain of participants was decreased after core training treatment. Studies also focused on effects of core training on balance ability of athletes (Filipa, Byrnes, Paterno, Myer, & Hewett, 2010; Hardy, Huxel, Brucker, & Nesser, 2008; Stanton, Reaburn, & Humpries, 2004; Tse, et al., 2005). Filipa and her colleagues (2010) examined balance ability of female soccer players. Findings showed that core training was effective on balance ability. Even most of studies showed positive effects of core training on balance, some studies found opposite results. For example, Sato and Mokha (2009) who studied on rear-foot striking runners found no significant effects of core training. Furthermore, core training and balance were effective on players of individual sports especially racket sports players (Handzel, 2003).

Badminton is the fastest racquet sport (427 km/s) and the speed of elite performance is getting faster and faster as techniques and athletes' physical conditioning keep improving (Ye & Chuan, 2009). Badminton at the elite level requires a combination of the aerobic and anaerobic systems and the involvement of these systems depends on the nature of the rally (short or long) and the duration of the game (short set or long match). Elite level badminton players need to have balance constantly while performing these rallies.

Effects of core training on dynamic balance ability are not obvious in literature. Moreover, there are very few studies about core training and dynamic balance for badminton sport. The purpose of this study was to examine effects of core training on dynamic balance ability of elite level badminton players. It is hypothesized that there will be differences on pretest and posttest dynamic balance results of 8 weeks core training for experimental group, not for control group elite level badminton players.

2. Material and Methods

Experimental design, specifically randomized pretest- posttest control group design, was used for this study. Participants were randomly divided two groups and both groups were measured at same time on pre and posttests. Using pretest for groups could be resulted pretest treatment interaction threat. In order to control this thread, researcher used matching design. Beside dividing groups randomly and equivalent, researcher controlled characteristics of participants which were similar such as their ages, their playing experiences and levels, training similar hall conditions.

Approvals of Ethics Committee of Osmangazi University and Turkish Badminton Federation were taken before conducting this study. Individually consent forms were collected from all participants. Forty (22 male and 18 female) national Badminton players were attended this study. Their age ranks were 16-24 years (*M*= 18.98, *SD*= 1.92). They were divided randomly two groups. Twenty of them were experimental group and other 20 of them were control group. All participants are the best players in Turkey according to results of last four years documents in Turkish Badminton Federation and World Badminton Federation (2016, March 12) (Retrieved from http://www.badminton.gov.tr/bilgi-bankasi/774-dunya-ranking-turk-sporcular.html, and http://bwfbadminton.com/rankings/).

They are performance players and regularly train six times in a week. They began badminton in young ages (*M*= 8.05, *SD*= 1.84). Their experience years were between 6-13 (*M*= 9.13, *SD*= 1.87) years.

Star Excursion Balance Test (SEBT) was conducted for dynamic balance of athletes for this study. *Star Excursion Balance Test (SEBT)* consists of 8 lines which are anterior, anterolateral, anteromedial, medial, posteromedial, posterior, posterolateral and lateral. SEBT are performed with standing at center of a grid. There are 45° increments between grid and each line.

Reliability of the SEBT is good to excellent for both inter-tester and intra-tester according to studies in literature (Olmsted, Carcia, & Hertel, 2002; Plisky, Rauh, & Kaminski, 2006). For example, Munro and Herrington (2010) investigated the reliability of SEBT. Test–retest reliability for all reach directions was moderate to high. Intra-class correlation coefficients' ranging was from 0.84 to 0.92.Good reliability of SEBT was also found in study of Hertel, Miller and Denegar, (2000). They indicated that results of intra-tester were from .83 to.96 and inter-tester reliability were from .81 to .93

Validity of SEBT was checked with the study of Benjamin and Rob Roy (2012). They systematically reviewed 26 articles about SEBT and found that findings were similar and test validity was very high. Studies showed that validity and reliability of SEBT were very high and SEBT is appropriate for testing dynamic balance ability.

