Journal of Physical Education and Sport ® (JPES), Vol. 24 (issue 6), Art 175, pp. 1551- 1560, June 2024
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

The effect of athletic performance training on selected parameters of elite football players in the preparation period

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Published online: June 30, 2024
Accepted for publication : June 15, 2024
DOI:10.7752/jpes.2024.06175

Abstract
Aim: The aim of the study is to determine whether or not a six-week athletic performance training applied to elite level football players during the preseason period has an effect on strength, endurance, flexibility, vertical jump, and balance parameters. **Method:** The study was conducted using the one-group pretest-posttest weak experimental design, which is one of the quantitative research approaches. The sample group consisted of a total of 27 volunteer professional male football players competing at the Spor Toto Super League level of the Turkish Football Federation. Pretests were applied to the football players in the study before the preparation period and posttests were taken after the 6-week training program was applied. Before the test, football players were randomly divided into groups via minimization according to their pre-existing maximal aerobic speed (MAS). The other tests (strength, balance, flexibility, and vertical jump) were taken 48 hours after this test was administered. SPSS 24 software was used to analyze the data obtained from the study. With the normal distribution of the data, paired samples t-test analysis was performed to determine the test results of the same sample group in the pretest and posttest. **Results:** It was found that there was a statistically significant difference between the pretest and posttest values of the balance anterior right and balance anterior left parameters of the football players in the study ($p<0.05$), while no statistically significant difference was found between the pretest and posttest values of the other parameters ($p>0.05$). While there was a statistically significant difference between the football players' pretest and posttest values of the endurance parameters MAS 400 m HR, MAS 600 m HR, and MAS 1000 m (sec.) ($p<0.05$), there was no statistically significant difference between the pretest and posttest values of the other parameters ($p>0.05$). It was found that there was a statistically significant difference between the pretest and posttest values of the strength parameters hip thrust AD/AB left, hip thrust AD/AB right, hip tightening AD/AB left, right, hip tightening AD/AB right, vertical jump (cm) and flexibility of the football players ($p<0,05$), while no statistically significant difference was found between the pretest and posttest values of the other parameters ($p>0.05$). **Conclusion:** It can be asserted that the athletic performance training applied to the football players during the preparation period contributed positively to their performance parameters such as balance, strength, endurance, jumping, and flexibility. However, in the current study, no statistically significant difference was found between the pretest and posttests of some parameters. Thus, it is thought that it will be important to prioritize proprioception and nordic hamstring trainings when designing training programs for players competing in football or other sports branches during the preparation period in future studies.
Keywords : Football, Elite football player, Preparation period, Athletic performance training

Introduction

Football is considered a versatile sport that includes a number of physical parameters such as speed, endurance and strength, as well as elements such as tactical competence and technical skills. These studies are needed because athletic performance training has a critical importance in the development of game strategies, technical-tactical structure and individual football player abilities, which are considered the basic criteria for increasing the competitive performance of football players.

In today's football, it is observed that in the athletic performance training carried out to increase the sports performance of the players to the highest levels, exercises requiring speed, endurance, strength, flexibility and balance play an important role in the development of football players. In this regard, for success, the player must demonstrate the highest level of sports performance in terms of biomotor characteristics (Zileli and Söyler, 2022). It is said that football players reach very low maximum speed during the competition, but the starting and acceleration phases are thought to have a higher value in their performance.

It is observed that elite football players have higher values in high-intensity running compared to the total distance they cover during the competition. This situation reveals the necessity of studies to increase the strength performance of football players. As a result of these statements, it is deemed appropriate to develop it with the training method applied at maximum speed values. Especially after the end of the season, it can be observed that most football players have performance losses in many parameters such as strength, flexibility and cardiovascular, due to lack of training. For this reason, intense training programs (such as aerobic-anaerobic

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endurance, power, strength, etc.) can generally be applied before the season in order for football players to prepare for the next competition season and to establish a physical basis. Thus, it is said that maximizing these performance parameters during the pre-season preparation period allows football players to successfully maintain repetitive high-intensity movements during competitions (Slimani et al., 2019; Wong et al., 2015). In addition, it is accepted that developing aerobic capacity during this period helps football players to recover quickly from the actions they encounter during competitions and to maintain their physical condition at an optimum level throughout the season (McEwan, et al., 2020). However, while performing actions such as sudden turning, acceleration and deceleration that football players exhibit during competitions, basic movement models, ballistic movements require developed strength of the neuromuscular system and high anaerobic power in order to use the stretch-shortening cycle efficiently.

