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INVESTIGATION OF THE EFFECTS OF CORE EXERCISES ON PHYSICAL PERFORMANCE: A CASE STUDY OF MALE FOOTBALL PLAYERS AGED 11-12

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Öz: This study aimed to investigate the effects of core exercises applied to male footballer children aged 11-12 on their physical performance variables. Prior to the study, participants were randomly assigned to two groups: core group (n:10) and control group (n:10). In addition to their regular football technical training, the core group performed core exercises twice a week for 8 weeks. The control group, on the other hand, continued with their routine training twice a week for the same period. Before and after the study period, all participants underwent Illinois Agility Test, Vertical Jump Test, Squat Jump Test, Hand Grip Strength Test, Sit and Reach Flexibility Test, 20-Meter Sprint Test, Medicine Ball Throw Test, and Standing Long Jump Test. Data were analyzed using SPSS 25 (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test was conducted to assess the normality of the data, and it was determined that the data did not follow a normal distribution. As a result, within-group comparisons were analyzed using the Wilcoxon Signed-Rank Test, and between-group comparisons were conducted using the Mann-Whitney U test. Statistical significance was set at $p<0.05$. Based on the findings, in the within-group comparison, a statistically significant improvement ($p<0.05$) was observed in all parameters except for the standing long jump test in the core group. Additionally, participants in the core group showed higher rates of improvement compared to those in the control group. In conclusion, regular core exercises implemented twice a week over 8 weeks contributed to the physical performance development of 11-12-year-old footballer children.

Key Words: Football, children, core exercises, physical performance tests

CORE EGZERSİZLERİNİN FİZİKSEL PERFORMANS ÜZERİNE OLAN ETKİLERİNİN ARAŞTIRILMASI: 11-12 YAŞ GRUBU ERKEK FUTBOLCULAR ÖRNEĞİ

Abstract: Bu çalışma, 11-12 yaş grubu erkek futbolcu çocuklara uygulanan core egzersizlerinin çocukların fiziksel performans değişkenleri üzerine olan etkilerini araştırmak amacıyla yapılmıştır. Çalışma öncesinde katılımcılar rastgele core grubu (n:10) ve kontrol grubu (n:10) olmak üzere iki farklı gruba ayrılmışlardır. Core grubuna kendi teknik futbol antrenmanlarına ek olarak, 8 hafta boyunca haftada 2 gün core egzersizleri uygulatılmıştır. Kontrol grubu ise, 8 hafta boyunca haftada 2 gün rutin antrenmanlarına devam etmişlerdir. Çalışmanın öncesinde ve 8 haftanın sonunda tüm katılımcılara illinois çeviklik testi, dikey sıçrama testi, squat sıçrama testi, el kavrama kuvvet testi, otur-eriş esneklik testi, 20 metre sürat testi, sağlık topu fırlatma testi ve durarak uzun atlama testi uygulatılmıştır. Verilerin analizlerinde SPSS 25 paket programı (SPSS Inc., Chicago, IL, USA) kullanılmıştır. Verilerin normal dağılım gösterip göstermediğini saptamak için Shapiro-Wilk normallik testi yapılmış ve verilerin normal dağılıma uygun olmadığı tespit edilmiştir. Bunun sonucunda grup içi karşılaştırmalarda Wilcoxon Eşleştirilmiş İki Örnek Testi, gruplar arası karşılaştırmalarda da Mann- Whitney U testi uygulanmıştır. Verilerin istatistiksel anlamlılık düzeyi $p<0.05$ olarak belirlenmiştir. Elde edilen bulgulara bakıldığında, grup içi karşılaştırmada, core grubunda durarak uzun atlama testi dışındaki tüm parametrelerde istatistiksel olarak anlamlı gelişme ($p<0.05$) tespit edilmiştir. Ayrıca core grubundaki katılımcıların son testteki gelişim oranlarının, kontrol grubundaki katılımcıların gelişim oranlarından daha yüksek olduğu belirlenmiştir. Sonuç olarak, 8 hafta boyunca haftada 2 gün 11-12 yaş grubu futbolcu çocuklara düzenli olarak uygulatılan temel core egzersizlerinin çocukların fiziksel performans gelişimlerine katkı sağladığı tespit edilmiştir.

