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6 Weeks Integrated Strength and Conditioning with Soccer Training Effect on 30m Sprint and Explosive Strength Performance in Youth Soccer Players

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Abstract

Background: Soccer is an intermittent high-intensity sport that requires players to repeatedly perform explosive movements such as sprinting, accelerating, jumping, and changing direction. Although strength and conditioning (S&C) is widely recommended for developing biomotor abilities, limited evidence exists regarding the effectiveness of short-term integrated S&C programs combined with regular soccer training among youth soccer players.

Purpose: This study examined the effects of a six-week integrated strength and conditioning programme combined with regular soccer training on 30 m sprint performance and lower-body explosive strength in U-17 male soccer players.

Methods: Thirty youth male soccer players (14–17 years) were randomly assigned to a training group (n = 15) and a control group (n = 15). The training group completed two 50-minute S&C sessions per week in addition to routine soccer training for six weeks, whereas the control group performed soccer training only. Sprint performance was assessed using a 30 m sprint test, and explosive strength was evaluated using the standing broad jump test. Data were analyzed using analysis of covariance (ANCOVA), with the level of significance set at $p < .05$.

Results: No significant differences were observed between groups at baseline for either 30 m sprint performance (F = 0.27) or explosive strength (F = 3.87). Following the intervention, the training group demonstrated significantly greater improvements than the control group in 30 m sprint performance (adjusted F = 22.29, $p < .05$), with sprint time improving from 4.85 ± 0.19 s to 4.66 ± 0.20 s. Similarly, explosive strength improved significantly in the training group (adjusted F = 39.69, $p < .05$), increasing from 2.02 ± 0.02 m to 2.14 ± 0.04 m.

Conclusion: A six-week integrated strength and conditioning programme performed concurrently with regular soccer training significantly enhanced linear sprint performance and lower-body explosive strength in U-17 soccer players. These findings support the inclusion of structured, age-appropriate S&C within youth soccer development programmes to improve biomotor fitness and optimize match-related physical

performance.

Keywords: Youth soccer, strength and conditioning, sprint performance, explosive strength, biomotor fitness, resistance training, soccer performance.

Introduction:

Soccer is the world's most popular sport and is characterized as an intermittent, high-intensity invasion game requiring players to perform a wide range of technical, tactical, physical, and psychological tasks throughout a match. The game alternates between high-intensity acts like sprinting, accelerating, decelerating, jumping, tackling, changing direction, and kicking and low-intensity exercises like strolling and jogging. These acts, which necessitate quick decision-making and effective movement execution, happen in an unpredictable manner in reaction to the dynamic match environment. Therefore, a player's ability to consistently execute explosive movements while retaining technical accuracy and tactical efficacy in the face of increasing fatigue is essential for success in modern soccer. (Mohr et al., 2003; Stølen et al., 2005; Di Salvo et al., 2007).

With the development of the contemporary game, soccer's physical and physiological demands have significantly risen. During competition, both elite and young athletes must now traverse significant distances while making multiple maximum or near-maximal efforts, which frequently determine the outcome of crucial games. Repeated sprinting, quick accelerations and decelerations, direction changes, and vertical leaping are examples of high-intensity exercises that are crucial for generating scoring opportunities, regaining ball possession, and carrying out defensive recoveries. Thus, a variety of biomotor skills, such as muscular strength, explosive power, speed, agility, aerobic endurance, anaerobic capacity, and neuromuscular coordination, affect soccer play. These physical attributes allow players to withstand the physiological demands of competition, postpone exhaustion, and maintain high levels of performance throughout the game (Barnes et al., 2014; Stølen et al., 2005; Rampinini et al., 2007).

Adolescence is marked by rapid growth, neuromuscular maturity, and enhanced reactivity to well-designed training stimuli, the development of these physical capacities becomes more crucial during this time. According to the Long-Term Athlete Development (LTAD) model, adolescence is a crucial time for improving athletic performance, power generation, muscle strength, and movement competency while also lowering the risk of injury. The foundation for long-term competitive success is thus provided by rigorous physical development during youth, which also equips athletes to handle the rising physical demands of elite soccer. (Faigenbaum et al., 2009; Lloyd & Oliver, 2012; Lloyd et al., 2014).