2.1 SEBT Protocol

Participants were instructed on where to stand and proper technique for performing the tests before starting test. They determined their dominant legs and used their reach foot as far as possible in the 8 directions. Before starting the test, subjects placed their hands on their iliac crests and were instructed to maintain the hand position as they performed the reach. Participant maintained a single leg stance on the non-dominant leg while reaching with dominant leg. Participants touched farthest point slightly and researcher marked the point.

Participants performed SEBT with the order of clockwise. Trial was discarded and repeated if(1) the researcher saw or felt that reach foot provided support while touching lines, (2) the participant lifted the stance foot from center grid, (3) participant lose his/her equilibrium while performing to reach (Hertel et al., 2000).The SEBT testing took approximately 20-25 minutes per subject. All scores were recorded on a form by the investigator assessing SEBT performance. The participants were given 6 trials to perform dynamic balance. Average of best 3 trails were recorded and used on analysis.

All procedure and applications were explained them before intervention began. After all explanations, participants were divided randomly two groups. SEBT pretest was applied on both groups. Eight weeks training program was done for experimental group, not for control group. Whenever 8 weeks intervention finished, post-test application for both groups were done at the same time.

Experimental group participants attended intervention three times a week. At the beginning of the training, an educational session for each individual by the investigator was conducted. Then, regular meetings between each badminton player and investigator as well as on-line checking were held. The flexibility training consisted of static, routine, and dynamic stretching. The static stretching was maintained while extending each body region maximally for 10-15 seconds. The routine stretching started from a body region, and then increased the extension range incrementally. Training was applied with observation of researcher. Every week, difficulties of training increased with controlling of players applications. Total time of training was approximately 20-25 minutes.

Literature was reviewed in order to determine core training program using for this study. Then, Program used on the study of Samson and Sandrey (2007) was determined. Reasons for determining this program were: a) Effectiveness of program has been proved; b) Program has been applied on tennis players who have similar abilities with badminton players, and c) Program was checked and accepted by training program expert. This program includes gravity control (i.e., lunges), eccentric control (i.e., med ball twists on Swiss ball) and isometric control (i.e., abdominal hollowing) in order to improve dynamic balance. The exercises have three level difficulties. First level begins stationary position with static contractions and continues to slow movements in an unsteady environment. Second level exercises begin with static contractions in an unsteady environment and continue on dynamic movements in a steadier environment. Lastly, third level begins with dynamic exercises and follows in an unsteady environment. Then, dynamic movement exercises were added in order to increase resistance. Selected exercises for this program were use of body weight, Swiss balls, badminton racquets, medicine balls, and therapeutic resistance bands.

Mixed ANOVA was used for checking statistical results of within and between subjects. Alpha level was set as 0.05. Assumptions were checked before conducting mixed ANOVA. Normality assumption was checked with Kolmogorov-Smirnov and Shapiro-Wilk which showed that scores are non-significant according alpha level .05. The Skewness and Kurtosis are close to zero point. Moreover, q-q plots and histograms showed that the normality has not been violated.

Homogeneity of variance assumption was checked with Levene's test which indicated all factors were non-significant according to alpha level.05 (Tabachnick & Fidell, 2001). Lastly, assumption of spherecity was checked and it was less than or equal alpha level (Mauchly's W. (27) = .50, $p < .05$). Hence, we used Greenhouse-Geisser row from all statistical tables (Tabachnick & Fidell, 2001).

3. Results

Table 1: Between-Subjects Effects of Groups

	df	*F*	*Sig.*	η^2
Groups	**1**	**117.46**	**.00**	**.61**
Error	76			

Descriptive results of study showed that there were mean differences between pre and post test results in experimental group. Highest increase in posterior (*Mean difference* = 15.37, *SD*= 4.83) and lowest increase in antero-lateral (*Mean difference* = 7.3, *SD*= 6.32) were recorded in experimental group. Descriptive results indicated that experiment group participants increased their scores in all directions of SEBT. In control group, anterior (*Mean difference* = 0.9, *SD*= 1.41) and posterior (*Mean difference* = 1.1, *SD*= 0.77) scores from pre to posttest were increased, but differences were in minimum level and were not significant.