Anahtar Kelimeler: Futbol, çocuklar, core egzersizleri, fiziksel performans testleri

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INTRODUCTION

Cultures, geographical conditions, lifestyles, and genetics of countries influence the sports followed and practiced in those regions. Despite each country having its own sports structure, football stands out compared to other sports. Due to its high participation and viewership levels across genders and all levels, football is the most popular sport worldwide. Interest and participation in football continue to grow steadily. One of the reasons for its popularity is the comprehensive physical and physiological demands that distinguish football from other sports (Gücük & Aydoğmuş, 2023; Luo et al., 2022). Performance in football is influenced by technical, tactical, physical, physiological, and mental aspects. Researchers also highlight physical factors as crucial for success in football. Alongside fundamental skills, optimal physical fitness is essential for football players (Gabett, 2007). To achieve optimal performance, motor skill development needs to be carefully planned alongside basic skills (Yaraş & Harmancı, 2022). Improving physical fitness and strength enables players to perform movements such as turns, speed, acceleration, deceleration, and jumps more effectively. Researchers emphasize the enhancement of strength, speed, endurance, and agility alongside technical and tactical aspects to improve football performance (Atlı, 2021). Increasing competition in modern football necessitates the absolute improvement of these athletic performance characteristics and has led to a focus on alternative motor skill development methods (Wang, 2022).

Core exercises are one such method used today and play a critical role in athletic performance development (Dinç & Ergin, 2019). The term "core" originates from English and refers to the central region of the body in Turkish. Anatomically, it includes the abdominal area, paraspinal muscles, hip muscles, diaphragm, pelvic floor, and hip girdle muscles (Granacher et al., 2014). The collective role of these muscles is to facilitate high-level movements, stability, and the transfer of power and strength between the upper and lower extremities (Handzel, 2003).

Core training involves exercises specifically targeting muscles relevant to football, contributing to athletic performance and technical football training (İri et al., 2021). These exercises can be performed using body weight or various equipment on the field (Sucan et al., 2022). Due to their involvement in power transfer movements between the field and upper and lower extremities, core exercises are crucial for football performance development. They aim to enhance agility-requiring movements such as shooting, change of direction, and sudden movements within football gameplay (Adıgüzel, 2018). Core training contributes to the strength development of football players. It is anticipated that the increased strength in footballers due to core training will also enhance their speed performance. There is a growing interest in core training nowadays because it helps mitigate the negative effects of injuries and physical stress that may occur during competition and training sessions. Additionally, core training is crucial not only for enhancing physical performance in footballers but also for protecting them from injuries (Afyon ve Boyacı, 2016). In professional soccer (Etxaleku et al., 2020; Kachanathu et al., 2014; Shinkle et al., 2012), amateur soccer (Afyon et al., 2017; Anant and Venugopal, 2021; Belli et al., 2022; Erdem and Akyüz, 2017; Pancar, 2023), and various other sports (Arslan and Ergin, 2022; Chok, 2020; Dehnou et al., 2020; Karpiński et al., 2020; Manchado et al., 2017; Sannicandro et al., 2020), despite numerous studies conducted on core training, In the national literature, studies that include fundamental core exercises (basic movements and low-load components) performed twice a week for 8 weeks, along with the Eurofit test battery, on youth football players aged 11-12 are observed to be quite limited.
Based on this information, this study was conducted to investigate the effects of core exercises applied to male footballer children aged 11-12 on their physical performance variables.

MATERIALS and METHODS

Research Group

Twenty male children actively playing football for at least one year in the youth academy of a football club located in Yozgat province volunteered to participate in the study (mean age: 11,70±0,47 years; mean height: 1,35±0,72 m; mean body weight: 36,66±7,77 kg) Prior to the study, the participants were randomly divided into two different groups: a core group (n:10) and a control group (n:10). In this study conducted during the 2023-24 season, the core group performed core exercises twice a week for 8 weeks in addition to their regular technical football training sessions. The control group continued their regular technical football training twice a week for 8 weeks. Before and after the study period, all participants underwent Illinois Agility Test, Vertical Jump Test, Squat Jump Test, Hand Grip Strength Test, Sit and Reach Flexibility Test, 20-Meter Sprint Test, Medicine Ball Throw Test, and Standing Long Jump Test.

