CORE VS PLYOMETRIC TRAINING EFFECTS ON DYNAMIC BALANCE IN YOUNG MALE SOCCER PLAYERS

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EFEITOS DO TREINAMENTO DE CORE VERSUS PLIOMÉTRICO SOBRE O EQUILÍBRIO DINÂMICO EM JOVENS JOGADORES DE FUTEBOL DO SEXO MASCULINO

EFECTOS DEL ENTRENAMİENTO DE CORE VERSUS PLIOMÉTRICO SOBRE EL EQUILIBRIO DINÁMICO EN JÓVENES JUGADORES DE FÚTBOL

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ABSTRACT

Introduction: Today, different types and volumes of strength training are used to increase the performance of athletes. However, the effect of this training on dynamic balance in young soccer players is a matter of curiosity. Objective: The purpose of this study is to determine the effects of core and plyometric training on dynamic balance in young male soccer players. Materials and Methods: Eighteen male soccer players between 17 and 18 years of age participated in the study voluntarily. Subjects were randomly separated into three groups: core training group (C, n=6), plyometric training group (P, n=6), and control group (Con, n=6). Group C and P subjects participated in the determined training programs, in addition to soccer training, two days a week for eight weeks. The Con group only continued their soccer training. The Y-balance test (before and after eight weeks) was applied to determine the balance performance of the subjects. Results: After eight weeks of core training, significant differences in anterior (ANT) and posteromedial (PM) balance performance on the dominant side and in ANT, PM, and posterolateral (PL) balance performance on the non-dominant side were observed in group C subjects. The PL and PM balance performance of group P subjects after plyometric training was found to be significantly different on both sides. Conclusion: As a result, it was determined that applying core and plyometric training in addition to soccer training increases dynamic balance. We recommend that trainers and coaches use core and plyometric exercises in their training, as these programs will provide a positive performance increase in balance and gains in muscle strength. ***Level of Evidence III; Prospective comparative study.***

Keywords: Soccer; Balance; Plyometric exercise; Core strength training.

RESUMO

Introdução: Atualmente, diferentes tipos e volumes de treinamento de força são usados para aumentar o desempenho dos atletas. Porém, o efeito desse treinamento sobre o equilíbrio dinâmico de jovens jogadores de futebol é motivo de curiosidade. Objetivo: O objetivo deste estudo é determinar os efeitos do treinamento do core e do pliométrico sobre o equilíbrio dinâmico de jovens jogadores de futebol do sexo masculino. Material e Método: Dezoito jogadores de futebol do sexo masculino com idades entre 17 e 18 anos participaram do estudo voluntariamente. Os indivíduos foram separados randomicamente em três grupos: Grupo de treinamento de core (C, n = 6), Grupo de treinamento pliométrico (P, n = 6) e Grupo controle (Con, n = 6). Os participantes dos grupos C e P realizaram determinados programas de treinamento, além do treinamento de futebol, dois dias por semana durante oito semanas. O grupo Con apenas continuou o treinamento de futebol. O Y Balance Test foi aplicado antes e depois de oito semanas para determinar o desempenho do equilíbrio dos participantes. Resultados: Depois de oito semanas de treinamento de core, foram observadas diferenças significativas no desempenho do equilíbrio anterior (ANT) e posteromedial (PM) no lado dominante e no desempenho do equilíbrio ANT, PM e posterolateral (PL) no lado não dominante nos indivíduos do grupo C. Verificou-se que o desempenho do equilíbrio PL e PM dos participantes do grupo P depois do treinamento pliométrico foi significativamente diferente em ambos os lados. Conclusões: Como resultado, determinou-se que a aplicação do treinamento do core e pliométrico, além do treinamento de futebol, aumenta o equilíbrio dinâmico. Recomenda-se aos treinadores e técnicos o uso de exercícios do core e pliométricos em seus treinamentos, pois esses programas proporcionam aumento positivo no desempenho do equilíbrio e ganho de força muscular. ***Nível de evidência III; Estudo prospectivo comparativo.***

Descritores: *Futebol; Equilíbrio; Exercício pliométrico; Treinamento de força central.*

