OPEN ACCESS

YALOVA ÜNİVERSİTESİ SPOR BİLİMLERİ DERGİSİ
YALOVA UNIVERSITY JOURNAL OF SPORTS SCIENCES

CİLT: 4 SAYI: 2 YIL: 2025

ISSN: 2822-664X

Effects of Core and Resistance Exercise on Sprint and Agility Outcomes in Adolescent Footballers: A Randomized Controlled Trial

Müjde ATICI[1], Akan BAYRAKDAR[2]

[1]**Kahramanmaraş Sütçü İmam University, Faculty of Sport Science, Kahramanmaraş/Turkiye**
https://orcid.org/0000-0002-2348-1914

[2]**Alanya Alaaddin Keykubat University, Faculty of Sport Science, Antalya/Turkiye**
https://orcid.org/0000-0002-3217-0253

DOI: 10.70007/yalovaspor.1760313 ORJINAL MAKALE

Abstract

This study aimed to investigate the effects of resistance (RT) and core (CT) training on sprint and agility performance in 12–13-year-old male soccer players for eight weeks. The participants were randomly divided into three groups: resistance training group (n=10), core training group (n=10), and control group (n=10). In the study, 10 m, 20 m and 30 m sprint tests and 505 and arrowhead agility tests were applied as pre-test and post-test. The data obtained were evaluated in SPSS program. Graphs were created in Graphpad Prism program. Results showed significant improvements in sprint distances in both experimental groups. In the RT group, significant improvements were found in 10 m (p=0.006), 20 m (p=0.038), 30 m (p=0.004) sprints and both agility tests (505: p=0.038; Arrowhead: p=0.027); effect sizes were medium-high (e.g. 10 m sprint, d=0.83). In the CT group, significant improvements were noted in the 10 m (p=0.034), 20 m (p=0.043), 30 m (p=0.024) sprints, while borderline significance was observed only in the Arrowhead test (p=0.064). In the control group, no significant change was found in any test. These findings suggest that the improvements were due to the training interventions. In conclusion, resistance-based training seems to be more effective in improving sprint and agility performance, while core training plays a supportive role in certain phases of sprint. These findings suggest that, considering the age group, it is important to select the type of training intervention according to the content for performance improvement in soccer players.

Anahtar kelimeler: *Soccer, Core exercise, Resistance exercise, Speed, Agility.*

Ergen Futbolcularda Core ve Direnç Egzersizlerinin Sprint ve Çeviklik Üzerine Etkileri: Randomize Kontrollü Bir Çalışma

Özet

Bu çalışma, 12–13 yaş grubundaki erkek futbolcularda sekiz hafta süresince uygulanan direnç (RT) ve core (CT) antrenmanlarının sprint ve çeviklik performansına etkilerini incelemeyi amaçlamaktadır. Katılımcılar rastgele üç gruba ayrılmıştır: direnç antrenmanı grubu (n=10), core antrenmanı grubu (n=10), ve kontrol grubu (n=10). Çalışmada 10 m, 20 m ve 30 m sprint testleri ile 505 ve arrowhead çeviklik testleri ön test ve son test olarak uygulanmıştır. Elde edilen veriler SPSS programında değerlendirilmiştir. Grafikler Graphpad Prism programında oluşturulmuştur. Bulgular, her iki deney grubunda sprint mesafelerinde anlamlı gelişmeler görülmüştür. RT grubunda 10 m (p=0.006), 20 m (p=0.038), 30 m (p=0.004) sprint ve her iki çeviklik testinde (505: p=0.038; Arrowhead: p=0.027) anlamlı ilerlemeler saptanmış; etki büyüklükleri orta-yüksek düzeydedir (örn. 10 m sprint, d=0.83). CT grubunda 10 m (p=0.034), 20 m (p=0.043), 30 m (p=0.024) sprintlerde anlamlı gelişmeler kaydedilirken, yalnızca Arrowhead testinde sınırda anlamlılık gözlenmiştir (p=0.064). Kontrol grubunda ise hiçbir testte anlamlı değişim bulunmamıştır. Bu bulgular, gelişimlerin antrenman müdahalelerinden kaynaklandığını göstermektedir. Sonuç olarak, direnç temelli antrenmanlar sprint ve çeviklik performansını artırmada daha etkili görünürken, core antrenmanları sprintin belirli fazlarında destekleyici rol oynamaktadır. Bu bulgular, yaş grubu dikkate alındığında, futbolcularda performans gelişimi için uygulanan antrenman türünün içeriğe göre seçilmesinin önemli olduğunu göstermektedir.

Keywords: *Futbol, Core egzersiz, Direnç egzersizi, Sürat, Çeviklik.*

Introduction

Football is a versatile team sport that requires repetitive high acceleration, deceleration, explosive sprints and sudden changes of direction (Sofuoğlu et al., 2024). While players cover an average distance of 9-12 km during the match, approximately 11% of this time is spent in sprints requiring maximum effort (Karababa & Kılınç Boz, 2023; Baron et al., 2020). Especially in adolescence, soccer players are in an important development process in terms of both physical and motor development. Systematic and planned trainings applied in this period provide significant improvement in the performance parameters of athletes (Paul et al., 2022). Speed and agility are among the key performance indicators of soccer; these skills play a decisive role in a player's ability to dominate his opponent in the game (Slimani et al., 2023). While speed is defined as the ability to reach top speed in a short distance, agility is a multi-component skill that includes the ability to change direction and decision-making (Sheppard & Young, 2006). In order to improve these physical requirements, the role of resistance and core-based exercises has become remarkable, especially in developmental athletes.

Resistance training is one of the effective methods that support sprint performance and agility development in young soccer players aged 12-14 years. In this age group, traditional strength training, plyometric exercises and resistance sprint practices contribute to shortening sprint time and increasing explosive power (Skratek et al., 2024; Chekle, 2025; Bayrakdar & Atıcı, 2025). In particular, sled sprints and resistance exercises with elastic bands result in significant improvements in 10-30-meter sprint performance and also allow progress in agility tests (Amore et al., 2024; Mor et al., 2022). Eccentric resistance and interval-based programs show superior effects on both speed and agility compared to conventional soccer training (Khortabi et al., 2024). Furthermore, it has been reported that the combination of plyometric and resistance training results in greater speed gains compared to only one type of resistance training (Ribič et al., 2025). In this direction, planned resistance exercise programs, which are performed 2-3 days a week and last 8-12 weeks, provide significant improvements in performance indicators such as sprint and agility in young soccer players. However, it is of great importance to adapt these programs considering age, biological maturity and individual development level (Edwards et al., 2021; Lehnert et al., 2024).