Study Design

Prior to the study, participants and their families were extensively informed about the measurements and potential risks involved. Children were not subjected to training sessions on the day of testing, and they were advised against consuming stimulant foods and beverages such as caffeine. Participants were encouraged to get adequate sleep, arrive rested, and wear suitable sports attire for the tests. Furthermore, before measurements, it was ensured that the children were in good health condition without any impediments to participating in the tests. Pre-test and post-test measurements of the study were conducted at the same hours on an outdoor football field (artificial turf) located approximately 1300 meters above sea level. On the same day, anthropometric tests were conducted first, followed by physical performance tests with adequate rest intervals provided between tests. Each test was performed twice, and the highest value was considered for analysis.

Ethics of Research

Ethical approval for this study was obtained from the Ethics Committee of Bozok University, Yozgat, with decision number 222163 and protocol number 14/24, during its meeting on 22/05/2024.

CORE Group Training Program

Table 1. Experimental group (CORE group) training program

Parameter	Description
Participants	Youth football players (Experimental Group)
Training Frequency	2 sessions per week
Program Duration	8 weeks
Timing of Core Exercises	Immediately after warm-up, before main technical session
Technical Training	Fundamental football-specific technical drills after core exercises
Total Core Exercises	10 exercises
Exercises Used	Medicine ball side twists, sit-ups, scissors, reverse crunches, planks, squats, lunges, bicycle crunches, mountain climbers, side bridges
Load Type	Bodyweight exercises
Supervision	Conducted and supervised by expert trainers
Form Emphasis	Focus on correct technique during execution

Table 2. Core group loading elements

Weeks	Set x Time (Loading)	Rest Between Exercises	Rest Between Sets	Notes
Weeks 1-4	3 sets x 20 sec loading	10 sec	3-4 minutes	Introductory phase
Weeks 5-8	3 sets x 40 sec loading	20 sec	3-4 minutes	Increased intensity phase

Control Group

The control group participated in basic football training sessions tailored for youth groups by team coaches twice a week for 8 weeks. These sessions focused on fundamental football skills including passing techniques, shooting techniques, dribbling skills, and combined football techniques. Only technical training sessions were conducted during this period.

Data Collection

Illinois Agility Test (sec): This test was set up on artificial turf with dimensions of 5 meters wide, 10 meters long, and a middle section of 3.3 meters (Hazır et al., 2010). The Illinois Agility Test consists of running 40 meters straight, with 180-degree turns every 10 meters, and slalom running between cones placed 20 meters apart. Measurements were taken using a Casio brand handheld chronometer with 1/100-second precision. The measurements were carried out by the same individuals. A total of three people simultaneously recorded the participants' speed measurements, and the calculations were made using the averages of these recordings.

Vertical Jump Test (cm): The "Countermovement Jump" test was conducted using the My Jump 2 iOS application. Participants' jump videos were recorded using the 240 Hz high-speed video feature of an iPhone 7 (Karaman et al., 2019).

Squat Jump Test (cm): The My Jump 2 mobile application was used to record participants performing squat jumps. Participants were instructed to position themselves with hands on hips, knees at a 90-degree angle, and to jump upwards with maximum force without a preparatory movement. The recorded video footage was used to determine the points of take-off and landing after the jump, and values were calculated using the mobile application (Arazoğlu, 2022).

Hand Grip Strength Test (kg): Hand grip strength of the football school students was measured using a Takkei (Japan) brand hand dynamometer. Measurements were taken for both hands (right and left) while participants stood upright, with instructions not to bend or bring the measured arm closer to the body during measurement (Zorba and Saygın, 2009).

Sit and Reach Flexibility Test (cm): A sit and reach box measuring 32 cm in height and 35 cm in length was used to measure participants flexibility. Children were instructed to sit on the floor without shoes, position their feet flat against the testing box, and extend their bodies forward without bending their knees, pushing a ruler as far forward as possible, and holding the furthest point for 2 seconds (Hazar and Taşmektepligil, 2008).

20-Meter Sprint Test (sec): Participants were instructed to sprint 20 meters at maximal speed from a predetermined starting point. Timing was conducted using the My Sprint iOS application, and sprint times were recorded in seconds (s). The My Sprint iOS application has high validity and reliability (Romero-Franco at al., 2017).