Previous research has revealed that there are positive correlations between muscle strength and balance ability in football players to both improve performance and prevent injuries. Vertical jump is an integral component of explosive performance. For this reason, it is thought that jumping ability plays a very important role in the realization of athletic skills in football. Vertical jump tests play a very important role in determining the parameters. It is said that vertical jumping, with appropriate training methods, plays a major role in the development of hips, legs, knees and ankles. However, it is said that vertical jump performance depends not only on lower extremity strength, but also on the force production speed of the muscle, contraction speed, degree of contraction and intramuscular coordination (Muehlbauer et al., 2015; Paoli et al., 2012). In line with this information, considering the competitive nature of today's football branch, it can be said that the success of football players does not only depend on factors such as technical-tactical, but also on their high level of athletic performance. For this reason, this study aimed to examine whether athletic performance training applied to elite level football players has an effect on strength, endurance, flexibility, vertical jump and balance, and if so, to determine at what level.

Method

Model of the Study

The study was conducted using one-group pretest-posttest weak experimental design, which is one of the quantitative research approaches. In this method, which is among the various experimental designs, an independent variable is applied to a group and measurements are made before and after the experiment (Cohen et al., 2002; Gay et al., 2012). The difference between pretest and posttest mean values shows the effect of the independent variable on the dependent variable.

Sample Group

The sample group consisted of a total of 27 voluntary professional male football players competing at the Spor Toto Super League level of the Turkish Football Federation. The football players in the study were informed about the tests and training program before the study. Pretests were applied to the football players in the study before the preparation period and posttests were taken after the 6-week training program was applied. In order to determine the VO_{2max} values of the football players, the University of Montreal Track Test protocol was applied on a 400-meter outdoor track in accordance with the recommendations of Leger and Boucher (1989). Before the test, football players were randomly divided into groups via minimization (Altman and Bland, 2005) according to their pre-existing maximal aerobic speed (MAS). The other tests (strength, balance, flexibility, and vertical jump) were taken 48 hours after this test was administered. The football players were given sufficient warm-up time before starting the tests and sufficient recovery time between the tests and between repetitions. The ethical report of the current study was approved by Istanbul Gelisim University Ethics Committee on **29.02.2024 with decision no**: **2024-03-97**.

Data Collection

Body Weight and Height Measurement

Weight was measured using an electronic balance with a precision of 0.1 kg and height was measured using a digital height meter with a precision of 0.01 cm (Zorba, 1999).

Body Mass Index Measurement

The body mass indexes of each football player were calculated according to the formula **Body Weight (kg)/Height^2 (m)** using the data obtained from their height and body weight measurements (Zorba, 1999).

Flexibility Test

The flexibility values of the football players were measured using the sit and reach test. After warming up, they were instructed to lie down as far as possible in a sitting position, without bending their knees. This movement was repeated twice, and the best result was recorded (Çolakoğlu et al., 2014).

Vertical Jump Test

Vertical jump status data of the players were determined by using the Fusion Sport-Smart Jump brand jumping mat. The body position of the players at the time of the test was asked to be in an upright posture with hands on the waist and a downward squat followed immediately by an upward maximal force jump. The time scale was organized in such a way that the players started with the upward jumping action and dropped off on the jumping mat. The time the players spent in the air was recorded as a score by automatically calculating the jump height data thanks to the software in the device used. The vertical jump test was performed by giving the

players 2 trials and 30 seconds as rest time between the trials and the best degree was recorded as a score (Usta, 2019).