In addition to resistance exercises, exercises aimed at strengthening the core (central region) muscles also make significant contributions to sprint and agility performance. Regular core exercises provide significant improvements in sprint speed and change of direction skills of young athletes by increasing body stability. In particular, core training practiced 2-3 times a week for 6 to 12 weeks resulted in 3% to 7.5% improvement in 10 m, 20 m and 30 m sprint distances, and significant improvements in parameters such as agility and explosive power (Sofuoğlu et al., 2024; Mossa, 2022; Yapici, 2016; Arslan et al., 2025; Başkaya et al., 2023). In addition, it was observed that dynamic core exercises provided more performance improvement than static exercises (Başkaya et al., 2023; Bayrakdar et al., 2020). These findings suggest that core exercises not only strengthen the central muscles but also improve physical competencies such as sprint and agility, which are critical for soccer.

In this study, the effects of resistance and core training on sprint and agility performance of young soccer players were compared separately. Although it is known that both training models give positive results in performance development, in this study, the performance changes of the experimental group in which resistance training was applied and another experimental group in which core training was applied were compared with the control group. Thus, the effects of both training types on the speed and agility skills of young soccer players were examined in detail. It is aimed that the findings obtained will guide the design of training programs suitable for the age group and contribute to the physical development of football players.

This study makes an important contribution to the limited number of studies in the literature that comparatively examine the effects of resistance and core exercises on sprint and agility performance in young soccer players aged 12-14 years. Although existing studies have shown that resistance and core training are effective in performance development in young athletes, direct comparison of these two training types in separate groups in the same age group and comparison of their effectiveness with a control group have not been investigated sufficiently. The aim of this study was to detail the individual effects of resistance and core training on sprint and agility in young soccer players and to determine which training model is more effective on specific performance parameters. Our hypotheses are that resistance training will lead to significant improvements in sprint and agility performance; core training will similarly have positive effects on these parameters; and both training groups will show significant differences in performance improvement compared to the control group. The findings obtained in this direction will contribute to the optimization of the training programs of young football players based on scientific basis.

Methods

Participants

The study group consisted of 30 young Turkish football players who were born between 2012 and 2013, had been training in football for four years, and were affiliated with Alanya Şafak Sezer Football Club (Table 1). The study group was randomly selected according to the following criteria: The health status of the participating children did not include any problems that would constitute an obstacle to the study, they had been practicing soccer regularly for at least two years, they voluntarily agreed to participate in the study, and they regularly participated in both club trainings and trainings planned by the researchers during the study.

Sample size was determined using G-Power (version 3.1.9.7; Franz Faul, Kiel University, Kiel, Germany). These calculations are based on a probability of error α of 0.05, power of 0.8 (1-β probability of error), effect size of 0.4, and tests such as F-tests and analysis of variance, which focus specifically on repeated measures and the interaction between them (Beck, 2013).

Written consent was obtained from parents and club managers to start the study. The study was conducted in accordance with the Declaration of Helsinki and approved by Alanya Alaaddin Keykubat University Non-Interventional Clinical Research Ethics Committee (2025/10). All data were analyzed confidentially.

Table 1. Anthropometric Characteristics of the Participants

Variables	Groups	N	$\bar{x}$	sd	Min	Max
Age (year)	RT	10	13,30	,82	12,00	15,00
	CT	10	13,90	,73	13,00	15,00
	Cont	10	13,30	,67	12,00	14,00
Height (cm)	RT	10	1,59	,05	1,52	1,68
	CT	10	1,54	,07	1,45	1,68
	Cont	10	1,57	,06	1,49	1,67
Body Mass (kg)	RT	10	47,69	4,41	38,00	52,00
	CT	10	44,75	3,89	37,50	49,40
	Cont	10	44,23	4,49	38,50	51,20
BMI (kg/m^2)	RT	10	18,71	1,47	16,45	20,57
	CT	10	18,82	1,25	16,62	20,56
	Cont	10	17,79	1,32	15,81	19,95

RT; resistance training group, CT; Core Training Group, Cont; Control groups, BMI; Body Mass Index, $\bar{x}$; mean, sd; standard deviation

When the data in Table 1 are analyzed, it is seen that the control and experimental groups have close mean values in terms of age, height, body weight and BMI variables. This shows that the groups were homogeneous at the beginning.

Study Design

A total of 30 adolescent soccer players who voluntarily participated in the study were divided into three groups by computer-assisted random assignment method: resistance training group (RT, n=10), core training group (CT, n=10) and control group (Control, n=10). All participants continued their regular soccer training during the study period. In addition, the RT group participated in resistance-based strength training and the CT group participated in a core-focused exercise program. Both training programs were applied three days a week for 30 minutes a day for a total of 8 weeks. The control group did not perform any additional training other than soccer training (Figure 1). Before the formal training and testing process, all participants underwent a one-week familiarization period. During this period, they were informed about the tests and training protocols and correct technical practices were demonstrated by an expert strength and conditioning coach. All training practices and performance tests were supervised by the research team specialized in exercise science. Detailed information about the training protocols applied in RT (Table 2) and CT (Table 3) groups are presented.