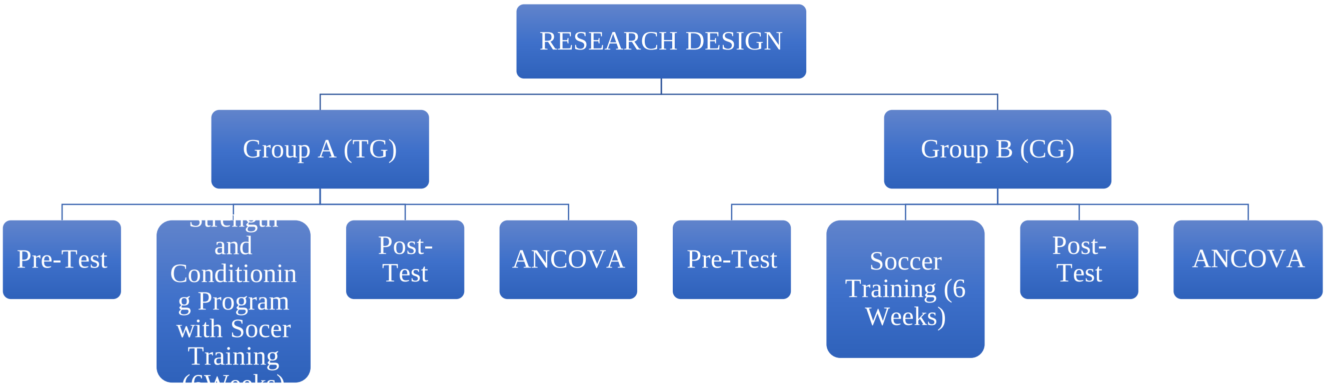
Strength and conditioning (S&C) has become a crucial part of modern soccer training in response to these demands. To increase maximal force output, rate of force development, movement efficiency, and athletic performance, modern S&C programs include resistance training, plyometric exercises, sprint drills, and neuromuscular training (Cormie et al., 2011; Suchomel et al., 2016). Importantly, when implemented using age-appropriate progression and qualified supervision, resistance and conditioning programs are recognized as safe and effective for youth athletes, producing significant improvements in strength, power, speed, bone health, and injury resilience without negatively affecting normal growth and maturation (Faigenbaum et al., 2009; Lloyd et al., 2014; American Academy of Pediatrics, 2020). Additionally, compared to soccer training alone, the integration of structured S&C with regular soccer-specific technical and tactical training has continuously shown greater increases in sprint performance, lower-body power, agility, and change-of-direction ability (Ramírez-Campillo et al., 2015; Lesinski et al., 2016; Hammami et al., 2018).

Despite the growing evidence supporting integrated Strength and Conditioning, several gaps remain in the literature. Existing studies have reported inconsistent findings due to variations in training duration, exercise selection, training intensity, participant maturity status, and intervention design. Moreover, most investigations have evaluated resistance or plyometric training independently and have predominantly employed interventions lasting longer than eight weeks. Consequently, limited evidence exists regarding the effectiveness of short-term integrated S&C programs conducted concurrently with regular soccer training, particularly among Indian youth soccer players. Additionally, few studies have simultaneously examined changes in linear sprint performance and lower-body explosive strength following such interventions. Addressing these gaps is important because coaches often face constraints related to competition schedules and limited training time, necessitating evidence-based, time-efficient training strategies. Therefore, the present study aimed to investigate the effects of a six-week integrated Strength and Conditioning program combined with regular soccer training on selected biomotor fitness parameters, specifically linear sprint performance and lower-body explosive strength, among U-17 soccer players. It was hypothesized that participants undertaking the integrated training program would demonstrate significantly greater improvements than those performing routine soccer training alone.

Materials and Methods

Research Design

A repeated-measures design involving two groups (a training group and a control group) was used to determine the effect of strength and conditioning combined with soccer training on sprint and explosive strength in soccer players as part of a 6-week training program. The study involved two groups of youth male soccer players. Half of the players constituted the training group (TG), which underwent the strength and conditioning program combined with the soccer training, and a control group (CG) which underwent the soccer training only.