Health Ball Throwing Test (meters): Participants positioned themselves facing away from the throwing direction, holding a ball with both hands, slightly bending their knees, and rapidly extending their bodies to throw the ball backward with both arms. The throwing angle for the children was set at 30 degrees, and if they crossed the designated line or fell backward after the

throw, the throw was repeated. A 2 kg medicine ball was used due to the young age group in the health ball throwing test.

Standing Long Jump Test (cm): Measurements were taken using the My Jump 2 iOS application. Participants were instructed to stand behind the starting line with their toes, assume a squat position, and jump forward with both feet. The distance between the point reached by the participants during the jump and the starting line was recorded in centimeters (cm) (Haynes et al., 2019).

Data Analysis

SPSS 25 software package (SPSS Inc., Chicago, IL, USA) was used for data analysis. Descriptive statistics were presented as mean, percentage, and standard deviation. To determine whether the data followed a normal distribution, the Shapiro-Wilk normality test was conducted, revealing that the data were not normally distributed. Consequently, for within-group comparisons, the Wilcoxon Signed-Rank Test was employed, and for between-group comparisons, the Mann-Whitney U test was used. A statistical significance level of $p<0.05$ was considered. The findings were presented in tables and subsequently interpreted.

FINDINGS

The findings obtained within the scope of the research have been presented in this section in the form of tables.

Table 3. Comparison of pre-test and post-test parameters of participants in the experimental group

Variables		n	X±SD	Z	p	%
Illinois Agility Test (sec)	Pre-test	10	21,27±1,66	-2,803	0,005*	-7,80
	Post-test	10	19,61±1,74			
Vertical Jump Test (cm)	Pre-test	10	19,11±4,18	-2,803	0,005*	14,96
	Post-test	10	21,97±4,04			
Squat Jump Test (cm)	Pre-test	10	24,29±4,67	-2,803	0,005*	11,98
	Post-test	10	27,20±5,08			
Hand Grip Test (right hand) (kg)	Pre-test	10	10,82±1,60	-2,803	0,005*	63,67
	Post-test	10	17,71±3,66			
Hand Grip Test (left hand) (kg)	Pre-test	10	10,44±0,95	-2,803	0,005*	55,65
	Post-test	10	16,25±3,43			
Sit and Reach Flexibility Test (cm)	Pre-test	10	27,40±4,03	-2,803	0,005*	10,76
	Post-test	10	30,35±4,59			
20-meter Sprint Test (sec)	Pre-test	10	4,29±0,25	-2,803	0,005*	-10,02
	Post-test	10	3,86±0,29			
Health Ball Throw Test (m)	Pre-test	10	4,14±0,74	-2,814	0,005*	22,22
	Post-test	10	5,06±0,85			
Standing Long Jump Test (cm)	Pre-test	10	111,55±18,56	-1,784	0,074	3,63
	Post-test	10	115,61±16,03			

*$p<0.05$

When examining the averages of pre-test and post-test variables for participants in the experimental group, improvement has been observed in all parameters following 8 weeks of core training. Additionally, statistically significant differences in favor of post-tests have been found in all parameters except for the standing long jump test (Table 3).

Table 4. Comparison of pre-test and post-test parameters of participants in the control group

Variables		n	X±SD	Z	p	%
Illinois Agility Test (sec)	Pre-test	10	20,96±1,08	-,816	0,415	-0,42
	Post-test	10	20,87±1,10			
Vertical Jump Test (cm)	Pre-test	10	21,08±3,06	-2,803	0,005*	2,89
	Post-test	10	21,69±3,11			
Squat Jump Test (cm)	Pre-test	10	21,63±4,67	-2,803	0,005*	3,05
	Post-test	10	22,29±4,80			
Hand Grip Test (right hand) (kg)	Pre-test	10	11,07±2,04	-2,803	0,005*	8,76
	Post-test	10	12,04±1,85			
Hand Grip Test (left hand) (kg)	Pre-test	10	10,68±1,62	-2,807	0,005*	5,52
	Post-test	10	11,27±1,67			
Sit and Reach Flexibility Test (cm)	Pre-test	10	23,60±7,61	-2,719	0,007*	3,17
	Post-test	10	24,35±7,70			
20-meter Sprint Test (sec)	Pre-test	10	4,53±0,31	-,204	0,838	-0,22
	Post-test	10	4,52±0,45			
Health Ball Throw Test (m)	Pre-test	10	3,45±0,99	-2,831	0,005*	11,88
	Post-test	10	3,86±0,87			
Standing Long Jump Test (cm)	Pre-test	10	92,81±10,59	-1,886	0,059	0,62
	Post-test	10	93,39±10,93			