RESUMEN

Introducción: Hoy en día, se utilizan diferentes tipos y volúmenes de entrenamiento de fuerza para aumentar el rendimiento de los deportistas. Sin embargo, el efecto de estos entrenamientos sobre el equilibrio dinámico en jóvenes futbolistas es una cuestión de curiosidad. Objetivo: El propósito de este estudio es determinar los efectos del entrenamiento de core y pliométrico sobre el equilibrio dinámico de jóvenes jugadores de fútbol. Material y

Método: Dieciocho jugadores de fútbol del sexo masculino entre 17 y 18 años participaron en el estudio de forma voluntaria. Los individuos fueron separados aleatoriamente en tres grupos: Grupo de entrenamiento de core (C, n = 6), Grupo de entrenamiento pliométrico (P, n = 6) y Grupo control (Con, n = 6). Los participantes de los grupos C y P realizaron determinados programas de entrenamiento, además del entrenamiento de fútbol, dos días a la semana durante ocho semanas. El grupo Con solo continuó su entrenamiento de fútbol. Se aplicó el Y Balance Test antes y después de ocho semanas para determinar el rendimiento de equilibrio de los participantes. Resultados: Después de ocho semanas de entrenamiento de core, se observaron diferencias significativas en el rendimiento del equilibrio anterior (ANT)y posteromedial (PM) en el lado dominante y en el rendimiento del equilibrio ANT, PM y posterolateral (PL) en el lado no dominante en los participantes del grupo C.. Se verificó que el rendimiento del equilibrio PL y PM de los participantes del grupo P después del entrenamiento pliométrico fue significativamente diferente en ambos lados. Conclusiones: Como resultado, se determinó que la aplicación de entrenamiento de core y pliométrico, además del entrenamiento de fútbol aumenta el equilibrio dinámico. Se recomienda a los entrenadores y técnicos el uso de ejercicios de core y pliométricos en sus entrenamientos, ya que estos programas proporcionarán un aumento positivo del rendimiento en el equilibrio y aumento de fuerza muscular. ***Nivel de evidencia III; Estudio prospectivo comparativo****.*

Descriptores: *Fútbol; Equilibrio; Ejercicio pliométrico; Entrenamiento de fuerza central.*

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INTRODUCTION

In recent years, it is aimed to improve the condition of players with different strength training programs in soccer. Trainers and conditioners wonder which of these methods are more effective and the effect of strength training methods on other motoric characteristics.

Today, soccer is an intermittent sport discipline with high conditional requirements.[1] It is known that strength training is applied to increase athletic performance in soccer.[2] For that purpose, core and plyometric training have been using frequently pre-season and in-season.

Soccer is an intermittent, highly intense and complex sport,[3] and during a ninety-minute match, there are vigorous activity changes in every 4-6 seconds with a number up to 1400 such as jumping, passing, kicking, turning and sprint and change of direction.[4] During and after all these movements, the players need to stay in balance to pass to the next movement, to prevent injuries that may occur and to the quality of the next move. The ability to keep the body's center of gravity on the support fundament can be defined as the balance and results from neuromuscular actions in response to continuous visual, vestibular, and somatosensory feedback.[5,6] Balance is divided into two as static and dynamic. Static balance is the ability to maintain the balance of the body in a certain place or position, while the dynamic balance is the ability to maintain the balance of the whole or a part of the body in motion.[7] Balance can be used for athletes both to increase sportive performance and to prevent injuries.[8]

It is possible to find the studies examining the effects of core[1,9] and plyometric training in soccer[2,10–14] on some motoric elements. Core and plyometric training can be helpful to increase the dynamic balance of athletes. However, soccer players need both strength and balance when they are performing technical movements (such as walking, running, jumping, sprint, backward running, changing direction) in competition and training. In addition to the large number of studies in the literature that mention the performance-enhancing effects of core and plyometric training besides some studies do not confirm this hypothesis. Therefore, the study aims to determine the effect of the core and plyometric training on dynamic balance in young male soccer players.