Participants

Twenty (30) summer camp players were included in the study age ranged between 14 and 17 years. Only the outfield players were included in the study, while goalkeepers and players below 14 years and above 17 years were excluded, as well as the injured and female players. All subjects were informed about the potential risks and benefits of the study and signed a written informed consent.

Procedures

The participants were familiarized with the different tests during a practice session to avoid the learning effect. Pre- and post-tests were performed with maximal intensity. The tests were conducted on the soccer field.

The TG (n=15) underwent soccer training combined with strength and conditioning, and the CG (n=15) underwent soccer training only. The TG completed 2 of 50-minute sessions per week oriented into strength and conditioning training (12 sessions in 6 weeks). The two weekly training sessions proposed to the TG were structured differentially (see Tables 1 and 2 for details). The scheduling of the exercises considered the demands of the soccer game, namely explosive strength and the ability to accelerate. The training session consisted of 15 minutes of warm-up (aerobic running, dynamic stretching and speed exercises), 30 minutes of strength and conditioning and 20 minutes of soccer-specific drills. In the other 2 sessions, the EG performed only soccer-specific drills (90 minutes).

Phase	**Week**	**Objective**	**Training Emphasis**
Phase I	Week 1	Neuromuscular Adaptation	Technique, movement competency, bodyweight strength
Phase II	Week 2–3	Maximal Strength	External resistance + acceleration
Phase III	Week 4–5	Strength–Power	Explosive strength, sprint, plyometrics
Phase IV	Week 6	Power & Transfer	Transfer of Gain into Game Demand Movements

Table I Division of the 6 Training Weeks

Week	**Phase**	**Training Group (TG)**	**Repetition and Sets**	**Recovery**
	Phase I	1A+1B- Back Squat + Box Jump 2A+2B- R. DeadLift + Broad Jump 3A+3B- Lateral Lunge + Lateral Bound	8 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase II	1A+1B Bulgarian Split Squat → Bounds 2A+2B Hip Thrust → Broad Jump 3A+3B Step-Up → Step Jump	6 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase II	1A+1B Front Squat + Squat Jump 2A+2B Romanian Deadlift + Broad Jump 3A+3B Band Lateral Walk + Lateral Hop	6 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase III	1A+1B Goblet Squat + Tuck Jump 2A+2B Romanian Deadlift + Bounds 3A+3B Band Lateral Walk + Lateral Hop	5 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase III	1A+1B Bulgarian Split Squat → Bounds 2A+2B Hip Thrust → Broad Jump 3A+3B Step-Up → Step Jump	5 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase IV	1A+1B Bulgarian Split Squat → Bounds 2A+2B Lateral Lunge → Lateral Bound 3A+3B Step-Up → Step Jump	5 Reps 3 Sets	Rest: 60-90s / 30-45s

Table II: EXERCISE Session 1 - Tuesday

Week	Phase	CST Group	Repetition and Sets	Recovery
	Phase I	1A+1B- IsoSquatHold+ CMJ 2A+2B- Iso Glute Bridge + Bound 3A+3B- Rear Foot Elevated Iso Hold + Alternate Bounds	8 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase II	1A+1B Iso Squat → CMJ 2A+2B Copenhagen Hold → Lateral Bound 3A+3B Iso Calf Hold → Pogos	6 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase II	1A+1B Mid-thigh Pull Hold + Vertical Jump 2A+2B Iso Hip Thrust Hold + Broad Jump 3A+3B Lateral Lunge Hold + Skater Jump	6 Reps 3 Sets	Rest: 60-90s / 30-45s
	Phase III	1A+1B Wall Sit + Squat Jump 2A+2B Lateral Lunge Hold + Skater Jump 3A+3B Iso Calf Hold + Pogos	5 Reps 4 Sets	Rest: 60-90s / 30-45s
	Phase III	1A+1B Iso Squat → CMJ 2A+2B Copenhagen Hold → Lateral Bound 3A+3B Iso Calf Hold → Pogos	5 Reps 4 Sets	Rest: 60-90s / 30-45s
	Phase IV	1A+1B Iso Squat → CMJ 2A+2B Copenhagen Hold → Lateral Bound 3A+3B Split Squat Hold → Split Jump	3–5 Reps 3 Sets	Rest: 60-90s / 30-45s

Table III Exercise Session 2 - Thursday

Data Analysis

The six-week comprehensive strength and conditioning program's impact on a few biomotor fitness measures was assessed using descriptive statistics and Analysis of Covariance (ANCOVA). The following tables and figures display the results, with statistical significance established at the 0.05 level.