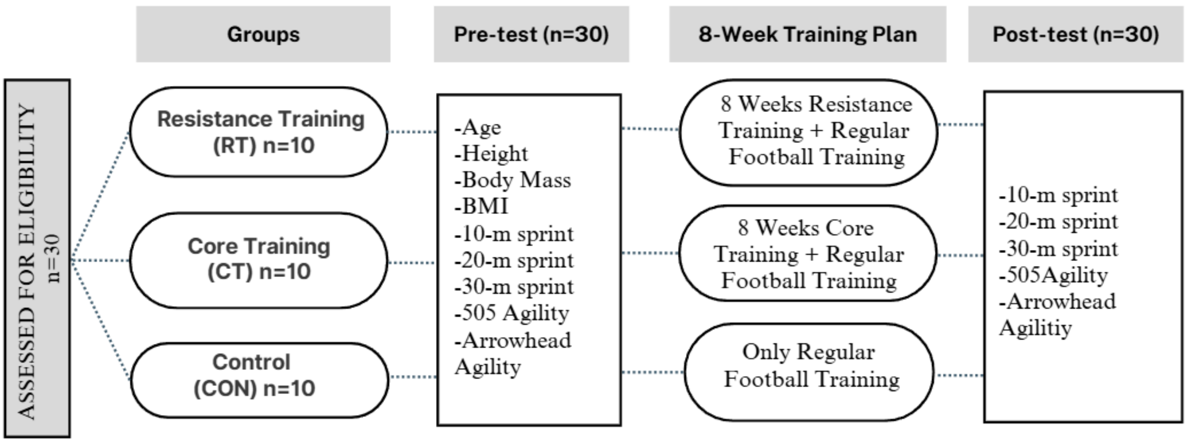


Figure 1. Study Design

Table 2. Resistance training program

Week	Exercise	Set	Again	Description
1-2	Bodyweight Squat	3	10	Technical priority
	Push-ups (with knee support)	3	8	Chest and arm strength
	Resistance Band Row	3	10	For the back muscles
	Calf Raises	3	12	Ankle strengthening
3-4	Goblet Squat (light dumbbells)	3	10	Introducing weight
	Push-up (full)	3	8	Difficulty increase
	Resistance Band Shoulder Press	3	10	Shoulder strength
	Step-up (low box)	3	8/yan	Lower limb strength
5-6	Lunge (body weight)	3	8/yan	Thighs and buttocks

	Resistance Band Chest Press	3	10	Pectoral muscles
	Resistance Band Pull Apart	3	12	Scapular balance
	Heel Walk / Toe Walk	3	10 m	Ankle stabilization
7-8	Jump Squat	3	6-8	Explosive force (controlled)
	Push-up + Shoulder Tap	3	6-8	Strength + core integration
	Resistance Band Deadlift Motion	3	10	Waist-back strength
	Single-leg Calf Raise	3	10/yan	Balance and force

This program consists of exercises that gradually become more difficult over 8 weeks. In the first weeks, basic movements with body weight (squats, push-ups with knee support) are technique-oriented, while in the following weeks, muscle strength and endurance are increased with light weights and resistance bands. In the final weeks, more dynamic and challenging exercises such as jump squats and push-ups + shoulder tap are included, targeting explosive strength and core integration. The program progresses systematically to promote upper and lower limb strength, balance and stabilization.

Table 3. Core Training program

Week	Exercise	Duration/Set	Again	Description
1-2	Plank (with knee support)	3x20 sec	-	Abdominal and back activation
	Glute Bridge	3 sets	10-12	Hip and hamstring activation
	Dead Bug	3 sets	10	Controlled, coordinated movement
	Bird Dog	3 sets	8/yan	Balance and muscle control
3-4	Plank (full, without knees)	3x30 sec	-	Difficulty level is increased
	Side Plank (with knee support)	3x15 sec	-	For the side core muscles
	Glute Bridge + Single Leg	3 sets	8	Hip stabilization
	Supine Leg Raises	3 sets	10	Lower abdomen
5-6	Plank Reach Forward	3 sets	10	Balance, shoulder and core together
	Side Plank (full)	3x20 sec	-	Activation of the Obliques
	Glute Bridge March	3 sets	8/yan	Hip+core coordination
	Hollow Hold	3x15 sec	-	Core muscle endurance
7-8	Plank + Shoulder Click (tap)	3 sets	10	Balance + force
	Side Plank + Hip Abduction	3 sets	8/yan	Difficulty increase
	Glute Bridge + Miniband	3 sets	10	For knee stability
	Dead Bug + Ball Retention	3 sets	10	Core + coordination

The core program is also designed with gradually increasing levels of difficulty over an 8-week period. In the beginning, the abdominal, back and hip muscles were activated with basic movements such as plank, glute bridge and balance exercises; in the following weeks, plank variations, exercises for the lateral core muscles and coordination movements were added. In the final phase, core muscle endurance and stabilization were improved by increasing resistance with shoulder clicks and miniband use to increase balance and strength. The program is aimed at increasing the functional and coordinative capacity of the core region.

Data Collection

Anthropometric measurements

The height measurements of the individuals were performed barefoot, in the morning and while standing in an upright position. Participants were positioned so that their heads were parallel to the Frankfort plane and their heels, buttocks, back and head were in contact with the measuring device. Measurements were made using a fixed stadiometer and the results were recorded in centimeters with an accuracy of 0.1 cm (Lohman et al., 1988). Body weight measurements were carried out in the morning, on an empty stomach and after toilet use, with the subjects wearing light clothing and barefoot. A digital scale with an accuracy of 0.1 kg was used for the measurements, and the participants stood in the center of the scale in an upright position, distributing their weight equally on both feet. Weight values were recorded in kilograms (kg) (Norton & Olds, 1996). Body Mass Index (BMI) was calculated by dividing body weight (kg) by the square of the height in meters ($kg/m^{2)}$ based on the height and body weight data obtained. The values obtained were evaluated according to the classification of the World Health Organization (WHO, 2000).

10, 20 and 30-meter sprint test

A 10, 20 and 30-meter sprint test was performed to evaluate the anaerobic speed performance of young athletes. The test was performed in a 30-meter long running corridor on a flat and hard surface. Timing was measured using the Brower Speed Trap I Timing System (Brower Timing Systems, Salt Lake City, UT, USA). This system works with dual lighted sensors placed at the start and end points and provides a measurement accuracy of one thousandth of a second (0.001 s). The young athletes were asked to perform a 10-minute general warm-up (light jogging, dynamic stretching and a few sprint attempts) before starting the test. Before the start of the test, they were placed on the starting line with their toes not touching the line, and they were allowed to start running at any time after the "ready" command. Thus, the reactive time effect was excluded from the test. The measurement started when the first photo-cell line was crossed and ended automatically when the second line (10-meter point) was crossed (Brown & Ferrigno, 2005). Each participant was allowed two trials and a full rest period (3-5 minutes) between trials. The best grade was used in the analysis (Figure 2A).