*p<0.05

When comparing the pre-test and post-test values of participants in the control group, improvement has been observed in all variables. Additionally, statistically significant differences have been found in all parameters except for the illinois agility test and standing long jump test. While participants in the control group showed improvement in post-test variables, this improvement was not at a higher percentage increase compared to the post-test improvement levels of participants in the experimental group as shown in Table 3 (Table 4).

Table 5. Comparison of pre-test variables between participants in the experimental and control groups

Variables		n	X±SD	Z	p	%
Illinois Agility Test (sec)	Exp. Pre-test	10	21,27±1,66	-0,265	0,791	-1,45
	Con. Pre-test	10	20,96±1,08			
Vertical Jump Test (cm)	Exp. Pre-test	10	19,11±4,18	-1,058	0,290	10,30
	Con. Pre-test	10	21,08±3,06			
Squat Jump Test (cm)	Exp. Pre-test	10	24,29±4,67	-1,436	0,151	-10,95
	Con. Pre-test	10	21,63±4,67			
Hand Grip Test (right hand) (kg)	Exp. Pre-test	10	10,82±1,60	-0,114	0,909	2,31
	Con. Pre-test	10	11,07±2,04			
Hand Grip Test (left hand) (kg)	Exp. Pre-test	10	10,44±0,95	-0,152	0,880	2,29
	Con. Pre-test	10	10,68±1,62			
Sit and Reach Flexibility Test (cm)	Exp. Pre-test	10	27,40±4,03	-1,629	0,103	-13,86
	Con. Pre-test	10	23,60±7,61			
20-meter Sprint Test (sec)	Exp. Pre-test	10	4,29±0,25	-2,080	0,037*	5,59
	Con. Pre-test	10	4,53±0,31			
Health Ball Throw Test (m)	Exp. Pre-test	10	4,14±0,74	-1,631	0,103	-16,66
	Con. Pre-test	10	3,45±0,99			
Standing Long Jump Test (cm)	Exp. Pre-test	10	111,55±18,56	-2,419	0,016*	-16,79
	Con. Pre-test	10	92,81±10,59			

*p<0.05

When comparing the pre-tests of participants in the experimental and control groups, statistically significant differences have not been found between the two groups except for the 20-meter sprint test and standing long jump test (Table 5).

Table 6. Comparison of post-test variables between participants in the experimental and control groups

Variables		n	X±SD	Z	p	
Illinois Agility Test (sec)	Exp. Post-test	10	19,61±1,74	-1,587	0,112	6,42
	Con. Post-test	10	20,87±1,10			
Vertical Jump Test (cm)	Exp. Post-test	10	21,97±4,04	-0,151	0,880	-1,27
	Con. Post-test	10	21,69±3,11			
Squat Jump Test (cm)	Exp. Post-test	10	27,20±5,08	-1,965	0,049*	-18,05
	Con. Post-test	10	22,29±4,80			
Hand Grip Test (right hand) (kg)	Exp. Post-test	10	17,71±3,66	-3,253	0,001*	-32,01
	Con. Post-test	10	12,04±1,85			
Hand Grip Test (left hand) (kg)	Exp. Post-test	10	16,25±3,43	-3,408	0,001*	-30,64
	Con. Post-test	10	11,27±1,67			
Sit and Reach Flexibility Test (cm)	Exp. Post-test	10	30,35±4,59	-2,081	0,037*	-19,76
	Con. Post-test	10	24,35±7,70			
20-meter Sprint Test (sec)	Exp. Post-test	10	3,86±0,29	-3,480	0,001*	17,09
	Con. Post-test	10	4,52±0,45			
Health Ball Throw Test (m)	Exp. Post-test	10	5,06±0,85	-2,648	0,008*	-23,71
	Con. Post-test	10	3,86±0,87			
Standing Long Jump Test (cm)	Exp. Post-test	10	115,61±16,03	-3,250	0,001*	-19,21
	Con. Post-test	10	93,39±10,93			

*p<0.05

When looking at the post-test values of participants in the experimental and control groups, statistically significant differences in favor of the experimental group have been found in all parameters except for the Illinois Agility and Vertical Jump tests. Compared to the findings in Table 3, it has been determined that the improvement rates of participants in the experimental group following core training, as shown in Table 4, are higher than those of participants in the control group (Table 6).