According to Mixed ANOVA results, there was an interaction between results of pre to post-test and groups (F (3.53, 532) = 17.83, η^2= .19, $p < .05$). Findings indicated that the change on posttest balance scores in both groups were significantly different than the change in the control group (See table 1).

Table 2: Within-Subject Effects of Groups

		df	*F*	*Sig.*	η^2
Pretest-Posttest	Sphericity Assumed	7,00	198.94	.00	.72
	Greenhouse-Geisser	**3,53**	**198.94**	**.00**	**.72**
	Huynh-Feldt	3,87	198.94	.00	.72
	Lower-bound	1.00	198.94	.00	.72
Error	Sphericity Assumed	532,00			
	Greenhouse-Geisser	268.18			
	Huynh-Feldt	293.94			
	Lower-bound	76.00			

Table 2 showed that experimental group participants performed significantly better than control group participants (F (1, 76) = 117.46, η^2= .61, $p < .05$).

4. Discussion

The purpose of this study was to examine effects of core training on dynamic balance ability for high level badminton players. Results indicated that 8 weeks core training had effectiveness on balance ability for high level badminton players.

Similar results were found in studies focusing on balance, rehabilitation and injury prevention (Byrne, Roberts, Squires, & Rohr, 2012). Studies indicated that core stability and balance exercises should be used on rehabilitation process and protecting injured extremity of athletes (Byrne et al., 2012; King, 2000). For example, relationship between core strength and lower extremity injuries has been examined. Abt and his colleagues (2007) studied on 15 competitive cyclists and found that increasing core stability and core endurance were decreasing the possibility of lower body injuries. On the other hand, researchers focused on athletes who were under the risk of lower extremity injuries found different results. For example, Gordon, Ambegaonkar and Caswell (2013) investigated core strength and balance ability of athletes. They used bent knee lowering test and SEBT. Study included 45 female lacrosse players. They did not find significant results regarding relationship between core strength and SEBT scores. Lack of core training intervention and method used for core strength might be reasons of different results.

Effectiveness of different intervention on dynamic balance has been examined (Byrne et al. 2012; Filipa, et al. 2010). Even different interventions were applied; balance scores of participants were significantly increased. For example, Byrne, et al. (2012) investigated effects of 3 weeks Wii Fit training on dynamic balance of 11 healthy young adults. Study showed that significant post-training improvements were observed for all SEBT reach directions except postero-lateral and antero-medial. Most of results are similar with this study. Differences might be reasons of training method and duration of training. Another study was Filipa et al. (2010) who studied on female soccer players. They found that 8 weeks neuromuscular training increased SEBT scores of experimental group participants.

Even many studies indicate importance of core training and balance ability, there are few studies examined this relationship. One of the important studies was conducted by Samson and Sandrey (2007) who examined effects of five-week core training on dynamic balance of tennis players. Results showed that all directions in SEBT scores were improved based on pre and post test scores in experimental group. On the other hand, different results have been found in the study of Sato and Mokha (2009). They investigated the effects of 6 weeks core strength training on balance of runners. SEBT scores showed that core strength training did not significantly influence balance of runners. Training duration and training program might be the reasons of different findings from this study.

As a conclusion, 8 weeks core training significantly increased dynamic balance of elite level badminton players. This study extended literature in terms of relationship between core training and balance, and effects of core training on elite level badminton sport. Future studies examining effects of core training on balance ability of different sport players are required.

Findings of this study showed that specific designed core training improved balance ability of elite level badminton players. Training program is to guide for badminton coaches who want to improve their players' balance ability. Moreover, balance is important not only for elite badminton, but also for developmental badminton. Coaches working on young badminton players can use this program.

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