MATERIAL AND METHODS

Participants

Eighteen male soccer players between the ages of 17-18 participated in the study voluntarily (Table 1). Parents' permission was obtained from the parents of the athletes and informed consent form was taken from the participants before the research. The study was conducted according to the latest version of the Declaration of Helsinki. The research has been approved by the Gazi University Institute of Health Sciences Ethics Committee. Subjects were randomly separated into three groups: core training group (C, n=6), plyometric training group (P, n=6), control group (Con, n=6, Table 1). Inclusion criteria to the study (1) being a male soccer player between the ages of 17-18 (2) not getting injured or having a surgical operation in the last six months (3) not having any plyometric and core training in the last six months (4) not practicing any sports branch other than soccer training during the measurement and experimental weeks (5) not missing any training during the measurement and experiment weeks (6) playing sports at least two years.

Table 1. Characteristics of the subjects.

	C	P	Con
Age (year)	17.2±0.4	17.3±0.5	17.7±0.5
Years of experience (year)	3.5±1.1	3.5±0.8	3.2±0.8
Body height (cm)	175.0±7.8	175.8±5.1	179.7±9.8
Body weight (kg)	76.4±12.4	61.4±4.3	70.7±12.1

C: Core training group, P: Plyometric training group, Con: Control group.

Research protocol

The study protocol was explained to the subjects in detail before the research. All subjects were in the same team and have completed the same soccer training for eight weeks. The measurements were carried out on two separate days. On the first day, the subjects were informed and their characteristics such as height, body weight, and years of experience were determined. Balance performance was measured on the second day. All training and measurements were performed between 17.00 and 20.00 out in the open court. Y-balance test (before and after eight weeks) was applied to determine the balance performance of the subjects (Figure 1).[15–18] In the balance test, the directions of access were determined using three tape measures on the ground, two of which have been aligned at 135 degrees' angle (between ANT and PM&PL) and one was at 90 degrees (between PM&PL). All subjects have been asked to stand on one of their legs while lying with the other leg as far forward as possible on the strips. Balance performance was performed in anterior (ANT), posterolateral (PL) and posteromedial (PM) directions, with dominant and non-dominant sides separately. In balance performance, measurements were recorded in "cm".

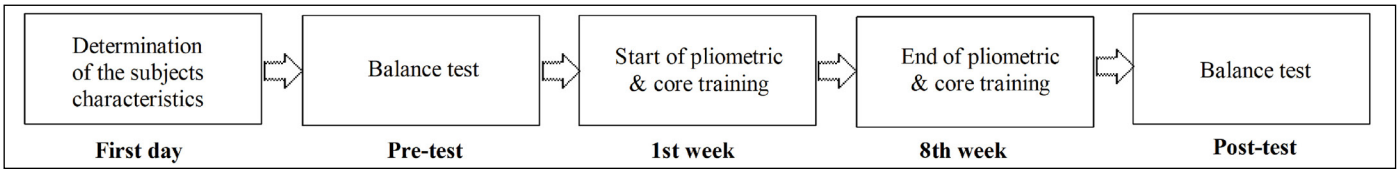

Figure 1. Study protocol.

The subjects were trained according to the determined training programs in addition to soccer training two days a week for eight weeks (Table 2, 3). The control group practiced only soccer training. Before the measurements, the subjects performed general and specific warm-up for 20 minutes. Groups P and C completed their training programs before soccer training for eight weeks, after 15 minutes of general and special warm-up in approximately 20 minutes in total, and then they participated in soccer training. Con group, on the other hand, participated in soccer training directly after 15 minutes of general and special warm-up before soccer training started.

Data analysis

Sigma Plot 11.0 (Systat Software, Inc.) was used to evaluate the descriptive statistics (mean ± SD) & statistical analysis. After the groups were formed randomly, no difference was found between the groups in dependent variables in the pre-test phase. Variables have been analyzed by using the Shapiro-Wilk test to determine whether the distributions were normal in the pre & post-tests. Wilcoxon paired t-test was used to compare the balance of the subjects before and after the training programs. The significance level was determined as $p<.05$.