Table IV: Analysis of covariance for Pre and Post test scores of 30m sprint for both experimental and control groups.

Test	Experimental Group	Control Group	Source of Variance	Sum of Squares	df	Mean Squares	Obtained 'F' Ratio
Pre Test							
Mean	**4.85**	**4.81**	**Between**	**.010**	**1**	**.010**	**.27**
S.D.	**.19**	**.18**	**Within**	**.987**	**28**	**.035**	
Post Test							
Mean	**4.66**	**4.84**	**Between**	**.250**	**1**	**.250**	**7.33***

S.D.	**.20**	**.17**	**Within**	**.956**	**28**	**.034**	
Adjusted Post Test							
Mean	**4.65**	**4.80**	**Between**	**.327**	**1**	**.327**	**22.29***
			Within	**.396**	**27**	**.015**	

**Significant at 0.05 level of confidence.*
(The table values required for significance at 0.05 level of confidence for 1 & 28 and 1 & 27 are 4.20 and 4.21 respectively.)

Table IV shows the pre-test mean scores of the experimental group and control group, which were 4.85 and 4.81 respectively. The obtained F-ratio was 0.27, which was lower than the required table value of 4.20 at the 0.05 level of significance. This indicates that there was no significant difference between the two groups before the training program.

In the post-test, the mean scores of the experimental group and control group were 4.66 and 4.84, respectively. The obtained F-ratio of 7.33 was greater than the table value of 4.20, showing a significant difference between the groups after the training period.

The adjusted post-test mean scores were 4.65 for the experimental group and 4.80 for the control group. The obtained F-ratio of 22.29 was higher than the required table value of 4.21, indicating a significant difference between the groups even after adjusting for the pre-test scores.

The results showed that the experimental group showed greater improvement in 30 m sprint than the control group following the training program.

For a better understanding of the results, the pre-test, post-test, and adjusted post-test mean scores of the experimental and control groups are presented in Figure I.

Figure I: Bar chart illustrating pre-test, post-test, and adjusted post-test mean scores on 30 m Sprint.

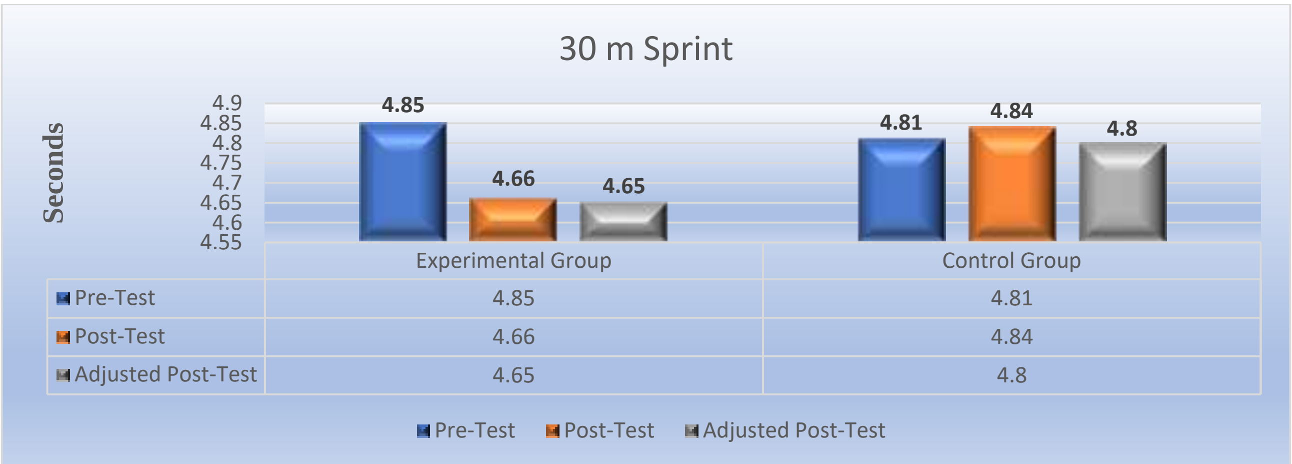


Table V: Analysis of covariance for Pre and post-test scores of 30m sprint for both experimental and control groups.

