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The relationship Between Strength and Speed among Youth Soccer Players (U19)

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Abstract: This study examines the relationship and causal effect between strength training and sprint performance in under-19 football players, emphasizing the central role of these physical qualities in competitive contexts. Speed is a decisive factor in match play and a key criterion in youth talent identification, while muscular strength underpins the development of multiple physical capacities. A structured training program targeting horizontal and vertical force production was implemented with 20 amateur-level players. Sprint tests over 10 m and 30 m were conducted before and after the intervention to assess performance changes. The results revealed significant improvements in sprint speed following the strength-based program. Enhancements in lower-limb muscular strength were closely associated with better acceleration and start ability. These findings support the effectiveness of targeted strength training for speed development in this age group. The protocol may therefore be adopted by coaches within youth football preparation programs.

Keywords: Strength, Speed , Youth , Soccer .

Article info

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1. Introduction

To be competitive in soccer, it is important to be well physically prepared, preparing a soccer player in different ways (physiological and physical as well as psychological) is crucial to cope with situation in football match, this preparation takes a soccer player to the optimal training level by developing the physical abilities enabling him moving in different areas across a soccer field (el sayed, 2016).

Soccer is an intermittent sport activity, where two qualities (speed and strength) among others are very important (Iaia and coll., 2009). Success in soccer is related to pure speed ability (Arumugam and Suriya, 2018). It is known that up to 10 meter is an acceleration phase and a maximum speed is considered over that 35 meter when analyzing a 100 meter sprint (Delecluse and coll., 1995). In football, speed is known as important quality especially within short-distance as well as changing direction as bases of performance (Nicholsson et al., 2021). The percentage of sprinting is about 1.4 of all soccer game activity (Mohr et al., (2003). A soccer player has to excute sprint, recover, then redo it again throughout the entire game with high tempo (Abrantes et al., 2004)

Scoring goals in soccer is affected by the quality of player's speed , both for the one who scores or even the one who assist (Chmura et al., 2022). It's shown that almost all sprint distances are less than 30 meters, more interesting, half of it were completed within 10 meters (Stølen et coll., 2005). With time effort lasting between two to three seconds (Bangsbo and coll., 1991).

As an evidence, within adult players, strength training is a way to improve fitness in general and reduce the risk of injury, but within youth athletes, research showing these benefits are less and fewer (MacKay et al., 2004). Research made by Sáez-Sáez de Villarreal. (2010) concluded that plyometric training is responsible for improving strength. Since then, testing muscular strength during a season is both interesting monitoring performance and the risk of injuries (Lehnerand coll., 2014)

When investigating the relationship between strength and speed performance, it's shows that being strong make faster athlete (Baker et al., 1999; Comfort et al., 2012). A negative correlation was observed between time spent in speed training and isokinetic quadriceps strength (Hrysomallis et al., 2013). Both RFD (rate of force development) as well as MCS (Maximal concentric strength) are responsible of initiating movement acceleration (Sleivert and Taingahue, 2004). Another study showed that being able to make faster force is synonym of sprint improvement, as an example the drop jumping test. Bissas and Havenetidis, 2008)

When reaching the U19 category, usually a soccer player is approaching his final development state, studying the effect of strength on speed is interesting question, does improving muscular strength directly increase players' speed, which types of strength have the most impact on speed, so our main concern is investigating whether strength affect the development of speed in under-19 football players?

Helping soccer coaches especially Algerian coaches to improve their training regime through qualitative exercises is beneficial for better performance as well as mitigating injuries, in another way our protocol also may lead to better soccer talent identification and development in term of producing youth soccer players capable of reaching the international soccer standards. Through this study we hope to bridge a gap between theory and practice in the training methodology related to youth soccer players.

2. Theoretical section

2.1 Hypothesis

Based on our question, we came to the following hypothesis:

-Strength training in soccer significantly contributes to improving players' physical performance.

- Strength training can have an impact on other physical attributes.

- There is a relationship between strength training and speed improvement.

- A training program based on developing strength can help improve speed.

2.2 Objectives

Our main concern and objective can be resumed following the study of the impact of muscular strength on the quality of speed among U-19 soccer players, through this objective we could Analyze the relationship between strength training and improving speed, also Identifying the types of strength that most influence speed. As result, proposing an integrated training program that effectively combines the development of strength and speed.