Y Balance Test

a) The football players were asked to wear light clothing and remove their shoes. After this step, they were asked to stand on the center platform behind the red line and wait for further instructions. The test was administered in the following order;

1. Right front
2. Left front
3. Right Posteromedial
4. Left Posteromedial
5. Right Posterolateral
6. Left Posterolateral

b) The player was then instructed to place their hands firmly on their hips, slide forward with their right foot as far as possible, and return to the initial upright position.
c) Reaching distances were recorded to the nearest 0.5 cm.
d) They were then asked to repeat this with the same foot for a total of 3 successful reaches.
e) After completing 3 successful moves with the right foot, the player was asked to repeat this process with the left foot.
f) After performing 3 successful reaches with each foot, the football player moved to the next test direction (posteromedial).
g) The tester recorded the reach distance of each trial to calculate the football player's Y balance test composite score (Shaffer et al., 2013).

Failure of the Test:

- The player may not touch his/her foot to the ground before returning to the starting position. If any loss of balance resulted in an unsuccessful trial, football players were allowed to place their feet behind the mid/balance foot box when they returned to the starting position (Shaffer et al., 2013).
- The football player cannot place his/her foot on the reach indicator to get support during the reach; he/she is asked to push the reach indicator using the red target area.
- The football player kept his/her foot in contact with the target indicator until he/she completed the reach. They cannot tap or kick the reach indicator to get a better performance (Shaffer et al., 2013).

Y Balance Test score will be calculated according to the formula below;

Absolute Reach Distance (cm) = (Reach 1 + Reach 2 + Reach 3) / 3 (Shaffer et al., 2013).

Hip Muscle Strength Test (Adductor/Abductor)

A previously validated hand dynamometer (Powertrack II Commander JTECH Medical, Salt Lake City, Utah, USA) was used for muscle strength measurements of the football players. The results of maximum isometric hip abduction and maximum hip adduction measurements were recorded. These tests were applied depending on the study conducted by Thorborg et al., (2011). The football players were asked to hold the edges of the table with their hands and position themselves in the appropriate position. Care was taken to ensure that the lower limb to be tested was in a straight position and the knee and hip of the other non-tested limb were in 90^0 flexion. Practitioner applied resistance to the most prominent point of the lateral mallolus (isometric hip abduction and maximal hip adduction) at a fixed position 8 cm proximal to it, and the football player voluntarily performed maximal contraction against the dynamometer and the tester. The rest period between each 5 sec. trial was 30 sec. The average of the highest amount of strength was taken after 4 individual trials. For hip tightening measurements, the practitioner applied resistance to the most prominent point of the lateral mallolus (maximal eccentric hip adduction and maximal eccentric hip abduction) at a fixed position 8 cm proximal to it and the tested football player was asked to perform an isometric maximal voluntary contraction movement for 3-5 s against the dynamometer and the practitioner. The rest period between each trial was 60 sec. The single test was repeated until a force plateau of less than 5% was reached between two consecutive trials and the average of these values was taken. The magnitude of the applied force was recorded in Newton (Thorborg et al., 2011; Thorborg et al., 2010).

Nordbord Max Force Test

The Nordbord test device was applied to measure maximum unilateral isometric hamstring strength. The football players were asked to perform a quadrupedal stance on the NordBord and securely fix their ankles with the supports on the lateral malleolus. They were asked to place their hands tied behind their necks directly in front of NordBord, on the ground or on the styrofoam platform. Their upper bodies were arranged using various numbers of Styrofoam plates until they were parallel to the ground and the knees were brought to 120° flexion (180° full extension). All participants were instructed to maintain their body position before the test started. The football players, included in the study, were asked to perform a set of 3 maximal isometric leg stretches with 30 s rest between repetitions. From the data obtained, the best left and right maximum absolute values between 3 repetitions were used and calculated by dividing the absolute values in Newton (N) by the body weight in kilograms (kg) (Franchi et al., 2019).