DISCUSSION

This study aimed to investigate the effects of core exercises applied to 11-12-year-old male soccer players on their physical performance variables. When comparing the pre-test and post-test values of participants in the experimental and control groups, improvement was observed in the Illinois Agility Test, Vertical Jump Test, Squat Jump Test, right-hand grip strength test, left-hand grip strength test, sit-and-reach flexibility test, 20-meter sprint test, medicine ball throw test, and standing long jump test (all variables). Additionally, statistically significant differences in favor of the post-tests were found in all parameters except for the standing long jump test in the experimental group, and in all parameters except for the Illinois Agility Test, 20-meter sprint test, and standing long jump test in the control group ($p<0.05$). These improvements in both groups do not provide sufficient information regarding the effect of core training, but in terms of percentage improvement, it was concluded that the percentage improvements in all parameters in the experimental group's post-tests were higher than those in the control group (Tables 3 and 4). Upon reviewing studies in the literature, the number of studies on core exercises in our field is quite limited. In this context, this section was discussed based on sources close to our study.

In a study where 11-13-year-old male soccer children were subjected to core exercises with a pre-test-post-test design twice a week for 10 weeks (Boyacı and Bıyıklı, 2018), statistically significant improvements were found in the Vertical Jump Test, 20-meter sprint test, and standing long jump test in the experimental group ($p<0.05$), while no statistically significant difference was found in these variables between the pre-test and post-test values in the control group ($p>0.05$). In another study involving 8-10-year-old male soccer children who underwent core exercises three times a week for 8 weeks (Tan and Çolak, 2021), statistically significant improvements were observed in vertical jump, sit-and-reach flexibility, and standing long jump test values ($p<0.05$). In another study on young soccer players (Mahmoud, 2018), athletes were subjected to core exercises twice a week for 10 weeks. Significant improvements were observed in vertical jump, standing long jump, medicine ball throw, 30-meter sprint, and shuttle run agility tests after 10 weeks ($p<0.05$). In another study conducted on amateur male soccer players aged 18-30 attending physical education and sports high school (Doğan et al., 2016), athletes in the experimental group underwent core training exercises twice a week for 8 weeks. When comparing the pre-test and post-test results of athletes in the experimental group, statistically significant improvements were observed in body mass index, body weight, body fat percentage, flexibility test, vertical jump test, leg and back strength test, maxVO2 test, and 20-meter sprint test (all parameters) after 8 weeks ($p<0.05$). When comparing the pre-test and post-test values of the control group, no statistically significant difference was found in body fat percentage, flexibility test, maxVO2 test, and 20-meter sprint test ($p>0.05$). In a study conducted on football players aged 10-12, it was found that core exercises improved both their football-specific skills and motor performance (Başkaya et al., 2023). In another study investigating the effects of core strength training on the agility, anaerobic power, and speed of 14-year-old football players (Mossa, 2022), it was generally observed that three months of core strength training significantly increased the speed, power, and agility of the experimental group (EG) players compared to the control group (CG). These results indicate that participants in the experimental group had higher rates of improvement, demonstrating the importance of core exercises in soccer. In another study on 18-year-old male soccer players, a study examined the effect of core training exercises on some motor skills (Afyon and Boyacı, 2016), athletes in the experimental group statistically significant improvements in the vertical jump, medicine ball throw, and 30-meter sprint tests ($p<0.05$), while no statistically significant difference was found in these parameters in the control group ($p>0.05$). In another study where amateur soccer players aged 18-25 underwent core exercises three times a week for 8 weeks (İri et al., 2021), statistically significant improvements were observed in the 20-meter sprint, vertical jump, and Illinois Agility tests in the experimental group ($p<0.05$), while no statistically significant difference was found in the control group ($p>0.05$). In a study involving 12-14-year-old male soccer players who underwent core exercise exercise lasts three times a week for 8 weeks, statistically significant improvements were found in the 20-meter sprint variable in the experimental group ($p<0.05$), while no statistically significant difference was found in the pre-test and post-test values of participants in the control group ($p>0.05$) (Gücük and Aydoğmuş, 2023). Prieste et al. (2015) found that 9 weeks of core exercises positively affected 10-meter and 20-meter sprint performances of elite young soccer players, while Parkhouse et al. (2011) found that 6 weeks of static core exercises improved 20-meter sprint performances of soccer players. Similarly, some studies have concluded that core exercises have a positive effect on sprint performance (İmai et al., 2014; Balaji and Murugavel, 2013). As seen in the results obtained from sources close to our study, it has been shown that core exercises have positive effects on athletes' performance improvements. In a review study (Luo et al., 2023), core training was found to improve physical fitness levels such as strength, speed, balance, and agility in soccer players. In another study on 12-14-year-old soccer players (Bayrakdar et al., 2020), players underwent core exercises twice a week for 9 weeks, and significant improvements were observed in 30-