2.3 Tasks

To verify the validity of the tools used in the research and the effectiveness of the procedures followed during the experiment, a pilot study was conducted on a sample of 20 players from the same under-19 soccer category. This study was conducted at the Al-Suwaidaniya Stadium. During this phase, a chronometer was used to measure the performance times in the 10m and 30m speed tests. The clarity of the instructions provided to the players was also confirmed. The time required to complete each test and the field conditions were also monitored.

2.4 Terminology

We think that some terms need to be clarified and highlighted:

-Strength: highest force of a single muscle or more can produce against resistance (source of internet)

-Speed: The rate of position and time (biomechanics courses)

-U19 category: Considered as the late adolescence stage in the process of youth development (approaching physical and psychological maturity). Very crucial in term of sports development, characterized by a possible way of leading towards professionalism (internet).

3. Experimental aspect

3.1 Methodology

Our group of research was deliberately selected, and included 20 soccer players out of 24 belonging to the amateur Al-Suwaidaniya team, which plays in the group called Honor Division Championship, for

the purpose of study we had two make two groups: experimental group and control group, the two groups train in the same manner except our experimental group has to experience our protocol.

The players undergo a regular training program consisting of four (4) training sessions per week, in addition to a match competition once week. It should be noted that most of the sample players have been training with the team for a period ranging between five and six years, gradually moving between the younger categories (from U13 to U15, then to U19), which provided them with a sense of group harmony and cohesion. The Field tests were conducted at the Souidania Municipal Stadium. The study was conducted from February 20 to April 28.

3.2 Research instruments

Theoretical Study

We relied on the bibliographic approach to construct the theoretical framework for the study, through reviewing and analyzing a group of academic sources relevant to the research topic. These sources included academic books and scientific articles as well as internet sources, and previous graduation theses

Training Program

A training program (protocol) was developed and implemented to develop speed for the experimental group of players through strength exercises, these types of exercises included particularly vertical and horizontal jumps, as these are among the most important exercises that contribute to improving explosiveness and accelerating.

The training program was implemented at the Swedaniya Stadium, with the participation of 20 players from the team. It extended over a period of approximately eight weeks, from the end of February to the end of April.

The training program consisted of weekly sessions, each of which included exercises aimed at developing strength through vertical jump exercises and horizontal jump exercises, following is our protocol:

- 1. Vertical jump

Exercise Description:

A set up consisting of 8 consecutive hurdles is made at equal distances.

-The athlete stands at the starting point.

-The athlete performs consecutive jumps with both feet over the hurdles without pausing, focusing on landing with only the tips of their toes to maintain fluidity and agility as basketball player.

- The track (jumping over all hurdles) is repeated 3 times as one series, maintaining the same movement form and precision, each player completes 3 series, with 2 minutes of rest between each series.

- 2 Horizontal Jumps

Exercise Description:

This exercise aims to develop explosive power and agility by performing intermittent horizontal jumps over low hurdles, with precise landing control and launching from semi-stationary positions.

• Eight (08) low hurdles are placed on the track, with each 2 hurdles forming a path for one jump (separated by a horizontal distance of approximately 80 cm).

• The athlete performs one double horizontal jump (with both feet) between each pair of hurdles.

• After each jump, the athlete pauses for a quick preparation (balance + readiness).

• The same pattern is repeated until four (04) jumps are completed
• Number of sets: 3/6
Rest: 2 minutes between sets.

3- Tests

We conducted a series of field tests to our two groups (experimental group and control group) before and after the protocol has been made. These tests were as follows:
- 10m and 30m speed test with objective to assess running speed over a specific distance.
- Equipment needed: A suitable space for the test, a stopwatch, a whistle, and cones.
Test Procedures: Upon receiving the starting signal, the player runs as fast as possible for a distance of 30m and 10m. Upon reaching the finish line, we stop the timer to record the time taken to cover the distance. Each player has three attempts, with the best attempt being recorded.

Statistical Analysis

The results were analyzed using SPSS Software. We used the average and standard deviation values. In order to compare between groups, we used the T test student for comparison.

Table No. (01): Represents a comparison of the results of the 10 m and 30 m speed test for the experimental group before and after the training program(protocol)

	Players number	Mean	SED	
10 m before protocol	10	1.70	± 0.09	P<0.05
10 m after protocol	10	1.67	± 0.08	
30 m before protocol	10	4.51	±0.19	
30 m after protocol	10	4.45	± 0.17	P<0.05

Table No. 1 shows the mean values and standard deviation. P: correlation coefficient for the differences in the 10 m as well as 30 m speed test for the experimental group before and after the training program.