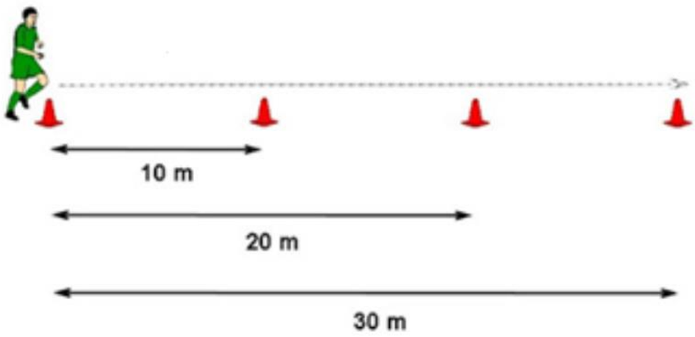


Figure 2. 10, 20 and 30-Meter Sprint Test

505 Agility test

Timing was measured using the Brower Speed Trap I Timing System (Brower Timing Systems, Salt Lake City, UT, USA). The timer tripod was set at a height of 42 cm. This height was selected to prevent the timer from being triggered by the subject's arm, allowing only leg movement to initiate and stop the timing. Cones were placed at 15, 5, and 0 m (Figure 2B). The distance from the optical lens of the timer to the opposite cone was set at 2.74 m to meet the timer's operational range of 0.31 to 3.66 m. The timer was positioned at the 5-m mark. The 505-agility test was performed as follows: Young athletes sprinted forward from the 15-m cones, and timing started once they passed the 5-m cones. Upon reaching the 0-m cones, the young athletes made a 180° COD and sprinted back through the 5-m cones, at which point the timing stopped. All young athletes completed three trials of the 505-agility test with 2 to 5 minutes of rest between each trial (Van Gelder & Bartz, 2011).

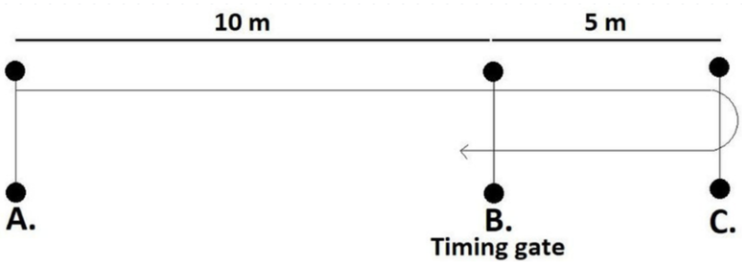


Figure 3. 505 Agility test

Arrowhead Agility test

We have used the protocol used by Jalilvand et al. for the Arrowhead Agility Test as shown in the figure 2C (Jalilvand et al., 2015). Timing was measured using the Brower Speed Trap I Timing System (Brower Timing Systems, Salt Lake City, UT, USA). All young athletes have started 1 meter behind of the photocell. In the beginning of the test, the young athletes sprint to the middle cone and turn from outside of the cone to the left or right what they want. After, the young athletes turn around the left/right cone and around the upper cone. Finally, young athletes sprint to the finishing photocell.