meter sprint, long jump, vertical jump, and agility tests. In a study examining the short-term effects of combined on-field core strength training and small-sided games on the physical performance of young soccer players (Arslan et al., 2021), it was demonstrated that incorporating core strength training into a periodized program based on small-sided games (SSG) is highly effective in improving speed and strength-based conditioning in young footballers. In another study investigating the effects of core exercises on physical and biomotor attributes such as strength, speed, flexibility, endurance, and agility in football players aged 9-12 (Sinecen, 2025), core training was applied to the core group three times a week for a period of 8 weeks. As a result of this study, which focused on the impact of core exercises on parameters such as flexibility, strength, speed, agility, endurance, and explosive power, it was determined that biomotor parameters can be influenced by the application of core training. In another study involving amateur soccer players aged 18-24, who underwent core training exercises three times a week for 6 weeks (Atlı, 2021), statistically significant improvements were observed in vertical jump, 30-meter sprint, agility, and flexibility tests after 6 weeks ($p<0.05$). No statistically significant difference was found in the pre-test and post-test comparisons of the control group in these parameters ($p>0.05$). In a study by Başkaya (2020) investigating the effects of core training on football skills and motor abilities in young football players, it was found that additional core training applied for different durations had a positive impact on both football skills and motor characteristics. It was particularly emphasized that long-term core training lasting at least 10 weeks was more effective, and that dynamic core exercises significantly contributed to the multidimensional development of the players. Doğanay et al. (2020) examined the effects of core training on speed, quickness, and agility performance in 24 young male football players. At the end of the eight-week training program, statistically significant improvements were observed in the experimental group's quickness and agility performance data. These findings are supportive of our study results. Many studies have shown improvements in physical performance parameters in both control and experimental groups, but it has been concluded that these improvements are proportionally much higher in the experimental group and are also statistically significant. The improvements observed in the physical performance of participants in the experimental group may be attributed to the benefits of core training in enhancing balance and stability, as well as supporting motor skills such as agility, speed, jumping, and force production. Additionally, core exercises improve intermuscular coordination and body awareness, which are particularly important for the fundamental motor development of children and young athletes.

When looking at the findings in Tables 5 and 6, statistically significant differences in favor of the experimental group were found in the pre-test values of participants in both the experimental and control groups in the 20-meter sprint test and standing long jump test ($p<0.05$). No statistically significant difference was found between the groups in other variables ($p>0.05$) (Table 3). When looking at the post-test values of the groups, statistically significant differences in favor of the experimental group were found in the squat jump test, right-hand grip strength test, left-hand grip strength test, sit-and-reach flexibility test, 20-meter sprint test, medicine ball throw test, and standing long jump test ($p<0.05$) (Table 6). In light of these findings, while significant differences were found in three different variables in the pre-tests of both groups, significant differences in favor of the experimental group were found in seven different parameters in the post-tests of the groups. These results indicate that the improvement in the experimental group is due to core exercises and that core exercises have a positive effect on the physical performance values of 11-12-year-old soccer children.