University of Montreal Track Test

In accordance with the recommendations of Leger and Boucher (1989), the test was conducted on a 400-meter grass field track. Safety cones were placed every 50 m of the track so that football players could maintain their running speed during the tests. The 27 football players in the study started to run continuously at a speed of 8 km/h^{-1} with a sound signal emitted from a sound band at certain intervals and the speed was increased by 1 km/h^{-1} every 2 minutes. During the test, the football players were asked to complete the stage on the track as much as possible and the test was terminated when they were 5 m behind the safety cones twice in a row or when they voluntarily did not want to complete the stage. Besides, a telemetric heart rate monitor (polar RS800 Sd, Finland) was used to monitor and record the heart rate of the football players during the runs. The maximal aerobic speed (MAS) of the football players in the study was calculated according to the formula below;

MAS= H +(HZ/120) x HEA)

H: Speed of the last completed stage in km/h^{-1}

HZ: Time spent running during the incomplete stage, in seconds

HEA: Increase in each stage in km/h^{-1}

The 6-Week Training Program for the Football Players

Weeks	Days	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1. Week	morning	(1) Strength Training	Tactical Training	(2) Strength Training	Endurance Running	(3) Strength Training		Permit
	evening	Endurance Running		Tactical Training	Tactical Training	Tactical Training	Field Game 11v11	
2. Week	morning	Tactical Training	(4) Strength Training	Field Game 7v7-6v6	(5) Strength Training	Tactical Training		Permit
	evening		Tactical Training		Tactical Training		Field Game 11v11	
3. Week	morning	Tactical Training	(6) Strength Training	Minimum Rest Sprint Training	(7) Strength Training			Permit
	evening		Tactical Training	Field Game 7v7-6v6	Tactical Training	Tactical Training	Field Game 11v11	
4. Week	morning	Permit	(8) Strength Training	Tactical Training	Maksimum Rest Sprint Training		Minimum Rest Sprint Training	Permit
	evening		Tactical Training	Tactical Training	Field Game 4v4-3v3	Tactical Training	Field Game 7v7-6v6	
5. Week	morning	(9) Strength Training	Maksimum Rest Sprint Training		Permit	Tactical Training	(10) Strength Training	Maksimum Rest Sprint Training
	evening	Tactical Training	Field Game 4v4-3v3	Field Game 11v11			Tactical Training	Field Game 4v4-3v3
6. Week	morning	Tactical Training	Tactical Training	Preparation Competition	Recovery Training for Competition Players	Permit	Tactical Training	Preparation Competition
	evening				Compensatory training for players who played little and no minutes in the competition			

The training program to be applied to the football players was applied as a double training (morning-evening). There were no training sessions during the times indicated in red in the program.

Strength Training Program

Training Content	HR (1)	HR (2)	HR (3)	HR (4)	HR (5)	HR (6)	HR (7)	HR (8)	HR (9)	HR (10)
Hip Dominant	Deadlift	Deadlift	Deadlift	Single Leg Rdl	Single Leg Rdl	Backward Lunge	Backward Lunge	Single Leg Rdl	Single Leg Rdl	Single Leg Rdl
Knee Dominant	Front Squat	Front Squat	Front Squat	Lateral Squat	Lateral Squat	Rear Elevated Split Squat	Rear Elevated Split Squat	One Leg Squat	One Leg Squat	Skater Squat
Upper Vertical Push	Shoulder Press		Shoulder Press		Single Arm Shoulder Press		Single Arm Shoulder Press		Single Arm Shoulder Press	
Upper Vertical Pull	DB Row		DB Row		Single Arm Row		Single Arm Row		Single Arm Row	
Upper Horizontal Push		DB Bench Press		DB Bench Press		DB Bench Press		DB Bench Press		DB Bench Press
Upper Horizontal Pull		Pull UP		Pull UP		Pull UP		Pull UP		Pull UP
Anti Extension	Deadbug Legs	Deadbug Legs		High Plank Arm Forward	High Plank Arm Forward		High Plank Forward Leg Raise	High Plank Forward Leg Raise		
Anti Rotation		Bird Dog	Bird Dog		Medicine Ball Push Up	Medicine Ball Push Up		Medicine Ball Switch Push Up	Medicine Ball Switch Push Up	
Anti Lateral Flexion	Side Plank Up And Down		Side Plank Up And Down	Side Plank Hip Flexor		Side Plank Hip Flexor	Side Plank Leg Raise		Side Plank Leg Raise	Side Plank Cable Pull

The number of strength training sessions (1-10) in the 6-week training program was specified.