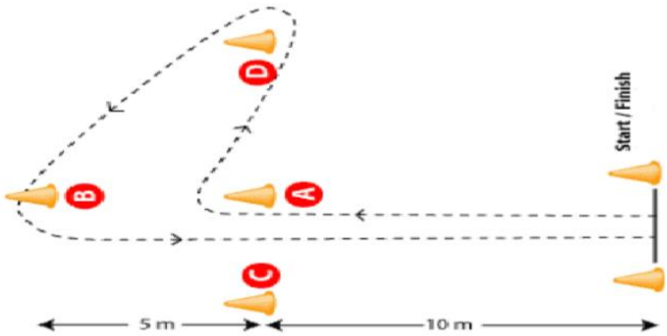


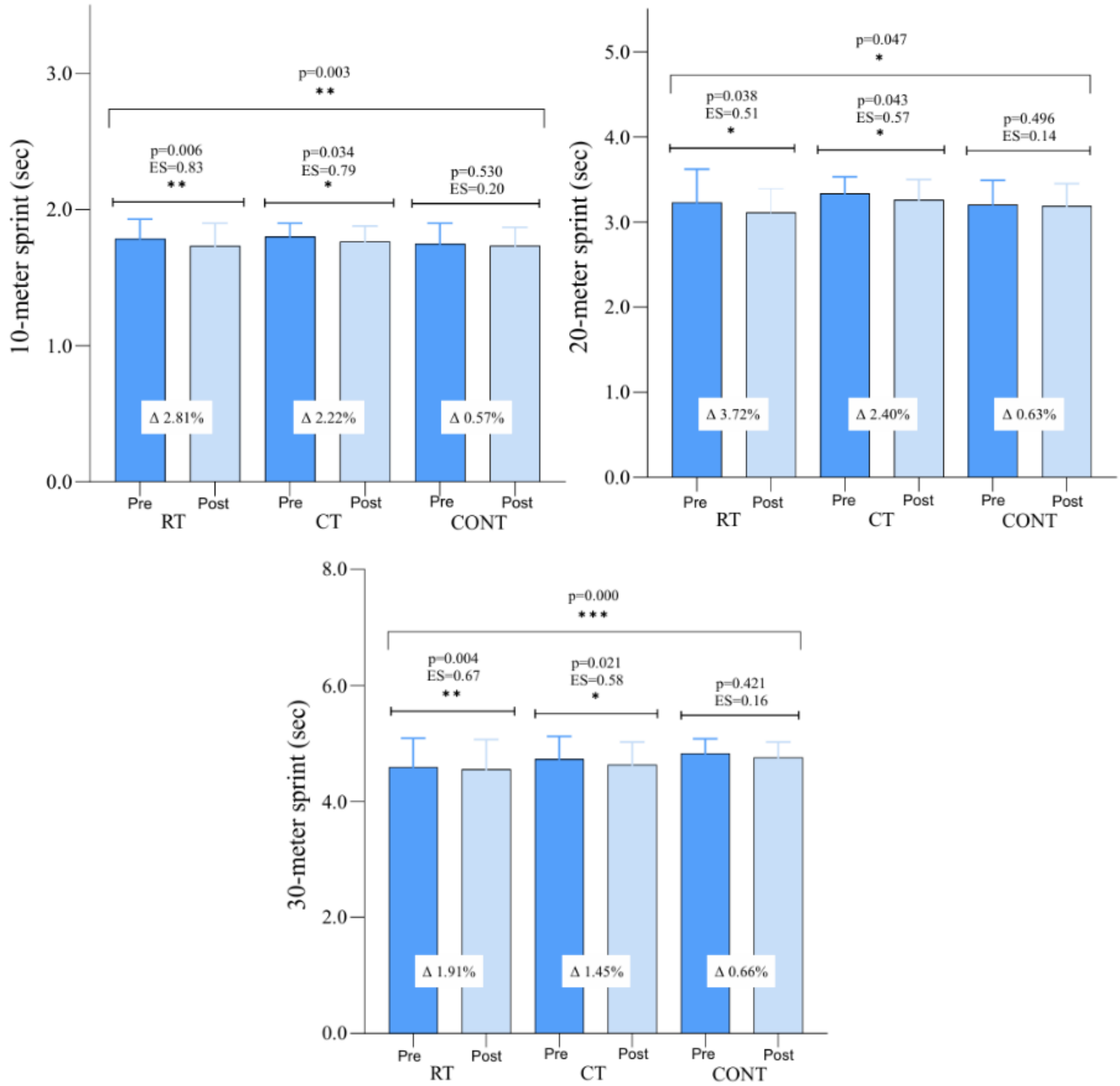
Figure 4. Arrowhead Agility Test

Data Analysis

Statistical analyses of the data obtained within the scope of the study were performed using the SPSS package program (version 27). The normality distribution of the data was evaluated with the Shapiro-Wilk test, and parametric tests were applied for the data that met the assumption of normal distribution. Paired samples t-test was used to determine the difference between pre-test and post-test scores for each group. For comparisons between groups, one-way analysis of variance (ANOVA) was performed and post-hoc analysis was performed with Tukey HSD test for significant results. The significance level was accepted as $p<0.05$. In addition, Cohen's d coefficient was calculated to determine the effect size of the intervention program (Cohen, 2013). This coefficient was interpreted as 0.2 small, 0.5 medium and 0.8 large effect. Both absolute change (Δ, in units) and percentage change (Δ%) were taken into account in the interpretation of the data. Results are reported under two categories: sprint tests (10 m, 20 m, 30 m) and agility tests (505, Arrowhead).

Results

Graph 1. Comparison of Changes in Participants' 10 m, 20 m and 30 m Sprint Performances

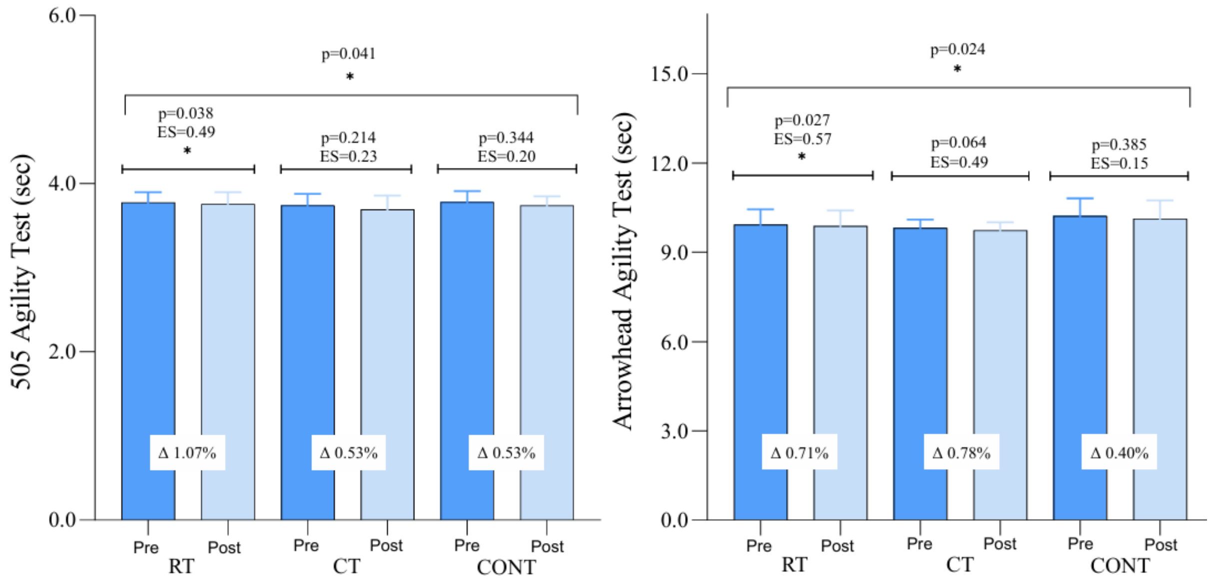


RT; resistance training group, CT; Core Trainig Group, Cont; Control group

In the 10-meter sprint test, while the pre-test mean was 1.78±0.12 s in the RT group, this value decreased to 1.73±0.12 s in the post-test. This corresponds to an improvement of 2.81% (t=3.56; p=0.006), and the effect size was determined as Cohen's d=0.83. In the CT group, these values were 1.80±0.06 s and 1.76±0.07 s, respectively, corresponding to an improvement of 2.22% (t=2.50; p=0.034; d=0.79). There was no significant change in the control group (1.74±0.09 s → 1.73±0.08 s; t=0.65; p=0.530; d=0.20). A significant difference was found in the comparison of these changes between the groups (F=7,087; p=0,003). In the 20-meter sprint test, the mean time of the RT group decreased from 3.23±0.28 s to 3.11±0.19 s, showing an improvement of

3.72% (t=2.45; p=0.038; d=0.51). In the CT group, a decrease from 3.33±0.14 s to 3.25±0.14 s was observed, indicating an improvement of 2.40% (t=2.36; p=0.043; d=0.57). The change in the control group was not statistically significant (3.20±0.18 s → 3.18±0.16 s; t=0.71; p=0.496; d=0.14). The difference between the groups was significant (F=3,016; p=0,047). In the 30-meter sprint test, the mean of the RT group decreased from 4.72±0.38 s to 4.63±0.36 s and an improvement of 1.91% was detected (t=3.80; p=0.004; d=0.67). In the CT group, this rate was 1.45% and the values decreased from 4.82±0.23 s to 4.75±0.24 s (t=2.72; p=0.024; d=0.58). The change in the control group was from 4.58±0.35 s to 4.55±0.34 s, but this difference was not statistically significant (t=0.84; p=0.421; d=0.16). Analysis between groups indicates a significant difference (F=9,458; p=0,000).

