Journal of Bodywork & Movement Therapies (2016) 20, 565–570

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/jbmt

ORIGINAL RESEARCH STUDY

Effect of core strength training on dynamic balance and agility in adolescent badminton players

Tarik Ozmen, PT, PhD [a,*], Mert Aydogmus, PhD [b]

[a] Department of Physiotherapy and Rehabilitation, School of Health, Karabuk University, 78050 Karabuk, Turkey
[b] School of Physical Education and Sports, Karabuk University, 78050 Karabuk, Turkey

Received 19 August 2015; received in revised form 6 October 2015; accepted 9 December 2015

KEYWORDS
Core strength;
Core exercise;
Balance;
Agility

Summary The aim of the present study was to investigate effect of core strength training (CST) on core endurance, dynamic balance and agility in adolescent badminton players. Twenty adolescent (age = 10.8 ± 0.3 years; height = 140.6 ± 4.4 cm, weight = 33.9 ± 5.8 kg) badminton players were randomly divided into two groups as training group (TG) and control (CG) group. All subjects were evaluated with Star Excursion Balance Test (SEBT), Illinois Agility Test, and the core endurance tests. The TG completed CST twice a week, for 6 weeks. There were significant increases in ($p < 0.05$) directions of SEBT and core endurance tests ($p < 0.05$). However, no significant change was observed for agility ($p > 0.05$). The CST resulted in significant gains in directions of the SEBT and core endurances in adolescent badminton players, but not in agility.

Introduction

Badminton is one of the most popular racquet sports in the world (Lees, 2003). The game of badminton is characterized by repetitive actions of short duration with high speed and intensity within an 80 m^2 court (Lees, 2003; Manrique and Gonzalez-Badillo, 2003). Badminton requires quick changes in direction, jumps, forward lunges, rapid arm movements and a wide variety of postural positions (Manrique and Gonzalez-Badillo, 2003). Therefore, badminton players need good balance and agility during rapid postural actions around the court. Tiwari et al. (2011) found that agility was associated with performance ($r = 0.83$) during a badminton game. Badminton has been considered to be a quite safe sport. Although badminton is a non-contact sport, previous studies have reported that badminton injuries constituted 1%–5% of all sports injuries (Fahlstrom et al., 1998; Hoy et al., 1994; Kroner et al., 1990). Boesen et al. (2011) demonstrated that repeated rapid forward lunges during a badminton match created high stress loads especially on the Achilles and patellar

* Corresponding author. Tel.: +90 (370) 4330202.
E-mail address: tarikozmen@karabuk.edu.tr (T. Ozmen).

http://dx.doi.org/10.1016/j.jbmt.2015.12.006
1360-8592/

tendons in the dominant leg. Kimura et al. (2014) observed that weak trunk flexion strength increased knee valgus moment during a single leg landing after an overhead stroke in badminton players. The authors speculated that this finding may indicate a predisposition to ACL injury. Shariff et al. (2009) reported that the majority of the badminton injuries (63.1%) occurred in the lower extremities such as the knee (37.1%), ankle (28.3%), thigh (13.2%), heel (11.2%), toes (5.7%), and others (4.4%).

The core strength training (CST) plays an important role in reducing and preventing lower and knee joint injuries (Leetun et al., 2004; Willson et al., 2005; Zazulak et al., 2007). In recent years, core strength training is widely used in improving performance (Saeterbakken et al., 2011; Schilling et al., 2013; Stanton et al., 2004; Tse et al., 2005), reducing the risk of injuries in athletes, increasing physical fitness in healthy individuals (Sekendiz et al., 2010), and rehabilitation of patients with a low back pain (Marshall and Murphy, 2006). Weak trunk extensor muscles may be a risk factor for low back pain (Lee et al., 1999). The core has been described as a muscular corset with the abdominals in the front, erector spinae and gluteals in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature in the bottom (Akuthota et al., 2008). The core muscles stabilize the spine and trunk during movements of lower and upper extremities such as jumping, running, and throwing. Previous studies revealed that trunk muscle fatigue led to decreased dynamic stability of the trunk and loss of balance control (Davidson et al., 2004; Granata and Gottipati, 2008; Van Dieën et al., 2012) Huang et al. (2014) suggested that knee pain affected trunk and knee motions during forehand lunges, and training programs for badminton players with knee pain should include core strength exercises.