HR (1): This indicates the number of strength training sessions performed in the 6-week training program.

Strength training was applied as follows;

Training Method: Superset

Training Type: Functional training

Number of repetitions: 6-8

Number of sets: 3-4

Rest between repetitions: 60 sec

Rest between sets: 3-4 minutes

Implementation: Number of movements performed in 1 strength training: 6

The first 3 training sessions were bilateral and then unilateral lifts were applied.
Load increases in the trainings were performed in the range of 5-10% every 2 trainings.

Statistical Analysis

The data obtained from the study are given as mean and standard deviation. The Shapiro-Wilk test and skewness and kurtosis values were analyzed to determine whether the variables were normally distributed. After the statistical analysis, it was determined that the skewness and kurtosis coefficients of the data were within the range of ±3 and the data were normally distributed. Upon the normal distribution of the data, paired samples t-test analysis was performed to determine the test results of the same sample group in the pretest and posttest. SPSS 24.0 software was used for the statistical analyses applied in the data assessment.

RESULTS

Table 1. Analysis of the descriptive data of the football players in the study

Variables	n	Min.	Max.	X±Sd
Age (year)	27	18.00	36.00	25.56±5.06
Height (cm)	27	168.00	196.00	182.11±8.29
Body Weight (kg)	27	55.00	90.00	77.04±8.77
BMI (kg/m^2)	27	19.49	27.17	23.16±1.42

It was determined that the mean age (year) was 25.56±5.06, the mean height (cm) was 182.11±8.29, the mean body weight (kg) was 77.04±8.77 and the mean BMI (kg/m^2) was 23.16±1.42 (**Table 1**).

Table 2. Analysis of the balance parameter data of the football players

Variables		n	X±Sd	t	p
Balance Anterior Right	pretest	27	55.33±7.10	-3.897	**.001***
	posttest	27	58.33±6.90		
Balance Anterior Left	pretest	27	56.07±6.68	-3.854	**.001***
	posttest	27	59.04±6.67		
Balance Posterolateral Right	pretest	27	109.26±7.48	.354	.726
	posttest	27	108.70±6.82		
Balance Posterolateral Left	pretest	27	109.30±7.81	.823	.418
	posttest	27	108.00±6.77		
Balance Posteromedial Right	pretest	27	109.89±7.32	-.967	.342
	posttest	27	110.93±7.17		
Balance Posteromedial Left	pretest	27	110.30±6.14	-1.762	.089
	posttest	27	112.22±6.55		

When **Table 2** was examined, it was found that there was a statistically significant difference between the pretest and posttest values of the balance anterior right and balance anterior left parameters of the football players ($p<0.05$), while there was no statistically significant difference between the pretest and posttest values of the other parameters ($p>0.05$).

Table 3. Analysis of the endurance parameter data of the football players

Variables		n	X±Sd	t	p
MAS Baseline Heart Rate	pretest	27	122.59±15.94	1.966	.060
	posttest	27	118.15±11.41		
MAS 200 m Heart Rate	pretest	27	173.85±9.25	1.712	.099
	posttest	27	170.33±9.45		
MAS 400 m Heart Rate	pretest	27	180.52±7.99	2.507	**.019***
	posttest	27	175.48±10.28		
MAS 600 m Heart Rate	pretest	27	182.96±7.95	2.083	**.047***
	posttest	27	179.70±8.79		
MAS 800 m Heart Rate	pretest	27	184.15±8.37	1.970	.060
	posttest	27	180.96±8.95		
MAS 1000 m Heart Rate	pretest	27	185.11±8.56	1.390	.176
	posttest	27	183.00±8.53		
MAS Max. Heart Rate	pretest	27	187.52±8.48	-.347	.731
	posttest	27	188.04±8.11		
MAS 1000 m Completion time (sec.)	pretest	27	217.37±14.51	2.738	**.011***
	posttest	27	209.11±11.53		

There was a statistically significant difference between the pretest and posttest values of the MAS 400 m HR, MAS 600 m HR and MAS 1000 m (sec.) parameters ($p<0.05$), while no statistically significant difference was found between the pretest and posttest values of the other parameters ($p>0.05$) (Table 3).