Graph 2. Comparison of Participants' Improvements in 505 and Arrowhead Agility Test Results



RT; resistance training group, CT; Core Trainig Group, Cont; Control group

In the 505 agility test, the RT group decreased from 3.74±0.12 s to 3.70±0.13 s with an improvement of 1.07% (t=2.45; p=0.038; d=0.49). In the CT group, the change was from 3.77±0.09 s to 3.75±0.09 s with an improvement of 0.53%, which was not statistically significant (t=1.33; p=0.214; d=0.23). Similarly, a non-significant change was found in the control group (3.77±0.09 s → 3.75±0.10 s; t=1.00; p=0.344; d=0.20). There was a significant difference between the groups (F=3,366; p=0,041). In the Arrowhead agility test, the mean time in the RT group decreased from 9.81±0.30 s to 9.74±0.30 s, an improvement of 0.71% (t=2.62; p=0.027; d=0.57). In the CT group, these values decreased from 10.21±0.35 s to 10.13±0.39 s and showed borderline significance with an improvement of 0.78% (t=2.11; p=0.064; d=0.49). The change in the control group was from 9.93±0.27 s to 9.89±0.28 s but was not statistically significant (t=0.91; p=0.385; d=0.15). The difference between the groups was significant (F=4,297; p=0,024).

Discussion

This study contributes to the literature as a controlled experiment comparing the effects of 8-week resistance (RT) and core training (CT) on sprint (10, 20, 30 m) and agility performance in 12–13-year-old child soccer players. The findings revealed that there were significant improvements in sprint performance in both experimental groups, while only the RT group achieved statistically significant improvement in agility.

The high effect size (d=0.83) recorded in the RT group, especially in the 10 m sprint, emphasizes the effectiveness of heavy resistance training in short-distance acceleration. The main reason for this effect is that resistance training especially increases the capacity for rapid force production. In the context of the force-speed relationship, as the muscle strengthens, the speed of contraction of muscle fibers also increases, thus producing higher power in a shorter time (Cormie et al., 2011). This is especially critical in short sprint distances such as 0-20 meters, where the acceleration phase is dominant (Mero et al., 1992). Furthermore, maximizing horizontal force production increases the thrust exerted by the athlete on the ground and thus positively affects acceleration (Morin et al., 2015). These mechanisms have been confirmed in previous studies in which horizontal force-oriented resistance training has supported sprint performance (Derakhti et al., 2021).

On the other hand, the consistent sprint improvements observed in the CT group support the positive contributions of core stability to energy transfer and running mechanics. Muscular stability of the core provides effective power transfer between the lower extremities and upper body, which increases movement efficiency (Willardson, 2007). Especially during running, the stability of the trunk makes it possible for the extremities to generate force with optimal movement (Hibbs et al., 2008). Therefore, core training contributes to improving running mechanics and thus sprint performance. Furthermore, systematic reviews and meta-analyses support that core training produces significant improvements in speed and power components (Sofuoğlu et al., 2024; Luo et al., 2023). However, the effect size of core training and its effect on sprint performance varies depending on the content and duration of the training program (Brull-Muria & Beltran-Garrido, 2021).

Agility performance is not only limited to the speed of changing direction but also includes the ability to re-accelerate after a turn. While the 505 test assesses acceleration after a 180° turn (Ja, 1985), the Arrowhead test measures multi-directional movement ability (Lockie & Jalilvand, 2017). In this study, significant improvements in the 505 and Arrowhead tests were observed only in the RT group, while a borderline significant improvement ($p \approx 0.064$) was recorded only in the Arrowhead test in the CT group. The fact that agility consists of multiple components such as eccentric force production, ground contact time and proprioceptive perception ensures that resistance training plays an important role in the development of agility (Sekulović et al., 2024). In particular, resistance training increases the eccentric and concentric force production of muscles and improves performance in sudden stops and direction changes (Luo et al., 2023). In addition, resistance training increases the stiffness of muscle tendon units, enabling faster response, which shortens ground contact time and improves agility performance (Kubo et al., 2001).

The improvements in 10 m and 20 m sprints and agility tests in the RT group suggest that resistance training provides a holistic presentation of speed-strength-related stimuli. The main reason for this is that resistance training improves the capacity of the muscle to produce maximal power and speed. The combined development of strength and speed components makes it possible for athletes to perform both rapid ground propulsion and sudden changes of direction (Young et al., 2002). In contrast, moderate improvements were observed in the CT group, especially in the 30 m sprint and Arrowhead test, but limited effects were found in short distance sprints and sudden changes of direction compared to the RT group. This finding is in accordance with the literature indicating that core training is more effective on postural control, central stabilization and late phase of sprint (Sofuoğlu et al., 2024).

The lack of a significant difference in 20 m sprint performance between the groups is consistent with previous findings suggesting the importance of training focused on high-speed running-specific neuromuscular stimuli and sprint mechanics in middle-distance sprints (Prieske et al., 2018). This distance is the phase in which speed is maximized and maintained, so sprint mechanics and endurance are not as important here as in the acceleration phase but rather force production. This suggests that 20 m performance should be supported not only by strength training, but also by technique and speed-oriented training (Mackala et al., 2019).

It can be said that 8 weeks of resistance training three days a week created significant adaptations in speed and agility performance in adolescent soccer players in a short time. Core training, on the other hand, plays a supportive role and provides benefits especially in postural stability and late stages of sprint (Bartolomei et al., 2025). In this context, it is recommended to plan resistance and core training together for performance improvement in young athletes. This not only increases muscle strength and acceleration capacity but also improves movement efficiency and postural control (Hibbs et al., 2008).

