ORIGINAL ARTICLE

The relationship between sprint performance and both lower and upper extremity explosive strength in young soccer players

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Abstract

Purpose: Sprint performance plays a major role in success of field-based team sports such as soccer. The aim of this study was to evaluate the relationship between sprinting performance and both lower and upper extremity explosive strength in young soccer players.

Material: One hundred forty-seven soccer players (mean±SD; age 11.6±1.66 years, height 143.2±11.8 cm, body mass 37.1±10.2 kg and training experience 1.11±1.5 years) voluntarily participated in this study. The sprinting performance of each player was determined using their 5, 10, 20 and 30m single sprint times. The lower and upper extremity explosive strength were evaluated by standing long jump and medicine ball throwing tests respectively. Prior to the study, each of the players was given detailed information about the risks and injuries they could encounter during the study, and parental consent was obtained by their signatures on informed voluntary consent forms since the subjects were under the age of 18. Permission to conduct the study was obtained from Ankara University Medical Faculty's Surgical and Medical Research Ethics Committee.

Results: The results indicated a strong relationship between sprinting performance and horizontal jump performance (r=-.671– -.764; p=0.001) and also a large relationship between sprinting performance and upper extremity strength (r=-.633 – -.703; p=0.001). The sprint performance (n=147) also significantly correlated with body weight (r=-.345 – -.373; p=0.001) and height (r=-.445 – -.505; p=0.001).

Conclusions: The study results suggest that upper extremity strength is as important as the lower extremity strength for sprinting performance and that trainers should emphasize lower and upper extremity strength in training intended to improve sprinting performance.

Keywords: sprinting performance, standing long jump, explosive strength, football

Introduction

For reasons such as high physical requirements, frequent change in exercise intensity and the vast number of movement profiles, in soccer, both adults and children must maintain their physical capacity at an optimal level. For a soccer player, this relates to having several superior physical characteristics. Among these characteristics, sprinting speed plays a major role in the success of field-based team players such as soccer players. For instance, it was reported in an analysis that a total of 360 goals scored during the 2007-2009 soccer seasons of Germany's Bundesliga and that 45% of the goals scored were achieved by straight sprinting and that straight sprinting was the dominant activity of players when scoring [1].

The average sprinting distance of a player during a soccer match was reported to be 600 meters [2]. 96% of this distance was shorter than 30 meters [3]. Accordingly, velocity, particularly the maximum velocity before reaching 30 meters, is a subject to be addressed. Defining the factors that affect sprinting velocity in the first 30 meters will contribute to improving sprinting performance. Lower and upper extremity strength is also considered to be affect sprinting performance. The standing long jump test can be used to determine lower extremity strength. This is a single jump attempting to make as much horizontal movement as possible in the air with both feet parallel to each other [4]. It is generally used to evaluate the lower extremity explosive strength of athletes [5, 6]. The medicine ball throw test was also used to measure upper extremity explosive strength.

Individual physical and physiological properties should be taken into account when evaluating the results of these tests. Age is an important factor. The movement system is affected by age-related changes, and these changes affect physical performance [7]. The improvement of acceleration and maximum velocity is possible through proper exercises during childhood [8]. Some studies examined the relationship between velocity and strength in soccer in the literature [9, 10]. The inadequacy of the studies on the relationship between sprinting performance and both lower and upper body explosive strength in young soccer players is the starting point of this study.

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In a study carried out on 15 soccer players with an average age of 16y, Köklü et al. [9] found moderate-strong relationships between 10 and 30m sprinting performances and vertical jump performance (r =-.599). Furthermore, in a study carried out on 14 soccer players with an average age of 20y, Lopez-Segovia et al. [10] found a relationship between the vertical jump performance and sprint performance of the players (r=-.46 − -.61) . These studies indicate the importance of the explosive strength in their respective populations. In our study, the objective was to evaluate the relationship between sprinting performance and the lower and upper extremity explosive strength in young soccer players.

Material and Methods

Experimental Approach to the Problem

This study was designed to investigate the relationships between sprint performance (times over 5, 10, 20 and 30m) jump performance (horizontal jump performance) and ball throwing performance (medicine ball throwing test) in trained (4 times per week) young soccer players.

Sprint performances over 5, 10, 20 and 30 m were selected because these are representative of sprint distances covered during competitive soccer matches [11], whereas the jump and ball throwing protocols were selected because they are commonly used to assess such athletes.