Test	**Experimental Group**	**Control Group**	**Source of Variance**	**Sum of Squares**	**df**	**Mean Squares**	**Obtained 'F' Ratio**
Pre Test							

Mean	**2.02**	**2.05**	**Between**	**.008**	**1**	**.008**	**3.87**
S.D.	**.02**	**.06**	**Within**	**.060**	**28**	**.002**	
Post Test							
Mean	**2.13**	**2.03**	**Between**	**.075**	**1**	**.075**	**37.15***
S.D.	**.04**	**.05**	**Within**	**.057**	**28**	**.002**	
Adjusted Post Test							
Mean	**2.14**	**2.03**	**Between**	**.077**	**1**	**.077**	**39.69***
			Within	**.053**	**27**	**.002**	

**Significant at 0.05 level of confidence.*

(The table values required for significance at 0.05 level of confidence for 1 & 28 and 1 & 27 are 4.20 and 4.21 respectively.)

Table II shows the pre-test mean scores of the experimental group and control group, which were 2.02 and 2.05 respectively. The obtained F-ratio was 3.87, which was lower than the required table value of 4.20 at the 0.05 level of significance. This indicates that there was no significant difference between the two groups before the training program.

In the post-test, the mean scores of the experimental group and control group were 2.13 and 2.03, respectively. The obtained F-ratio of 37.15 was greater than the table value of 4.20, showing a significant difference between the groups after the training period.

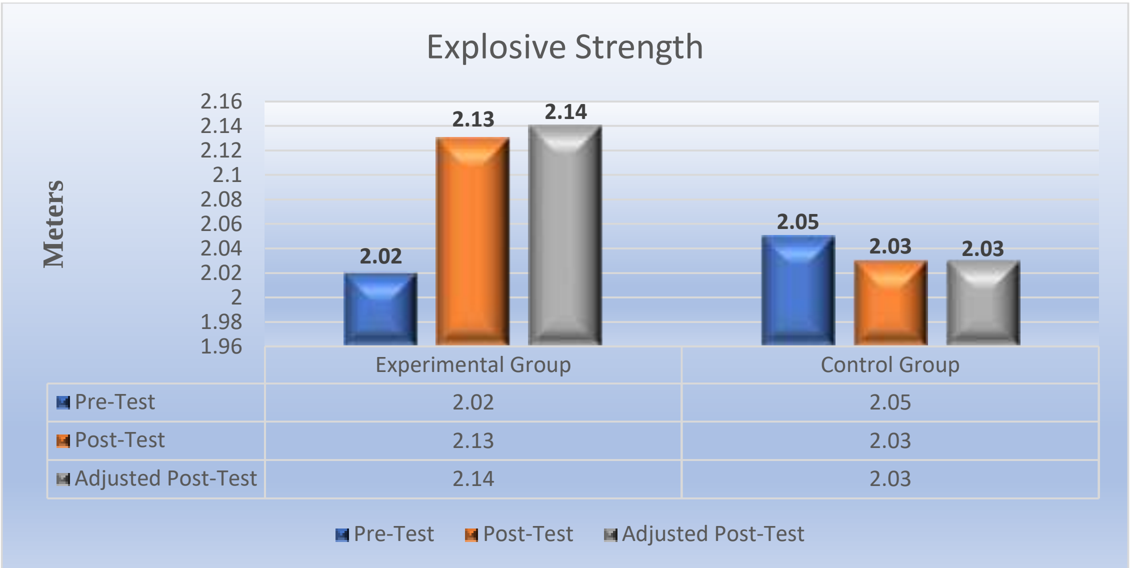
The adjusted post-test mean scores were 2.14 for the experimental group and 2.03 for the control group. The obtained F-ratio of 39.69 was higher than the required table value of 4.21, indicating a significant difference between the groups even after adjusting for the pre-test scores.

The results indicate that the experimental group showed greater improvement in explosive strength than the control group following the training program.

For a better understanding of the results, the pre-test, post-test, and adjusted post-test mean scores of the experimental and control groups are presented in Figure II.