Conclusions

This study comparatively investigated the effects of 8 weeks of resistance (RT) and core (CT) training on sprint and agility performance in 12–13-year-old child soccer players. The findings revealed that both training protocols significantly improved sprint performance, while improvements in agility were predominantly realized in the resistance-trained group. This supports that heavy resistance training is more effective in improving short-distance acceleration and change of direction skills by triggering neuromuscular adaptations. Core training played a supportive role in postural stability and late phases of running. These results emphasize the importance of designing training programs according to the targeted performance components.

Limitations of the Study

This study has some limitations. First, the results were based only on performance tests and no direct biological measurements were made on the musculoskeletal or neuromuscular mechanisms of training. Therefore, the physiological adaptations underlying the performance improvements obtained could not be elucidated in detail. Furthermore, the sample consisted of only 12–13-year-old male soccer players, which limits the generalizability of the results for different age groups, genders or sports branches. In addition, the study period was limited to 8 weeks, and the long-term effects of training and the permanence of adaptations were not examined. Finally, the extent to which sprint and agility performances measured in the laboratory environment correlate with actual match performance was not evaluated in the study.

Suggestions for Future Research

It is recommended that future studies should comparatively examine the effects of resistance and core training in different age groups, gender and sports branches. In addition, long-term adaptations can be monitored by extending the training period and the permanence of these adaptations can be investigated. It is important to associate field performance measurements with laboratory tests in studies in order to reveal the effectiveness of training in real game conditions. Furthermore, examining the synergistic effects of resistance and core training in combination with other types of training (e.g. plyometric and speed training) may contribute to performance improvement strategies.

Reference

Amore, M., Minciacchi, D., Panconi, G., Guarducci, S., Bravi, R., & Sorgente, V. (2024). Impact of sled-integrated resisted sprint training on sprint and vertical jump performance in young U-14 male football players. *Journal of Functional Morphology and Kinesiology, 9*(4), 25. https://doi.org/10.3390/jfmk9040256

Arslan, O., & Akkuş, H. (2025). Investigation of the effects of core training on some athletic performance parameters in male amateur football players. *Balneo and PRM Research Journal.* https://doi.org/10.12680/balneo.2025.771

Baron, J., Bieniec, A., Swinarew, A. S., Gabryś, T., & Stanula, A. (2020). Effect of 12-week functional training intervention on the speed of young footballers. *International Journal of Environmental Research and Public Health, 17*(1), 160. https://doi.org/10.3390/ijerph17010160

Bartolomei, S., Beato, M., & Coratella, G. (2025). Manipulating resistance exercise variables to improve jumps, sprints, and changes of direction in soccer: What we know and what we don't know. *Journal of Functional Morphology and Kinesiology, 10*(2), 145. https://doi.org/10.3390/jfmk10020145

Başkaya, G., Ünveren, A., & Karavelioglu, M. (2023). The effect of static and dynamic core exercises on motor performance and football-specific skills of football players aged 10-12. *Gazi Journal of Physical Education and Sport Sciences.* https://doi.org/10.53434/gbesbd.1148408

Bayrakdar, A., & Atıcı, M. (2025). Effects of plyometric and agility-based training on physical performance in adolescent male volleyball players: a controlled experimental study . *Pedagogy of Physical Culture and Sports*, *29*(4), 297–307. Retrieved from https://sportpedagogy.org.ua/index.php/ppcs/article/view/3212

Bayrakdar, A., Kılınç Boz, H., & Işıldar, Ö. (2020). The Investigation of the Effect of Static and Dynamic Core Training on Performance on Football Players. Turkish Journal of Sport and Exercise, 22(1), 87-95.

Beck, T. W. (2013). The importance of a priori sample size estimation in strength and conditioning research. *Journal of Strength and Conditioning Research, 27*(8), 2323-2337. https://doi.org/10.1519/JSC.0b013e318278eea0

Brown, L. E., & Ferrigno, V. A. (2005). *Training for speed, agility, and quickness* (2nd ed.). Human Kinetics.

Brull-Muria, E., & Beltran-Garrido, J. V. (2021). Effects of a specific core stability program on the sprint and change-of-direction maneuverability performance in youth, male soccer players. *International Journal of Environmental Research and Public Health, 18*(19), 10116. https://doi.org/10.3390/ijerph181910116

Chekle, B. (2025). The effects of plyometric and resistance training on linear sprinting speed and repeated sprinting ability of youth players in Ethiopia. *SPORT TK-Revista EuroAmericana de Ciencias del Deporte.* https://doi.org/10.6018/sportk.572191

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge.

Cormie, P., McGuigan, M. R., & Newton, R. U. (2011). Developing maximal neuromuscular power. *Sports Medicine, 41*(1), 17-38. https://doi.org/10.2165/11537690-000000000-00000

Derakhti, M., Bremec, D., Kambič, T., Ten Siethoff, L., & Psilander, N. (2021). Four weeks of power optimized sprint training improves sprint performance in adolescent soccer players. *International Journal of Sports Physiology and Performance, 17*(9), 1343-1351. https://doi.org/10.1123/ijspp.2020-0959

Doganay, M., Bingul, B. M., & Álvarez-García, C. (2020). Effect of core training on speed, quickness and agility in young male football players. *The Journal of Sports Medicine and Physical Fitness, 60*(9), 1240-1246. https://doi.org/10.23736/S0022-4707.20.10999-X

Edwards, T., Weakley, J., Banyard, H., Cripps, A., Piggott, B., Haff, G., & Joyce, C. (2021). Influence of age and maturation status on sprint acceleration characteristics in junior Australian football. *Journal of Sports Sciences, 39*(13), 1585-1593. https://doi.org/10.1080/02640414.2021.1886699

Hibbs, A. E., Thompson, K. G., French, D., Wrigley, A., & Spears, I. (2008). Optimizing performance by improving core stability and core strength. *Sports Medicine, 38*(12), 995-1008. https://doi.org/10.2165/00007256-200838120-00004

Ja, D. (1985). The 505 test: A test for agility in horizontal plane. *Australian Journal of Science and Medicine in Sport, 17*(1), 15-18.

Jalilvand, F., Mock, S., Stecyk, S., Crelling, J., Lockwood, J., & Lockie, R. (2015). The arrowhead change-of-direction speed test: Reliability and relationships to other multidirectional speed assessments. In *Proceedings of the 38th National Strength and Conditioning Association National Conference and Exhibition* (pp. 8-11). Las Vegas, NV, USA.