Table 4. Analysis of the strength, vertical jump and flexibility parameters of the football players

Variables		n	X±Sd	t	p
Hip Thrust AD/AB left	pretest	27	413.70±55.27	-3.941	**.001***
	posttest	27	435.26±64.73		
Hip Thrust AD/AB Right	pretest	27	410.15±56.77	-5.288	**.000****
	posttest	27	431.89±61.03		
Hip Tightening AD/AB Left	pretest	27	386.52±82.20	-3.217	**.003***
	posttest	27	413.85±78.89		
Hip Tightening AD/AB Right	pretest	27	396.15±85.92	-4.104	**.000****
	posttest	27	429.52±88.38		
NORTBORD Max. Force Left	pretest	27	421.96±69.35	1.204	.239
	posttest	27	409.63±71.95		
NORTBORD Max. Force Right	pretest	27	458.37±117.18	.540	.594
	posttest	27	447.04±109.91		
Vertical Jump (cm)	pretest	27	39.26±5.61	-5.610	**.000****
	posttest	27	41.57±5.59		
Flexibility (cm)	pretest	27	30.56±8.36	-3.886	**.001***
	posttest	27	33.15±8.41		

Table 4 shows that there was a statistically significant difference between the pretest and posttest values of hip thrust AD/AB left, hip thrust AD/AB right, hip tightening AD/AB left, right, hip tightening AD/AB right, vertical jump (cm) and flexibility parameters of the football players ($p<0.05$), while no statistically significant difference was found between the pretest and posttest values of the other parameters ($p>0.05$).

Discussion and Conclusion

Considering the competitive structure of today's football branch, it can be said that the success of football players depends not only on factors such as technical-tactical, but also on their athletic performance levels. Thus, the present study was conducted to investigate the effects of athletic performance training on strength, endurance, flexibility, vertical jump and balance parameters of elite level football players.

In the present study, it was determined that while there was a statistically significant difference between the pretest and posttest values of the balance anterior right and balance anterior left parameters of the football players ($p<0.05$), there was no statistically significant difference between the pretest and posttest values of the other parameters ($p>0.05$).

When the studies in the literature were examined, Aloui et al., (2021) investigated the effect of different training methods on athletic performance in male football players. As a result of the study, they found that there was a statistically significant difference between the balance parameter pretest and posttest values of the football players ($p<0.05$). In another study, Navarro-Santana et al., (2020) investigated the effects of two different training programs applied for amateur male football players and found that there was a statistically significant difference in the dynamic balance parameters pretest and posttest values of the football players ($p<0.05$). In another study conducted in football players, Yoka et al., (2021) concluded that there was a statistically significant difference between the balance parameter pretest and posttest values of football players as a result of the core training program they applied with a pilates ball ($p<0.05$). The results of some studies in the literature support the present study. When the studies reporting different results with the current study are examined, Hammami et al., (2020) did not find a statistically significant difference in the balance parameter of football players after the loaded and unloaded plyometric training program they applied in elite young football players ($p>0.05$). The results of the said study are compatible with the present study. This situation is thought to be caused by the content of the training program. In another study, Deniz (2019) found no statistically significant difference between the pretest and posttest values of the right-left foot anterior, right-left foot posteromedial, and right-left foot posterolateral parameters of female football players as a result of 6-week functional dynamic balance training ($p>0.05$). This study differs from the results of the current study. This difference is thought to be caused by the gender variable.

In the present study, there was a statistically significant difference between the pretest and posttest values of the MAS 400 m heart rate, MAS 600 m heart rate, and MAS 1000 m completion time parameters of the football players ($p<0.05$); whereas, there was no statistically significant difference between the pretest and posttest values of the other parameters ($p>0.05$).