The CST may help to improve dynamic balance and muscle coordination between lower and upper extremities, as well as reducing injury risk and muscle imbalances. Thus, the purpose of this study was to investigate the effect of core strength training on core endurance, dynamic balance and agility in badminton players.

Methods

Subjects

Twenty adolescent badminton players (11 males, 9 females; age = 10.8 ± 0.3 years; height = 140.6 ± 4.4 cm, weight = 33.9 ± 5.8 kg) participated in the study. Descriptive data are presented in Table 1. All subjects had prior badminton experience of at least 1 year. None of the subjects had lower-extremity or lumbar-spine pathology or surgery within 6 months prior to the initial testing. This study was approved by university ethics committee.

Table 1 Descriptive characteristics of groups.

Variables	TG (n = 10)		CG (n = 10)		p
	Mean	SD	Mean	SD	
Age (yrs)	10.9	0.3	10.8	0.4	0.55
Height (m)	139.4	2.6	141.7	2.6	0.06
Weight (kg)	31.7	4.6	36.2	6.3	0.08

Procedures

All subjects were tested to assess agility, core endurance, and dynamic balance before (pretest) and after 6-weeks training period (posttest). Subjects were randomly divided into two groups of training (TG) and control (CG) groups. The TG completed core strength training twice a week for 6 weeks in addition to the regularly scheduled training.

Agility performance was evaluated using Illinois Agility Test (IAT) (Raya et al., 2013). The course was set up on a basketball court and had a length and width of 10 m and 5 m, respectively. Four cones marked the start, finish and the two turning points. Another four cones were placed down the center in equal intervals. The cones in the center were spaced 3.3 m apart. The subjects were instructed to run as quickly as possible around the course in the direction indicated to reach the finish line. Their time was measured by photocells located from start to finish and the best result of the two attempts was recorded.

The Star Excursion Balance Test (SEBT) was used to assess dynamic balance of subjects. Leg length was used to normalize excursion distances by dividing the distance reached by leg length and then multiplying the result by 100. Leg length was measured from the anterior superior iliac spine to the most prominent bony point of the ipsilateral medial malleolus with a standard tape measure while subjects lay supine on a treatment table. The reach directions were determined by affixing three tape measures to the gymnasium floor, one orientated anterior to the apex (A) and two aligned at 135° to this in the posteromedial (PM) and posterolateral (PL) directions. Each subject was instructed to reach as far as with the non-dominant leg in each of the 3 directions while maintaining dominant-leg stance. The dominant leg was determined by asking which leg would be their take-off leg in a lunge or jump. High inter-tester and intra-tester reliability of the SEBT has previously been reported (Hertel et al., 2010; Munro and Herrington, 2010).

Core muscle endurance tests described by McGill et al. (1999) were used to assess core stability. For the side bridge test (SBT), subjects lay on their side with their legs extended on a treatment table, resting on their forearm with the elbow flexed to 90°. Subjects were instructed to lift the hip off the table with the other arm and hand across the chest resting on the opposite shoulder. The test was terminated when straight body position could no longer be maintained. Time was recorded in seconds using a stopwatch. For the abdominal fatigue test (AFT), the subjects were seated with their back resting against a wedge that maintained 45° flexion from the horizontal on the treatment table. Knees were flexed to 90° and the feet stabilized by a researcher. The test was terminated when the upper body could no longer remain at the 45° angle. Time was recorded in seconds using a stopwatch. For back-extensor test (BET), the subjects laid on the treatment table in a prone position with the upper body cantilevered out over the end of the table. Subjects were asked to maintain a horizontal body position with arms crossed across the chest while a researcher stabilized the lower