RESULTS

After eight weeks of core training, ANT & PM balance performance on the dominant side and ANT and PM, PL balance performance in all three directions on the non-dominant side of the subjects in the C training group were found significantly different (Table 4, 5).

After the plyometric training, the PL and PM balances of the P training group subjects were found significantly different on both the dominant and the non-dominant side. The balance of the Con group, who participated only in soccer training for eight weeks, was not found significantly different in any direction (Table 4 & 5).

Table 2. Plyometric training program.

	1-4 weeks		5-8 weeks	
Movements	**Repetition**	**Set**	**Repetition**	**Set**
Horizontal jump	6	2	8	2
Vertical jump	6	2	8	2
Lateral horizontal jump (right)	6	1	8	1
Lateral horizontal jump (left)	6	1	8	1
Lateral bounding	10	2	12	2
30 cm hurdle jump	6	2	8	2
30 cm hurdle lateral jump (right)	6	1	8	1
30 cm hurdle lateral jump (left)	6	1	8	1

Table 3. Core training program.

	1-4 weeks		5-8 weeks	
Movements	**Repetition**	**Set**	**Repetition**	**Set**
Plank	15 sec	4	15 sec	6
Side plank (right)	15 sec	2	15 sec	4
Side plank (left)	15 sec	2	15 sec	4
Crunch on pilates ball	15 rep	1	15 rep	2
Back extension on pilates ball	15 rep	1	15 rep	2
Russian twist	15 rep	2	15 rep	4
Hip raise	15 rep	1	15 rep	2
Dog kick (right & left)	15 rep	1	15 rep	2

Table 4. Comparison of pre-post balance test in dominant leg.

		Dominant leg					
Balance		**C**	**p**	**P**	**p**	**Con**	**p**
ANT	Pre	82.9±6.7	.001*	88.3±8.9	.177	87.1±5.6	.969
	Post	84.5±6.7		90.9±7.5		87.0±6.6	
PL	Pre	87.0±9.7	.585	85.0±13.6	.031*	92.9±6.8	.125
	Post	88.3±9.6		92.0±16.2		94.2±5.8	
PM	Pre	78.9±8.9	.003*	77.3±12.8	<.001*	87.3±7.8	.125
	Post	80.8±8.5		82.8±12.9		89.9±5.7	

*: The significant difference between pre & post-test, p<.05, C: Core group, P: Plyometric group, Con: Control group, ANT: anterior, PL: Posterolateral, PM: Posteromedial.

Table 5. Comparison of pre-post balance test in non-dominant leg.

		Non-dominant leg					
Balance		**C**	**p**	**P**	**p**	**Con**	**p**
ANT	Pre	86.6±5.8	.031*	88.2±10.7	.670	86.9±6.6	.849
	Post	88.3±6.6		89.3±7.2		86.8±6.7	
PL	Pre	86.3±7.6	.031*	86.3±12.7	.004*	93.3±9.5	1.00
	Post	88.2±7.1		91.3±12.9		93.8±8.3	
PM	Pre	80.0±6.3	.004*	80.2±11.7	.031*	85.2±5.8	.052
	Post	82.3±6.2		87.3±14.4		86.0±5.9	

*: The significant difference between pre & post-test, p<.05, C: Core group, P: Plyometric group, Con: Control group, ANT: anterior, PL: Posterolateral, PM: Posteromedial.

DISCUSSION

In this study, the effect of core and plyometric training for eight weeks (2 sessions per week) on balance was investigated in young male soccer players. For that purpose, C & P group were applied group-specific exercises in addition to soccer training, but the Con group was practiced only soccer training. At the end of the study, it was determined that the balance increased significantly in both training groups, but there was no increase in balance performance in the Con group, who only practiced soccer training (Figure 2).

In a study on the prevention of injuries by balance training in soccer, researchers recommend adding balance training to soccer players' daily training programs or at least three session per week.[6] In a study in which balance performance was determined to be differentiated according to different competition levels, no bilateral leg balance difference was found in any group (high-school, collegiate, professional) among soccer players.[8] Although the highest balance value of the subjects was obtained in PM, the lowest balance value in the ANT direction; ANT direction balance findings of this study are lower than those obtained in our study.

