THE EFFECTS OF SOCCER SPECIFIC BALANCE TRAINING ON AGILITY AND VERTICAL JUMP PERFORMANCES IN YOUNG SOCCER PLAYERS*

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ABSTRACT

The purpose of this study is to examine the effects of soccer specific balance training for six weeks on young soccer players on agility and vertical jump performance. 32 licensed male amateur soccer players voluntarily participated in the study. The participants were separated into groups such as balance training group (n=16) and control group (n = 16). The training group continued the static and dynamic balance training and routine soccer training for six weeks, 3 days a week, and for 40 minutes a day. The control group continued only routine soccer practice during the six-week period. All groups were subjected to dynamic balance, agility and vertical jump tests one week earlier than the study and after six weeks of dynamic balance training. At the end of the study, Mann-Whitney U and Wilcoxon Signed Ranks tests were used to compare the difference between the training and control groups and to compare agility, vertical jump and balance skill parameters with the aim of determining the group in which the difference occurred. At the end of six weeks, there was no difference between the agility and vertical jump values of the control group, while there was a statistically significant difference of 2.81% ($p < 0.01$) in the agility value and 12.67% ($p < 0.01$) in the vertical jump value in the training group. ($p > 0.05$) It was found in the study carried out that static and dynamic equilibrium training for 6 weeks improved soccer players' agility and explosive power performance. Balance training should be used as a supportive training for soccer training.

Key Words: Soccer, Explosive Power, Postural Stability, Change of Direction

GENÇ FUTBOLCULARDA FUTBOLA ÖZGÜ DENGE ANTRENMANLARININ ÇABUKLUK VE DİKEY SIÇRAMA PERFORMANSINA ETKİLERİ

ÖZ

Bu çalışmanın amacı genç futbolcularda uygulanan altı hafta futbola özgü denge antrenmanlarının çabukluk ve dikey sıçrama performansları üzerine etkileri incelemektir. Çalışmaya gönüllü olarak n= 32 lisanslı erkek futbolcu katılmıştır. Katılımcılar denge antrenmanı grubu (n=16) yaş: 15.82 ± 0.83, boy uzunluğu: 172.25 ± 4.97, vücut ağırlığı: 65.39 ± 4.77 ve Antrenman Yaşı : 3.77 ±1.90, ve kontrol grubu (n=16) yaş: 15.74 ± 0.91 , boy uzunluğu: 174.06 ± 5.65, vücut ağırlığı: 66.68 ± 5.48 ve Antrenman Yaşı : 4.22 ±2.27 olarak ayrılmışlardır. Antrenman grubu altı hafta süresince, haftada gün, 40 dakikalık statik ve dinamik denge antrenmanı ve rutin futbol antrenmanlarına devam ettiler. Kontrol grubu ise altı haftalık dönemde sadece rutin futbol antrenmanlarına devam ettiler. Antrenman ve kontrol grubu altı haftalık çalışma süresince çabukluk, kuvvet ve güç antrenmanı yapmadılar. Tüm gruplara çalışma bir hafta önce ve altı haftalık dinamik denge antrenmanlarından sonra dinamik denge, çabukluk ve dikey sıçrama testleri gerçekleştirildi. Çalışma sonunda antrenman ve kontrol grupları arasındaki farklar ve farkın hangi gruptan kaynaklandığını belirlemek amacı ile çabukluk dikey sıçrama ve denge beceri parametrelerinin karşılaştırılmasında Mann-Whitney U ve Wilcoxon Signed Ranks testi kullanılmıştır. Antrenman grubunda altı hafta sonunda, çabukluk değerinde % 2,81 ($p<0.01$) ve, dikey sıçrama değerinde %12,67 ($p<0.01$) istatistiksel olarak anlamlı fark gözlenirken, kontrol grubu çabukluk ve dikey sıçrama değerleri arasında bir fark oluşmamıştır($p>0.05$). Yapılan çalışmada 6 haftalık statik ve dinamik denge antrenmanlarının futbolcuların çabukluk ve güç performansını geliştirdiği bulunmuştur. Futbol antrenmanlarına destekleyici olarak denge antrenmanların destekleyici bir antrenman olarak kullanılması gerekmektedir.