Table No. (02): Represents a comparison of the results of the 10 m and 30 m speed test for the control group before and after the training program(protocol)

	Players number	Mean	SED	
10 m before protocol	10	1.81	± 0.08	P<0.05
10 m after protocol	10	1.82	± 0.08	
30 m before protocol	10	4.22	±0.09	
30 m after protocol	10	4.23	± 0.10	P<0.05

Table No. 02 shows the mean values and standard deviation. P: correlation coefficient for the differences in the 10 m as well as 30 m speed test for the control group before and after the training program.

Table No. (03): Represents a comparison of the results of the 10 m and 30 m speed test for the experimental group and control group before the training program(protocol)

	Players number	Mean	SED	
10 m experimental	10	1.70	± 0.09	P<0.05
10 m control	10	1.81	± 0.08	
30 m experimental	10	4.50	±0.07	P<0.01
30 m control	10	4.23	± 0.03	

Table No. 3 shows the mean values and standard deviation. P: correlation coefficient for the differences in the 10 m as well as 30 m speed test for experimental group and control group before the training program(protocol).

Table No. (04): Represents a comparison of the results of the 10 m and 30 m speed test for the experimental group and control group after the training program(protocol)

	Players number	Mean	SED	
10 m experimental	10	1.67	± 0.08	P<0.01
10 m control	10	1.82	± 0.08	
30 m experimental	10	4.45	±0.17	
30 m control	10	4.23	± 0.10	P<0.01

Table No. 4 shows the mean values and standard deviation. P: correlation coefficient for the differences in the 10 m and 30 m speed test for experimental group and control group after the training program(protocol)

4. RESULTS and DISCUSSION

Below, we will discuss our findings across two main axes: Axis number (01) discusses the results achieved between the two groups (control and experimental) **before** the training protocol then we do the same thing between the same groups **after** the training protocol, while Axis number two (02) discusses the results achieved regarding speed test performance before and after the training protocol for both groups.

<u>Axis number 01:</u> The results obtained between the two groups (control and experimental) before the protocol then after the training protocol.

In light of the results obtained during the tests before the training protocol, it was shown that the 10-meter sprint performance was better in the experimental group compared to the control group. This advantage was based on statistically significant differences (P<0.05). The opposite results were found for the 30-meter sprint performance, as the time achieved in the control group was better compared to the performance of the experimental group. This is leads us to say that sprint performance in the 10-meter sprint differs from sprint performance in the 30-meter sprint. In other words, the best 10-meter sprinter does not automatically guarantee that he is the best 30-meter sprinter. These results were confirmed even after implementing the training protocol, as we note that the results over the 10-meter sprint are better in the experimental group. On the other hand, the 30-meter sprint performance is considered the best in the control group. These results contradict the results obtained in the study of Santander et al. (2022), where the fastest players in the first 10 meters were the fastest in 30 meters. This discrepancy can be explained

by the nature of the sample and the age difference.

From this, we can say that implementing a specific training program for each distance requires a specific skill set. For example, running requires a certain amount of skill. Our argument is supported by some studies that have shown that the 5-meter distance requires certain specific skills, such as explosiveness and techniques such as a correct starting position, compared to other distances such as those for 10 and 30 meters (Marques and coll, 2011; Duthies and coll, 2006).

Our results are consistent with the results of the study, which confirms that elite soccer players differ from amateur soccer players in their performance over a distance of 10 meters, not 30 meters. This is because elite soccer requires players to perform at a high speed over short distances, with the majority demonstrating that high-intensity running movements are less than 20 meters. This highlights the importance of initial acceleration over short distances in soccer (Haugen et al., 2013).

Di Salvo and al. (2010) found that the number of efforts made during competition, with regard to distances covered, belongs the 0-5 meter zone compared to the higher zones. On the other hand, the results indicate that the use of strength training (such as weight training or jumping exercises) during training may be necessary to improve speed over a distance of 5 to 10 meters, demonstrating the importance of players in team sports such as football incorporating specific protocols (i.e., weight training and jumping exercises) into their training regimens.