Figure II

Bar chart illustrating pre-test, post-test and adjusted post-test mean scores on explosive strength.



Discussion

30 m Sprint Performance

The present investigation revealed a significant improvement in 30 m sprint performance in the experimental group compared with the control group following the intervention. The pre-test analysis demonstrated no significant difference between the two groups (F = 0.27), indicating that both groups possessed comparable sprinting ability before the commencement of training. However, significant differences emerged in the post-test (F = 7.33) and adjusted post-test (F = 22.29), confirming that the intervention was effective in improving sprint performance.

Sprinting ability represents one of the most decisive performance variables in modern soccer because players repeatedly perform maximal accelerations, high-speed running, and recovery sprints during competition. Improving sprint performance is an important objective of strength and conditioning programs (Di Salvo et al., 2009; Barnes et al., 2014).

Previous investigations have consistently demonstrated that improvements in maximal strength are strongly associated with faster sprint performance. Comfort et al. (2014) demonstrated that increases in lower-limb strength significantly improved sprint performance among rugby athletes through enhanced force production capabilities.

The findings of the present study are also supported by the work of Seitz and Haff (2016), who, in a comprehensive meta-analysis, concluded that resistance-based conditioning programs consistently improve sprint performance through post-activation performance enhancement and neuromuscular adaptations.

The observed reduction in sprint time from 4.85 s to 4.66 s in the experimental group, compared with only a marginal change in the control group, suggests that the training programme successfully improved the participants' ability to generate force rapidly during sprinting.

Explosive Strength

The findings further demonstrated that the experimental group achieved significantly greater improvements in explosive strength than the control group. Although no statistically significant difference was observed during the pre-test (F = 3.87), significant differences were evident during the post-test (F = 37.15) and adjusted post-test (F = 39.69), indicating the effectiveness of the intervention in enhancing lower-body power.

Actions such as jumping for headers, accelerating from stationary positions, tackling, kicking, and changing direction depend heavily on explosive muscular power (Turner & Jeffreys, 2010). Therefore, improving explosive strength contributes directly to match performance. Improvements in musculotendinous stiffness and the efficiency of the stretch-shortening cycle enable athletes to utilize stored elastic energy more effectively during explosive movements (Markovic & Mikulic, 2010).

The findings agree with those reported by Chelly et al. (2010), who observed significant improvements in jumping performance, sprint speed, and muscular power following lower-body resistance training in young soccer players. Likewise, Ramírez-Campillo et al. (2015) demonstrated that structured neuromuscular and plyometric training significantly enhanced explosive strength among youth soccer players.

The increase in explosive strength from 2.02 m to 2.13 m in the experimental group, together with the highly significant ANCOVA results, indicates that the intervention effectively enhanced the participants' explosive power.

The simultaneous improvements in sprint performance and explosive strength observed in the present study may be explained by complementary neuromuscular adaptations induced by the training intervention. Resistance and power-oriented training increase maximal voluntary force, improve neural activation, enhance muscle-tendon stiffness, and increase the efficiency of the stretch-shortening cycle (Cormie et al., 2011a). The findings of the present investigation are consistent with numerous previous studies reporting that structured strength and conditioning programmes improve sprint performance and explosive strength in soccer players. Wisloff et al. (2004), Chelly et al. (2010), Loturco et al. (2015), and Ramírez-Campillo et al. (2015) all demonstrated significant improvements in speed and power following resistance and neuromuscular training interventions. Similarly, recent systematic reviews by Suchomel et al. (2016), Seitz and Haff (2016), and Moran et al. (2017) concluded that improvements in muscular strength serve as the foundation for enhanced athletic performance across multiple explosive tasks.

Conclusion

The findings of this study illustrate that, when compared to soccer training alone, a six-week integrated strength and conditioning program in addition to normal soccer training greatly enhanced lower-body explosive strength and 30-meter sprint performance in U-17 soccer players. These gains show that regular soccer practice combined with age-appropriate, controlled strength and conditioning sessions improves important biomotor fitness elements necessary for soccer performance. In order to maximize athletic development and enhance match-related physical performance, coaches and practitioners are urged to incorporate evidence-based strength and conditioning into youth soccer training programs.

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