Anahtar Kelimeler: Futbol, Patlayıcı Güç, Motor Beceri, Postural Stabilite, Yön Değiştirmeli Koşu

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INTRODUCTION

In a soccer match, soccer players cover a distance of 9-12 km on average[22]. Soccer players are doing a lot of high-intensity movements such as jumps, and sudden change of directions which affect the score[1,21,28]. Although these high speed runs constitute about 10-15% of the total distance covered, these activities usually involve movements during important positions that affect the score or with the aim of winning the ball from the opponent team[8,28]. The high-intensity changes of direction that take place within these activities are called agility skills. The studies show that agility is an important measure of performance in the soccer. Generally, agility is defined as the ability to change direction quickly. In addition, agility includes explosive acceleration, deceleration, and maintaining postural control during the sudden change of direction, gathering speed fast by reducing the decrease in running speed[27]. In short, agility is defined as the ability to change direction quickly, maintaining balance without loss of speed[17]. Balance is maintenance of the body balance base of support fast and accurate with visual vestibular and somatosensory feedback and working of the neuromuscular system co-ordinately[18]. Static balance is the ability to maintain a base of support with minimal movement[15]. Dynamic balance is the regulation and statically maintenance of balance during performance[35] or balance with minimal movements in unstable ground[24]. Balance skill can be improved by training on stable or unstable grounds. Balance exercises are usually used by physiotherapists with the aim of rehabilitation or injury prevention. However, recent studies show that balance exercises improve explosive power performance. It is seen in different studies that agility, strength and power outputs of soccer players, who do balance exercises, increase[11,12,13,31]. In the research in which the effects of balance exercises on knee extensor and flexor muscles were investigated, it was stated that balance exercises improve knee extensor and flexor muscles[12]. In addition, one study found that balance performance was positively correlated with quadriceps muscle strength[7]. In another study, it was stated that balance exercises involving ballistic movements caused an increase in the lower extremity explosive power output[12]. It has also been reported that balance training may have potential for improving the performance of the lower extremities, postural control and jumping and agility in young people.

Although balance trainings are used for rehabilitation and injury prevention efforts, current studies show that it improves explosive power performance. For this reason, the purpose of the study is to investigate the effects of functional balance exercises for six weeks on agility and vertical jump performance of young soccer players.

MATERIAL and METHOD

In this study, field and laboratory tests and anthropometric measurements of 32 elite soccer players playing soccer in the TFF Coca Cola Elite Academy U-16 and U-15 League were conducted. Subjects were excluded if they had a lower extremity injury, vestibular problems and visual problems in the 6 months before the study. All players and parents were notified of the research procedures, requirements, benefits, and risks before giving informed consent. The study was approved by the local Ethical Committee of Celal Bayar University, and was conducted in a manner consistent with the institutional ethical requirements for human experimentation in accordance with the Declaration of Helsinki

Subjects

Licensed male soccer players (N = 32) voluntarily participated in the study. The participants were separated into groups such as balance training group (n=16); age group: 15.82 ± 0.83, height: 172.25 ± 4.97, body weight: 65.39 ± 4.77, age of training: 3.77 ± 1.90, and control group (n = 16); height: 174.06 ± 5.65, body weight: 66.68 ± 5.48, and age of training: 4.22 ± 2.27.

Balance Test

The dynamic balance tests of the double leg and right-left of the athletes participating in this study were performed with the isokinetic balance leg device containing a force platform (20 Hz sampling rate and a sensitivity of 0.1°-ProKin, Tecnobody; Italy). All subjects participated in the balance test on 3 different days with the purpose of familiarization before the pre-tests. Before the pre-test and post-test, each participant was made dynamically exercise for two minutes on the balance device to warm-up. After explaining the tests to the participants, data entry (height, weight, age) and the calibration of the instrument were made. The feet of the subjects were placed on the balance platform nakedly (in a fashion that the distance between feet was 10 centimeters and the projection of the maximum point of the medial arcs was on the x-axis). They then performed the double leg stance and right-left leg balance tests on the balance device platform equally spaced (8 cm from the center of the horizontal axis) by moving the equilibrium tests five times in the 180-degree scale shown on the screen for 60 seconds. The test was repeated when five rounds could not be completed within 60 seconds. Participants made dynamic movements clockwise.

Agility Test

The Zigzag agility test (Little and Williams 2005) contained three 100 ° degrees of rotation between the starting point and the finish. The zigzag agility tests course consisting of four 5-m sections set out at 100◦ angles (see Fig. 1). After 10 minutes of standard warm-up, the test started at a distance of one meter from the starting point. Participants started voluntarily without any command when they felt ready to test, and when they passed the endpoint the test was terminated. All participants repeated the test three times and their best scores in these repetitions were recorded as the test scores. Participants were actively rested for three minutes between repetitions. The test was terminated and repeated when participants breached the rule. Time was measured using an electronic timing system (Newtest Powertimer 300 System, Tyrnava Finland).