Karababa, A., & Kilinc-Boz, H. (2023). Effect of 8 weeks of core training on speed, agility and balance in 14-16 year old male footballers. *Journal of ROL Sport Sciences, 4*(3), 843-862. https://doi.org/10.5281/zenodo.8246467

Khortabi, A., Carral, J., Rezavandzayeri, F., & Suárez, H. (2024). The effect of resistance training focused on eccentric phase and interval exercises in young football players. *Retos, 58*, 104084. https://doi.org/10.47197/retos.v58.104084

Kubo, K., Kanehisa, H., Kawakami, Y., & Fukunaga, T. (2001). Influences of tendon stiffness, joint stiffness, and electromyographic activity on jump performance in humans. *Journal of Applied Physiology, 90*(2), 573-579. https://doi.org/10.1152/jappl.2001.90.2.573

Lehnert, M., Holík, R., Prycl, D., Sigmund, M., Sigmundová, D., & Malý, T. (2024). Talent identification in football: Different effects of maturation on sprinting, change of direction and jumping in 13-year-old players. *Applied Sciences, 14*(13), 5571. https://doi.org/10.3390/app14135571

Lockie, R. G., & Jalilvand, F. (2017). Reliability and criterion validity of the Arrowhead change-of-direction speed test for soccer. *Facta Universitatis, Series: Physical Education and Sport, 15*(1), 139-151. https://doi.org/10.22190/FUPES1701139L

Lohman, T. G., Roche, A. F., & Martorell, R. (1988). *Anthropometric standardization reference manual*. Human Kinetics.

Luo, S., Soh, K. G., Zhang, L., Zhai, X., Sunardi, J., Gao, Y., & Sun, H. (2023). Effect of core training on skill-related physical fitness performance among soccer players: A systematic review. *Frontiers in Public Health, 10*, 1046456. https://doi.org/10.3389/fpubh.2022.1046456

Mackala, K., Fostiak, M., Schweyen, B., Osik, T., & Coch, M. (2019). Acute effects of a speed training program on sprinting step kinematics and performance. *International Journal of Environmental Research and Public Health, 16*(17), 3138. https://doi.org/10.3390/ijerph16173138

Mero, A., Komi, P. V., & Gregor, R. J. (1992). Biomechanics of sprint running. *Sports Medicine, 13*(6), 376-392. https://doi.org/10.2165/00007256-199213060-00002

Mor, A., Karakaş, F., Mor, H., Yurtseven, R., Yılmaz, A., & Acar, K. (2022). The effects of resistance band exercises on some performance parameters in young football players. *SporMetre: Journal of Physical Education and Sports Sciences, 20*(1), 1-12. https://doi.org/10.33689/spormetre.1095371

Mossa, M. (2022). The effect of core strength training on 14-year-old soccer players' agility, anaerobic power, and speed. *American Journal of Sports Science.* https://doi.org/10.11648/j.ajss.20221001.14

Norton, K., & Olds, T. (1996). *Anthropometrica: A textbook of body measurement for sports and health courses*. UNSW Press.

Paul, D. J., Gabbett, T. J., & Nassis, G. P. (2022). Physical fitness and performance tests in youth soccer: A systematic review. *Sports Medicine, 52*(2), 215-242. https://doi.org/10.1007/s40279-021-01556-1

Prieske, O., Krüger, T., Aehle, M., Bauer, E., & Granacher, U. (2018). Effects of resisted sprint training and traditional power training on sprint, jump, and balance performance in healthy young adults: A randomized controlled trial. *Frontiers in Physiology, 9*, 156. https://doi.org/10.3389/fphys.2018.00156

Ribič, A., Pleša, J., Ujaković, F., & Kozinc, Ž. (2025). Effects of strength, speed and non-specific resistance training on athletic performance and FVP profile characteristics of youth professional soccer players. *International Journal of Strength and Conditioning.* https://doi.org/10.47206/ijsc.v5i1.392

Sekulović, V., Jezdimirović-Stojanović, T., Andrić, N., Elizondo-Donado, A., Martin, D., Mikić, M., & Stojanović, M. D. M. (2024). Effects of in-season velocity-based vs. traditional resistance training in elite youth male soccer players. *Applied Sciences, 14*(20), 9192. https://doi.org/10.3390/app14209192

Sheppard, J. M., & Young, W. B. (2006). Agility literature review: Classifications, training and testing. *Journal of Sports Sciences, 24*(9), 919-932. https://doi.org/10.1080/02640410500457109

Skratek, J., Kadlubowski, B., & Keiner, M. (2024). The effect of traditional strength training on sprint and jump performance in 12- to 15-year-old elite soccer players: A 12-month controlled trial. *Journal of Strength and Conditioning Research, 38*(7), 1900-1910. https://doi.org/10.1519/JSC.0000000000004890

Slimani, M., Nikolaidis, P. T., & Bragazzi, N. L. (2023). The relationship between agility and sprint performance in youth soccer players: A meta-analytic approach. *Journal of Human Kinetics, 89*(1), 101-111. https://doi.org/10.2478/hukin-2023-0010

Sofuoglu, C., Topçu, Z., & Tunay, V. (2024). The effect of core stability training on ball-kicking velocity, sprint speed, and agility in adolescent male football players. *PLOS ONE, 19*(6), e0305245. https://doi.org/10.1371/journal.pone.0305245

Van Gelder, L. H., & Bartz, S. D. (2011). The effect of acute stretching on agility performance. *Journal of Strength and Conditioning Research, 25*(11), 3014-3021. https://doi.org/10.1519/JSC.0b013e318212e42b

Willardson, J. M. (2007). Core stability training: Applications to sports conditioning programs. *Journal of Strength and Conditioning Research, 21*(3), 979-985.

World Health Organization. (2000). *Obesity: Preventing and managing the global epidemic. Report of a WHO consultation* (WHO Technical Report Series No. 894). World Health Organization.

Yapici, A. (2016). Investigation of the effects of teaching core exercises on young soccer players. *International Journal of Environmental and Science Education, 11*, 9410-9421.

Young, W. B., James, R., & Montgomery, I. (2002). Is muscle power related to running speed with changes of direction? *Journal of Sports Medicine and Physical Fitness, 42*(3), 282-288.