Core strength can be defined as the force produced and sustained by core muscles.[19] It is accepted that core muscle strength improves performance in skill-related components such as balance, coordination, speed and health-related components such as strength and flexibility.[20]

In the previous studies which investigated the effect of core training on balance, there is a consensus that balance performance has been increased after core training. It has been observed that core training (six weeks, two times/week) in healthy but untrained adolescents increased the performance of trunk muscle strength, sit-and-reach test, and Y balance test.[20] It has been determined that eight weeks of core training for male basketball players over the age of 18 increase dynamic balance efficiency.[7] In a study investigating the effects of core training in badminton on dynamic balance and agility, it has been determined

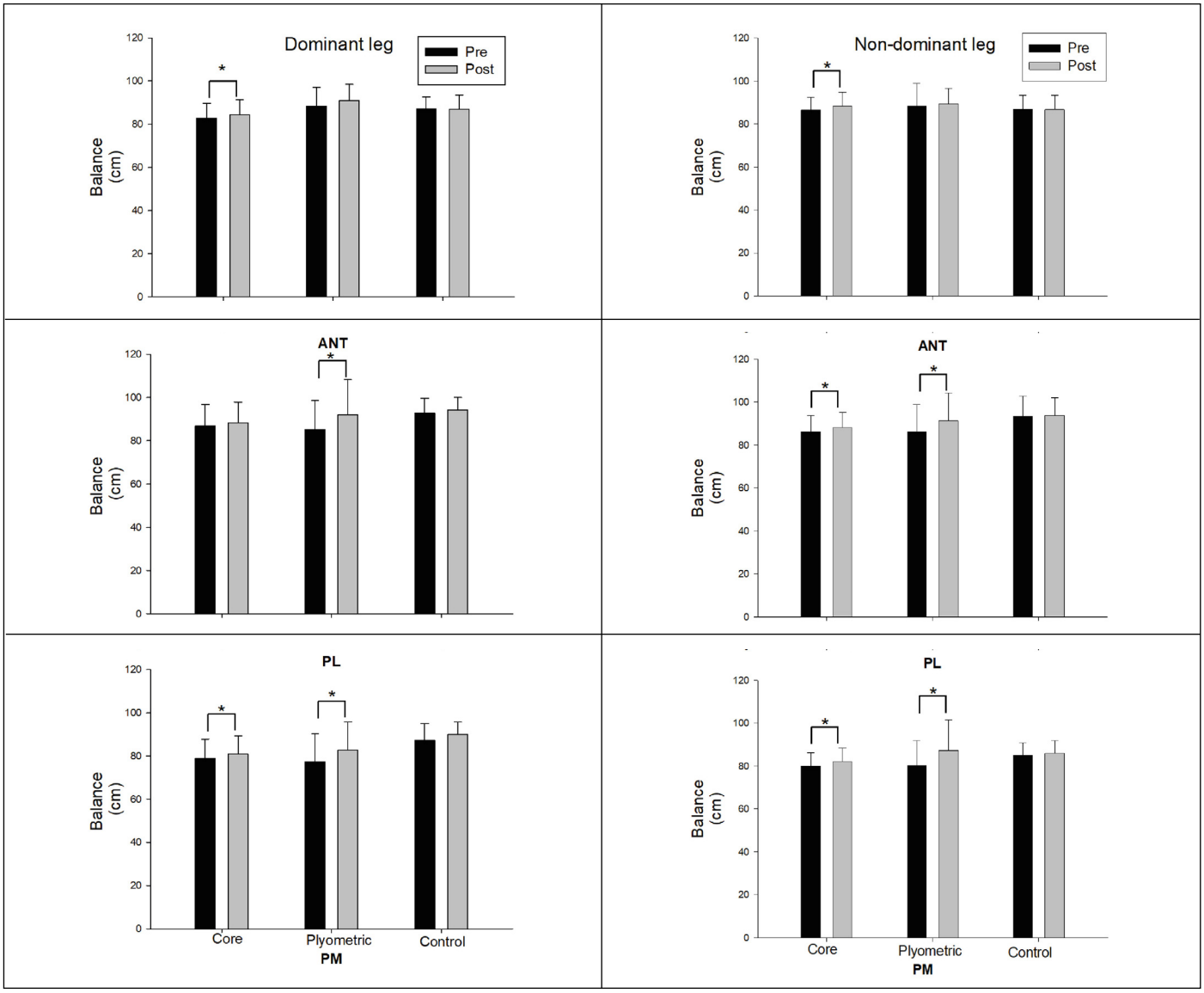

Figure 2. Balance before and after core & plyometric training in soccer players.