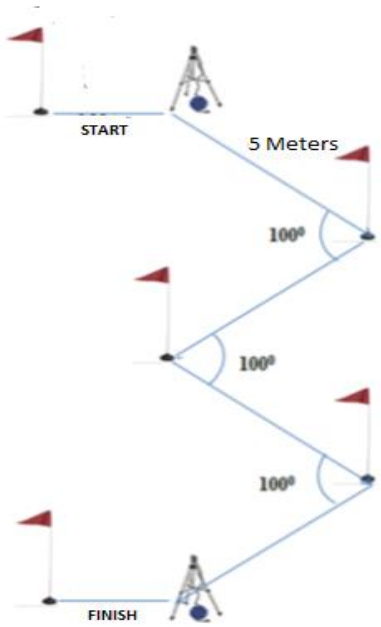

Figure 1- Zigzag agility test (Little and Williams, 2005)

Vertical Jump Test

Measurements of vertical jump tests were performed with a portable force platform (Newtest Powertimer 300 System, Tyrnava Finland) device. All participants performed right-left and double-leg counter movement jump. Participants started the test after 10 minutes of standard warm-up. When the participants were ready they made a maximal jump on the jumping pad. Participants were allowed to use their arms during testing. Participants completed three repetitions and their best grades were recorded as the test score.

Balance Training

Balance training was performed three days a week and 30 minutes before routine team training on a day-to-day basis. In the balance training, balance paddle and balance board were used. Each balance training session consisted of 6 different drills. Balance workouts were done with 3 sets and 30-60 seconds drill, 60 seconds rest. Balance training group continued routine soccer training along with balance training. The control group only did routine soccer practice. Each group average 5 days a week training and match one day.

Statistical Analysis

Analysis of the data was done with the SPSS 22.0 package program. The normality distribution of the data was determined by the Shapiro-Wilk normality statistical method. Mann-Whitney U test was performed in intergroup pre-test and post-test analysis of the data which show non-normal distribution. Intra-group pre-test and post-test values were compared using the Wilcoxon Signed Ranks Test.

RESULTS

Descriptive characteristics such as age, height, body weight, body mass index (BMI) and training age of participants are given in Table 1.

Table 1- Participants Anthropometric Measurement Values

	Age(year) Mean ±SD	Height(cm) Mean ±SD	Body Weight(kg) Mean ±SD	BMI(kg/cm^2) Mean ±SD	Age of Training(year) Mean ±SD
Training group (n=16)	15.82±0.83	172.25±4.97	65.39±4.77	22.1±2.36	3.77±1.9
Control group (n=16)	15.74±0.91	174.06±5.65	66.68±5.48	22.07±2.58	4.22±2.27

BMI=Body Mass Index

Table 2- Pre-test and post-test statistical analysis between groups of training and control

		Training Group Mean ±SD	Control Group Mean ±SD	*p*
BDLS	Pre-Test	29.06±6.43	24±6.62	0.36
	Post-Test	17.06±5.39	21.75±5.36	0.20
BRLS	Pre-Test	31.43±7.81	27.31±5.94	0.10
	Post-Test	19.93±5.01	23.43±5.41	0.06
BLLS	Pre-Test	36.37±11.21	26.93±5.73	0.05
	Post-Test	21.06±4.49	25.25±4.15	0.10
Agility	Pre-Test	5.9±0.13	5.96±0.22	0.35
	Post-Test	5.73±0.11	5.95±0.24	0.002*
VDL	Pre-Test	41.33±4.29	42.99±4.45	0.29
	Post-Test	46.34±3.35	42.79±4.31	0.014*
VRL	Pre-Test	27.3±2.86	28.13±3.89	0.49
	Post-Test	30.29±3.33	27.8±3.57	0.50
VLL	Pre-Test	29.73±3.54	29.64±2.81	0.93
	Post-Test	31.18±3.63	29.46±2.29	0.121

***p<0.05**

BDLS= Balance double leg stance, **BRLS**: Balance right leg stance, **BLLS**: Balance left leg stance, **VDL** : vertical jump double leg, **VRL**: vertical jump right leg, **VLL**: vertical jump left leg

Pre-test and post-test statistical analysis between groups of training and control are shown in table 2. As a result of balance training, there was a statistically significant difference between the pre-test and post-test values in the agility performances of training and control group (p = 0,002) and VDL (p = 0,014). No statistical difference was found in other performance parameters.