Participants

One hundred forty-seven male soccer players (mean±SD; age 11.6±1.66 years, height 143.2±11.8 cm, body mass 37.1±10.2 kg and training experience 1.11±1.5 years) voluntarily participated in the study. The study was carried out in the 2013-2014 soccer season before the competition period and after the preparation period, during which the soccer players were not engaged in any other training or soccer match. Prior to the study, each of the players was given detailed information about the risks and injuries they could encounter during the study, and parental consent was obtained by their signatures on informed voluntary consent forms since the subjects were under the age of 18. Permission to conduct the study was obtained from Ankara University Medical Faculty's Surgical and Medical Research Ethics Committee.

Research Design.

Tests

All athletes rested the day before testing and were asked to attend testing in a fed and hydrated state, similar to their normal practices before training. In addition, participants were asked to avoid caffeine consumption 24h before testing. Before the tests, soccer warm-up exercises were performed for 15 minutes. Then the physical measurements (height and weight) and performance tests (5, 10, 20, 30m sprinting, medicine ball throwing test and standing long jump test) were conducted.

The Five, Ten, Twenty and Thirty Meter Sprint tests

An electronic timing system (Prosport TMR ESC 2100, Tümer Engineering, Ankara) with the capability to record a hundredth of a second was used to determine 5, 10, 20, 30m sprint velocities. Photocells were placed at the starting point, 5, 10, 20, 30m distances. At the starting line of the 30 meters distance, the subjects took a standing position with one of their knees in the front and the other in the back. Their velocities at 5, 10, 20, 30m were recorded in meters/second. Each player ran twice, and 3 minutes of resting time was allowed to each participant between the two runs.

The Medicine Ball Throwing Test

A medicine ball weighing 1 kilogram with a 66-centimeter circumference and a measuring tape were used for the ball throwing test. Players were asked to stand at a line marked with tape and to throw the medicine ball forward over their heads in the throw-in position. The ball's first point of contact with the ground was measured using the measuring tape and recorded. The best one of two throws were used for analysis.

The Standing Long Jump Test

The players were asked to open their legs shoulder wide and stand with their feet behind the line. A ruler was used to ensure that their tiptoes were at the same distance from the line. They were instructed to bend their knees and sway their arms backward. Then, they were asked to jump as far as possible and stand still at the point where they landed. The distance from the heel nearest to the line was measured. The best one of two jumps were used for analysis.

Statistical Analysis:

Statistical analysis was performed using SPSS 19.0 software. The distribution of the data was evaluated using the Shapiro-Wilk normal distribution test and variance and homogeneity were tested using Levene's test. Due to the non-parametric character of the data, the relationships between the parameters were evaluated using Spearman's correlation test.

Results

The soccer players' physical characteristics and test performance are listed in Table 1.

There was a strong relationship between the 5, 10, 20, 30m sprint performance and lower extremity explosive strength (r=-.671 − -.764) , also the upper extremity explosive strength correlated with 5, 10, 20, 30m sprint performance (r=-.633 − -.703).

The correlation coefficients were highest between the 30m sprint and standing long jump performance (r=-.764; p=0.001) virtually in all cases compared to 5, 10 and 20m sprint performance. The relationship between the sprint performance of a sub-group of 13-14 years old (n=57) participants and their standing long jump performance (r=-.731; p=0.001) was stronger compared to 9-10 (n=38) and 11-12 (n=52) years old sub-groups in all sprint distances of 5, 10, 20 and 30m (Table 2).

There was a strong correlation between the 5, 10, 20, 30m sprint and medicine ball throwing performance (n=147; r=-.633 − -.703; p=0.001). However, the sprint performance of the sub-groups of 9-10, 11-12 and 13-14 years old participants had a relatively low correlation with medicine ball throwing performance (Table 2).

The sprint performance of the participants (n=147)

Table 1. The soccer players' physical characteristics and test performances (n=147)

Characteristics	Mean	Standard Deviation
Age (years)	11.7	1.66
Height (cm)	143.6	11.8
Body mass (kg)	37.1	10.2
Training experience (months)	23.1	17.0
5m Sprint (s)	1.146	0.1
10m Sprint (s)	2.051	0.2
20 m Sprint (s)	3.698	0.3
30 m Sprint (s)	5.357	0.5
Standing Long Jump (cm)	154.51	22.4
Medicine ball throwing (cm)	470.17	144

Table 2. The correlation coefficients between sprint speed, standing long jump and medicine ball throwing performance.