that there was a significant increase in the balance performance of the subjects after six weeks of core training.[15] In the literature, the effect of core training on balance in soccer includes similar results. Afyon[21] determined that 12-week core training for 16-year-old male soccer players has increased the static balance (Flamingo balance test) of the subjects. Manolopoulos et al.[22] applied sensorimotor strength training to one of the groups of subjects that they divided into two, and only strength training to the other. At the end of their research, they have determined that both strength training increased balance performance. In another study with a high population (n = 130), the researchers have found a significant positive relationship between back extensor strength and balance in soccer players.[18]

It has been demonstrated that plyometric training in soccer increases athletic and soccer performance. Rubley et al.[12] found that plyometric training increased jumping and kicking performance in adolescent soccer players. They reported that low-intensity plyometric training one day a week during 12 weeks would provide this effect. However, most of the studies mention the positive effect of plyometric training on balance. Only one study reported a latent deterioration in balance performance following high-intensity plyometric exercises.[23] A significant increase in balance performance has been observed after vertical and horizontal plyometric training in male soccer players between 10-14 years old.[24] Granacher et al.[25] reported that the balance of young male soccer players increased significantly after the plyometric training they applied on stable and unstable surfaces. Besides, it has been determined that different plyometric training (vertical, horizontal and combined) increases the balance in soccer players as well as other motoric elements.[24] Plyometric training performed to basketball players on land and water provides a significant increase in sprint and strength performance. In dynamic balance, it has been found that plyometric training on land ensured more increase in balance but this increase was not significant.[26]

In another remarkable study on young soccer players, balance and plyometric training have been combined and applied into two groups for eight weeks. One group was trained balance for the first 4 weeks followed by plyometric for 4 weeks; the other group completed the first 4 weeks of plyometric followed by 4 weeks of balance training. In addition to the motoric features of the subjects such as jump, agility and speed, balance performance in the pre & post-tests was also obtained by the Y balance test. Although the balance of both groups increased significantly; the balance performance of the group that performed balance first and then plyometric training was higher than the other group. In this study, it is uncertain whether balance training increases balance or plyometric training increases balance.[27] However, in our research, we have determined that practicing plyometric training for only eight weeks significantly increased balance performance.

CONCLUSION

In the literature, it is possible to find studies in which the effect of core and plyometric training on some parameters including balance is examined separately. However, the number of studies examining the effect of both core and plyometric training in the same study is quite a few. Nevertheless, the training programs have been applied differ in terms of the number of repetitions, the number of sets and the number of weeks have been performed in each study. For this reason, the effect of the training programs we used in our research provides an example "independently" from other studies.

After eight weeks of core and plyometric training, a significant increase in the balance performance of young male soccer players was determined and the balance increase in plyometric training is higher than the balance increase in core training. One of the limitations of our study is the number of subjects in the groups. This limitation was determined to apply the same soccer training to all subjects in the same team. The subjects will have applied the same soccer training on the same day and time, and the subjects in the training groups will be subjected to specific strength programs in addition to the soccer training. This situation provided a more homogeneous research environment to conclude which training program was more effective on balance at the end of eight weeks. As a result, it was determined that applying core and plyometric training in addition to soccer training increases balance. In the soccer season where intense training and competition programs take place, it should not be overlooked in terms of athletic performance that the core and plyometric training is not only intensively exercised in pre-season, but also applied daily or twice a week in-season. Trainers and coaches are recommended to use core and plyometric exercises in their training, as it will provide a positive performance increase in the balance as well as gaining muscle strength in these programs.

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