Table 3- Statistical analysis of pre-test and post-test in the training and control group

	Groups	Pre-tests	Post-tests	%	*p*
	Mean ±SD	Mean ±SD	Mean ±SD	Difference	
BDLS	Training	29.06±6.43	17.06±5.39	%39.51	0.001*
	Control	24±6.62	21.75±5.6	%7.43	0.035*
BRLS	Training	31.43±7.81	19.93±5.01	35.49	0.001*
	Control	27.31±5.94	23.43±5.41	13.19	0.001*
BLLS	Training	36.37±11.21	21.06±4.49	38.54	0.001*
	Control	26.93±5.73	25.25±4.15	5.11	0.011*
Agility	Training	5.9±0.13	5.73±0.11	2.81	0.001*
	Control	5.96±0.22	5.95±0.24	0.06	0.35
VDL	Training	41.33±4.29	46.34±3.35	12.67	0.001*
	Control	42.99±4.45	42.79±4.31	0.40	0.81
VRL	Training	27.3±2.86	30.29±3.33	11.2	0.001*
	Control	28.13±3.89	27.8±3.57	0.98	0.64
VLL	Training	29.73±3.54	31.18±3.63	5.05	0.005*
	Control	29.64±2.81	29.46±2.29	0.41	0.64

BDLS= Balance double leg stance, **BRLS**: Balance right leg stance, **BLLS**: Balance left leg stance, **VDL** : vertical jump double leg, **VRL**: vertical jump right leg, **VLL**: vertical jump left leg

Statistical analysis results of pre-test and post-test in the training and control group are shown in Table 3. Statistically significant differences were found in training group's BDLS (p=0,001), BRLS (p=0,001), BLLS (0,001), agility (p=0,001), VDL (p=0,001), VRL (p=0,001) and VLL (p=0,005) values. While statistical differences were found in pre-test and post-test results of control group in the values of BDLS (p=0,035), BRLS (0,001) and BLLS (p=0,011), there were not found any differences in the values of agility, VDL, VRL and VLL. (p>0.05)

DISCUSSION

The aim of this study is to investigate the effects of six weeks of functional balance training on the agility and vertical jump performances of young soccer players. As a result of present study's functional balance trainings, statistical differences were determined in training group's values of agility (p=0.001), VDL (p=0,001), VRL (p=0,001) and VLL (p=0,005). In the control group, there was no statistically difference between agility and vertical jump values (p> 0.05).

Although there are many studies in the literature about the effects of balance training on rehabilitation and injury prevention, its effects on performance parameters such as agility and vertical jump are controversial. Agility is a complex skill that involves coordination, joint mobility, dynamic balance, strength, power and speed[33]. It is thought that working these skills properly improves the agility performance. In various studies, it has been indicated that lower extremity exercise with proper balance training affects reaction time, proprioception,

muscular activation in leg muscles, and balance ability[26,19]. Apart from these studies, it has been stated in some studies that balance exercises improve the strength and vertical jump performances[6,9,11,13,32].

As a result of the balance training in the present study the agility and the vertical jump performances increased. Similar to the results of the present study, Šimek (2007) reported in the study researched proprioceptive training for agility and vertical jump performance that there is improvement in 20-yard and HOPS agility tests, but no lateral agility improved[31]. In another study, it was reported that dynamic balance exercises, which were applied to male basketball players for four weeks, affected the T-test agility score positively[28]. Moreover, in a study conducted in active female athletes, it was stated that balance training increased rectus femoris muscle activation during jump and positively affected vertical jump performance[15]. In another study, Simek (2007) stated that proprioceptive balance exercises increase the vertical jump performance. In a study of elite young soccer players, it was found that six months balance training along with soccer training was statistically positive in the squat and countermovement vertical jump performance in hip extension torque[14]. In a study of young skiing athletes, it was observed that while there was no increase in isometric leg strength, there were improvements in squat, countermovement and drop jump performances[32]. Contrary to these results, in a study conducted by Bruhn (2004), there was no difference in vertical jump performance as a result of 4-week training[6]. Another study reported that there was no effect on the vertical jump performance of balance exercises performed in prepubertal children. It is thought that the lack of improvement in vertical jump performance as a result of balance training in these studies may originate from the inadequacy of the training period or differences in the study group.

In previous studies it was seen that balance training has a positive effect on agility and vertical jump performance including explosive power. Studies on the balance training's mechanism of action have shown that balance training reduces antagonist muscle co-activation although there is no muscle activation difference in agonist muscle as a result of balance training[2]. However, it is seen from the studies that balance training reduces spinal excitability in the mono-synaptic motor pathways by decreasing the h-reflex amplitude; so, an increase in power occurs as a result of adaptation in the motor pathways even if the structural alteration is not obtained in muscle[4,12,30,33]. As a result of this study, it is thought that the increase in agility and vertical jump performance is caused by the effects of the equilibrium trainings on the maximal force generating mechanisms. It is recommended to conduct in the future studies to evaluate neural adaptations of balance training.

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