Age	Task	5m Sprint	10m Sprint	20m Sprint	30m Sprint
9-10 years n=38	Standing Long Jump	-.347	-.367	-.496	-.503
	p	0.033	0.023	0.002	0.001
	Medicine Ball Throwing	-.408	-.530	-.503	-.430
	p	0.011	0.001	0.001	0.007
11-12 years n=52	Standing Long Jump	-.445	-.522	-.507	-.511
	p	0.001	0.001	0.001	0.001
	Medicine Ball Throwing	-.148	-.288	-.364	-.421
	p	0.296	0.038	0.008	0.002
13-14 years n=57	Standing Long Jump	-.569	-.616	-.665	-.731
	p	0.001	0.001	0.001	0.001
	Medicine Ball Throwing	-.411	-.488	-.434	-.410
	p	0.001	0.001	0.001	0.002
Total n=147	Standing Long Jump	-.671	-.721	-.740	-.764
	p	0.001	0.001	0.001	0.001
	Medicine Ball Throwing	-.633	-.692	-.700	-.703
	p	0.001	0.001	0.001	0.001

also significantly correlated with their body weight (r=-.345 − -.373; p=0.001) and height (r=-.445 − -.505; p=0.001).

Discussion

The aim of this study was to evaluate the relationship between the maximum velocity of young soccer players and their lower and upper extremity explosive strength. In consideration of the close relationship between these parameters and the rate of success in soccer, the relationship between these variables was evaluated, and statistically significant relationships were found.

There are other studies in agreement with the results of our study in terms of the relationship between maximum sprint velocity and horizontal jump performance. Jones & Lorenzo [12] reported a significant relationship (r=-0.64) between the 18.2 meter maximum velocity and horizontal jump performance of the athletes with an average age of 11.7. In the study conducted with young baseball players, Nakata et al. [13] found a strong relationship (r=-0.78) between 10 meter sprint maximum velocity and horizontal jump performance. Tambalis [14] investigated the relationship between 30 meter sprinting performance and horizontal jump performance of children between the ages of 7 and 10 and reported a moderate relationship (r=-.46). Additionally, Hammami et al. [15] found a moderate relationship (r=-0.40-0.48) between the maximum sprinting performance and vertical and horizontal jump performance of children (8-14 years old).

The relationship between sprinting performance and vertical jump performance has also aroused interest in the literature. Swinton et al. [16] reported a strong relationship (r=-0.52-0.82) between the 5-10-30 meter sprinting performance and vertical jump performance. In their study, Wisløff et al. [17] reported a moderate relationship between the vertical jump and maximum velocity performances (r=-0.55- -0.60). Erikoğlu & Arslan [18] found a significant relationship between 30 meter sprinting and vertical jump performances. Köklü et al. [9] reported a strong relationship (r=-0.59) between maximum velocity of 30 meter sprint and vertical jump performance. They suggest that the relationship between maximum velocity and jump performance can be attributed to the high strength requirement of both activities with similar energy requirements. Comfort [19] found a strong relationship (r=-0.87) between maximum sprint velocity and vertical jump performance, and they underlined the importance of improving the lower extremity strength to improve sprinting and jumping performance. In addition, Cronin & Hansen [20] found a moderate relationship (r=−0.43 −0.66) between the vertical jump and 5-10- 30 meter sprinting performances of rugby players. In contrast to these studies, Chamari et al. [21] found no relationship between the 20 meter, 30 meter sprinting performance and vertical jump performance. These varying results are attributed to the varying ages, training conditions, sports as well as being elite or non-elite athletes.

This study indicated that the relationship between the sprinting performance and lower and upper extremity strength becomes stronger at increased sprinting distances. The 10 meter sprinting distance indicates acceleration, and the 30 meter sprinting distance indicates maximum velocity [22]. These results indicate that the lower and upper extremity explosive strength has a strong relationship with the maximum sprint velocity. This is attributed to the increased muscle strength requirement from the lower and upper extremity at increased sprinting distances. The study results also showed that the sprint performance enhances with age and the relationship between the sprint performance and both upper and lower extremity explosive strength becomes larger with age. In a study conducted with a large sample of boys (n=375; 11-16 years old), Meyers et al. [23] concluded that the additional leg compression increases with age and may provide beneficial effects in sprint performance.

The relationship between maximum sprinting performance and horizontal jump performance can be ascribed to the maximal activity requirement of both types of performances, both of which call for horizontal movement of the centre of gravity. In the literature, some studies investigated the relationship between the maximum velocity performance and upper extremity strength of athletes. Tambalis et al. [14] found a moderate relationship (r=-0.42) between the 30 meter maximum velocity and medicine ball throwing performance of children. As opposed to the present study, Jones & Lorenzo [12] found a weak relationship (r=-0.14) between the maximum velocity and medicine ball throwing performance of young athletes.

Conclusions

In conclusion, the relationship between the maximum sprint velocity and lower and upper extremity strength can be considered to be in direct proportion with explosive strength. The study results also suggest that upper extremity strength is as important as lower extremity strength, and that trainers should emphasize lower and upper extremity strength in training targeted to improve sprinting performance.

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Conflict of interest

The authors declare no conflict of interest

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