According to the studies in the literature, Michaelides et al., (2021) found that there was a statistically significant difference between the pretest and posttest values of aerobic endurance parameters of professional male football players as a result of endurance training applied to them in the preseason period ($p<0.05$). In another study, Bahtra et al., (2023) concluded that there was a statistically significant difference between the aerobic endurance parameter pretest and posttest values of football players as a result of the small field games they applied in football players ($p<0.05$). Turna et al., (2022) found a statistically significant difference between the pretest and posttest values of aerobic and anaerobic endurance parameters of elite football players after the eight-week training program ($p<0.05$). In a doctoral thesis study conducted in female football players during the

preparation period, Aksoy (2023) found that there was a statistically significant difference between the aerobic and anaerobic pretest and posttest values of female football players as a result of high-intensity endurance training based on running ($p<0.05$). Ergün et al., (2019) found statistically significant differences between the pretest and posttest values of aerobic and anaerobic endurance parameters of football players as a result of the eight-week training program ($p<0.05$). When the results of some studies in the literature are reviewed, it is seen that they support the results of the present study.

When other studies that differ with the current study are examined, in their study with university students Helgerud et al., (2023) found no statistically significant difference between the pretest and posttest values of the aerobic endurance parameter of the participants as a result of endurance training based on running determined according to their maximal aerobic speed ($p>0.05$). When the result of the said study was evaluated, it was found that it was not similar to the result of the current study. It is believed that this situation arises from the fact that the football players in the present study compete at elite level. Kelly et al., (2018) found no statistically significant difference between the pretest and posttest values of aerobic endurance parameters of Gaelic male football players as a result of the endurance training. As can be seen, the study contradicts the results of the current study. It is interpreted that the reason for this contradiction is that the content of Gaelic football branch is different from the normal football branch and that they are in the competition period.

The present study revealed that while there was a statistically significant difference between the pretest and posttest values of hip thrust ad/ab right and left, hip tightening ad/ab right and left parameters of football players ($p<0.05$), there was no statistically significant difference between the pretest and posttest values of nordbord max. force right and left parameters ($p>0.05$).

When the studies supporting the results of the current study are examined in the literature, Gonzalez-Garcia et al., (2019) applied a seven-week hip thrust training program in female football players. According to the results of the study, a statistically significant difference was found between the pretest and posttest data ($p<0.05$). In another study, Delgado (2017) found a statistically significant difference between the pretest and posttest data of the hip thrust parameter of lower limb strength training in his doctoral thesis study in the players who regularly performed different strength trainings ($p<0.05$). Abade et al., (2021) found that there was a statistically significant difference between the pretest and posttest data of lower limb strength and hip thrust parameters as a result of the strength training they applied in elite young football players ($p<0.05$). As a result of a systematic and meta-analysis study conducted on another parameter, Bautista et al., (2021) concluded that there was no statistically significant difference between Nordic hamstring trainings on eccentric strength in elite football players. The results of some studies are compatible with the results of the present study.

On the other hand, when the studies that do not support the results of this study are examined, Oliveira et al., (2020) found that there was a statistically significant difference between the eccentric strength pretest and posttest values of the football players after Nordic Hamstring trainings applied to them during the preparation period ($p<0.05$). As can be seen, the research does not support the current study. This situation suggests that the training programs of the football players in both studies were different. Amundsen et al.,(2022) examined the effects of high and low volume nordic hamstring trainings on female football players during the preparation period. According to the results of the Nordbord tests, they concluded that there was a statistically significant difference between the pretest and posttest results of the eccentric forces of both groups. When the results of the said study are evaluated, it is seen that they differ from the present study. This difference may have been associated with the relationship between volume, frequency, and intensity in the training programs.

In the current study, a statistically significant difference was found between the pretest and posttest values of vertical jump parameter of the football players ($p<0.05$).