When reviewing studies in the literature, in a study where 12-14-year-old soccer players underwent core exercises twice a week for 12 weeks (Boyacı and Afyon, 2017), no statistically significant difference was found between the experimental and control groups in the pre-test results of participants in the 20-meter sprint test, standing long jump test, medicine ball throw test, and vertical jump test ($p>0.05$), while statistically significant improvements were observed in all variables in the post-tests of both groups in favor of the experimental group ($p<0.05$). These findings indicate improvement in the performance of athletes due to core training. In another study on young soccer players (Yapıcı, 2016), statistically significant improvements were observed in flexibility, standing long jump, agility, and 20-meter sprint values of the experimental group ($p<0.05$). These findings are consistent with our study. In the same study, there was no statistically significant difference in flexibility, standing long jump, agility, and 20-meter sprint values between the pre-test and post-test of the experimental and control groups ($p>0.05$). However, these findings are not consistent with our study. In another study where 6 weeks of core exercises were applied three times a week to 11-13-year-old soccer players (Aslan and Kahraman, 2023), no statistically significant difference was found between the experimental and control groups in the pre-test results of participants in the 30-meter sprint test, vertical jump test, and Illinois Agility Test ($p>0.05$), while statistically significant improvements were observed in favor of the experimental group in the post-tests of these variables ($p<0.05$). In a study where elective soccer courses were provided to students at the Civil Aviation University for 8 weeks, three times a week (Li, 2014), no statistically significant difference was found between the experimental and control groups in the pre-test results of participants in the 20-meter shuttle run test and standing long jump test ($p>0.05$), while statistically significant improvements were observed in favor of the experimental group in the post-tests of these variables ($p<0.05$). In a study conducted with children aged 9-12, who underwent core training sessions three times a week for six weeks (Rahmat et al., 2014), statistically significant improvements were observed in the shuttle run test and standing long jump test. The study results indicate that core training contributes to improvements in physical performance variables among young male soccer players and is particularly crucial for performance development in younger age groups.

The considerably lower improvements observed in the specified variables among participants in the control group, compared to those in the experimental group, can be attributed to several factors:

Training adaptations are largely dependent on the type and intensity of the exercises performed. As the control group only engaged in routine technical football training, they did not receive specific loading targeting the core musculature, which may have limited meaningful development in these muscle groups. For physiological improvements to occur through exercise, the training stimulus must exceed the body's current capacity. The inability of routine training sessions in the control group to surpass this threshold may have prevented adaptive responses, resulting in no significant changes in performance parameters.

Core exercises play a critical role in developing balance, coordination, body awareness, stability, and intermuscular synergy, particularly in children. The absence of such exercises may have limited motor performance improvements, especially during this crucial stage of growth and development.

Training loads based solely on technical drills may not engage all muscle groups in a balanced manner, which can result in a weak transfer effect to football-specific skills that require core-centered strength and stability.

CONCLUSION

As a result of the present study, it has been determined that the regular implementation of fundamental core exercises, conducted twice per week over a period of eight weeks, significantly enhances the physical performance of male soccer players aged 11–12. These improvements were observed in multiple parameters related to motor performance, suggesting that core training plays a pivotal role in developing essential athletic skills such as balance, stability, coordination, and muscular endurance during a critical stage of physical development. Given the positive outcomes observed, it is strongly recommended that youth football coaches systematically integrate core training into their regular practice routines. Prioritizing core-focused exercises can serve not only to improve athletic performance but also to contribute to injury prevention by promoting neuromuscular control and postural alignment in young athletes. Moreover, the findings highlight the value of structured and age-appropriate strength and conditioning programs in youth sports settings. Allocating specific time within training sessions for core development may lead to more comprehensive long-term athlete development, supporting both performance enhancement and the foundational movement competencies needed for success in football and other dynamic sports.

SUGGESTIONS

In future studies:

- Future research is encouraged to explore variations in core training protocols, including different exercise modalities, session frequencies, and combined training approaches, to further understand their effects on various physical and functional performance metrics in youth athletes across different sports.
- Core training can be implemented in the same or different age groups, and across various sports disciplines.
- The weekly frequency of core training sessions can be increased.
- Different core exercises can be applied.
- The effects of core training can be examined using alternative measurement methods.
- Another type of training can be added alongside core training to compare the effects of both programs.

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