Therefore, our conclusion is in line with the same view, which indicates that although developing acceleration (less than 20 meters) is important for most athletes, it's also important developing speed in more distances (i.e., 30 meters or more). Coaches should try to use the most appropriate protocols for developing speed over specific distances (i.e., 0-10, 20-0-0, 30-0, and 31 meters). For example, resistance training is used as an attempt to improve speed over distances up to 20 meters, on the other hand, according to Santander et al. (2022), distances of 5, 10, 15, and also 20 meters are suitable evaluating acceleration, while distances greater than 20 meters are used to evaluate maximum speed.

<u>Axis number 01:</u> The results obtained regarding the speed test performance before and after the training protocol for both groups.

The results obtained regarding speed performances before and after implementing the protocol show that speed performance over distances of 10 meters and 30 meters in the experimental group was better after implementing the protocol compared to the same speeds (10 and 30 meters) before implementing the protocol. This indicates an improvement in speed performance based on training. There were statistically significant differences of ($P<0.05$) for the 10 meters and ($P<0.05$) for the 30 meters. Our results are consistent with the results of a study that demonstrated that strength training can improve short-distance speed (Lockie et al., 2012).

With reference to our training protocol, our results are also consistent with those indicating that the application of horizontal-force producing exercises leads to greater propulsion, which enhances acceleration development. Our results are also consistent with those stating that the use of plyometric exercises, such as repeated jumps, in training sessions is an effective way of improving the strength of the lower limb muscles, and thus leads to an increase in jumping level, as well as running speed (Hunter et al. 2005), in movement and agility, in addition to the best change in direction and movement (Psarras I L and Bogdanis G C, 2024)

For example, another study, a 6-week strength training program with jumping drills in addition to a soccer training program, resulted in improvements in 20-meter sprint performance (Márquez-Franco et al., 2015). In a similar study to ours (under 19 years of age), which combined plyometric jump training with linear speed training in male soccer players, this program led to improvements in the squat jump (SJ), counter jump (CMJ), standing long jump (BJ), 5-meter and 20-meter linear speed, and change of direction speed (Aloui and al., 2015).

Rimmer and Sleivert. (2000); Mero and Komi. (1994) and Young .(1992) suggested that jumping could be considered a specific exercise that uses the muscle eccentric and concentric cycle to develop acceleration. These exercises are characterized by contact times similar to sprinting during the initial acceleration phase, and thus a more practical transfer of explosive power to speed can occur. Sprinters also require strong leg and back muscles to perform speed, and the maximum power gained in squats and deadlifts has been closely linked (Wisloff et coll., 2004).

While plyometric training has shown opposite results, in one hand, plyometric training has improved 10-meter sprint performance for PE students and rugby players, but not the same improvement in four (04) and twelve (12) meter sprint performance in novice tennis players (Lockie R G et al., 2012). A study conducted on adolescent soccer players showed that 20-meter sprint performance improved during a 7-week plyometric training program coupled with soccer practice (Ramírez-Campillo et al., 2014).Further research is needed to determine whether typical lower-body training, using weights alone or plyometric exercises, ultimately improves sprint acceleration and the technical mechanisms that may lead to this. Training protocols that encourage high force production (i.e., weight training or jumping exercises) may be needed to improve performance in the transition from acceleration to maximum speed in team sports (Lockie G.R et al., 2012).

Speed performance is affected by multiple causes, such as the strength of the quadriceps and the explosive capabilities of the lower extremities. A correlation between the counter-movement jump (CMJ), the squat jump (SJ), or the full squat and speed over distances of 5 meters, 10 meters, 20 meters, and 30 meters (Dragula et al., 2017).

On the other hand, the effect of jumping exercises on speed performance can be due to mechanical identity (e.g., flexion/extension movements, foot contact), which lead to increased force production at ground contact (i.e., improved stride length) and rapid leg swing (Washif D J et Kok L Y, 2021).

5. CONCLUSION

In conclusion, this study, which examined the effect of strength training on developing speed in under-19 football players, can be concluded that the results obtained confirm the effectiveness of our training program, particularly in improving performance in short-distance speed tests (10m and 30m). The statistical differences between the pre- and post-test measurements revealed a positive and tangible effect of targeted strength training, proving its vital role in developing this essential quality in modern football performance. This study also opens the door for further research designing other strength protocol and their impact in different speed distances. Therefore, this study contributes to enriching the scientific literature on training young players and encourages the use of scientific methods in constructing and analyzing training programs, also our study is snapshot of the level of Algerian soccer players, that we hope to be raised to international level. Our study may have some limitation especially the nature of our group level of competition, it is interesting to expand this study to elite or sub-elite groups.

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