In the literature, Doğan et al., (2016) investigated the effect of eight-week core training on some physical and physiological parameters in male football players. As a result of the study, it was found that there was a statistically significant difference between the vertical jump parameter pretest and posttest values of the football players ($p<0.05$). In another study, Atli (2021) investigated the effect of core training program applied to football players on some performance parameters and found that there was a statistically significant difference in the vertical jump pretest and posttest values of the football players ($p<0.05$). In another study supporting the result of this study, Lohan et al. (2015) found that there was a statistically significant difference in the pretest and posttest values of the vertical jump parameter of the football players as a result of the training program applied to the football players in the preseason preparation period ($p<0.05$).

Furthermore, Ergün et al., (2019) investigated the effect of preparation period training on some motoric parameters in football players. As a result of the research, it was found that there was a statistically significant difference between the vertical jump parameter pretest and posttest values of the football players ($p<0.05$). However, in a study conducted in a different branch (basketball), Bouteraa (2018) found that there was no statistically significant difference between the pretest and posttest values of the jump parameter of strength training. It can be stated that this may be caused by various factors (training load, exercise selection, etc.). In a different study, Mazurek et al., (2018) found that there was no statistically significant difference on the vertical jump parameter of short-term plyometric training applied during the preparation period in male handball players. The reason for this result to be different from the results of the current study is that the training program was not applied with sufficient intensity.

In the current study, a statistically significant difference was found between the pretest and posttest values of flexibility parameter of the football players ($p<0.05$).

In the literature, Ergün et al., (2019) investigated the effect of preparation period training on some motoric parameters in football players. As a result of their study, they found a statistically significant difference between the flexibility parameter pretest and posttest values of the football players ($p<0.05$). In another study, Lohan et al., (2015) investigated the effect of eight-week preseason training on the physical and physiological characteristics of football players and found that there was no statistically significant difference in the pretest and posttest values of the flexibility parameter ($p>0.05$). While it is concluded that some studies in the literature support the present study, there are also some studies supporting the present study.

Gürkan et al., (2023) found that there was no significant difference between the pretest and posttest values of the flexibility parameter as a result of the six-week tabata training program applied to female football players ($p>0.05$). As it was determined, while the training program applied to female football players in the said study was thought to improve endurance, the different content of the training program does not support the result of the current study. In another study, Delvaux et al., (2020) found that there was no significant difference between the pretest and posttest values of the flexibility parameter after a six-week eccentric training program applied to amateur players ($p>0.05$). The results of some studies in the literature do not support the results of the present study. The reason for not supporting this result is thought to arise the diversity of player characteristics and from the fact that the athletes are involved in different branches.

In conclusion; When the balance parameters in the study were examined, there was a statistically positive difference in the right and left frontal balance scores. This can be explained as the moves made by the football players during the competition are generally caused by moves forward to the right or left. Especially in the training of football players, the fact that their actions are similar in forward-right-left direction during sudden changes of direction supports the result. While it was seen that the trainings made a positive contribution to the endurance parameter, there were statistically positive differences, especially in the MAS (400 and 600 m) parameters. In this case, it can be stated that the training program applied to football players affects the middle distance endurance parameters, and that it provides support especially in situations where the structure of the training program and the movements in the competition require continuity. When we examined the power parameter, a significant positive difference was found in both lower legs as a result of the hip thrust and hip tightening tests. It has been determined that the studies carried out on our other two parameters, vertical jump and flexibility, have a positive impact on the development result. However, when the balance (posteriolateral and posteriomedial right-left) and Nordboard strength test results in our study were evaluated, no statistically significant difference was found. We can interpret this as the fact that although the training performed during the preparation period showed improvement in the right and left balance frontal balance parameters, they did not have a sufficient effect. In the Nordbord parameter, it can be said that the hamstring muscle of athletes affects performance in many factors. Therefore, although there was improvement in the hamstring muscle during the preparation period, no statistically significant difference was detected. For this reason, it is thought that giving a separate place to promotion and nordic hamstring exercises when designing a training program for athletes competing in football or other sports during the preparation period in future research will make a significant contribution to athletic performance experts and sports science.

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