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Evaluation of the Relationship between Sprint and Change of Direction Speed in Youth Male Soccer Players Using Two Vertical Jumping Tests

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Abstract

The purpose of this study was to determine the relationship between change of direction speed, acceleration, and maximal velocity using both the countermovement jump and squat jump for young soccer players. A total of 77 healthy male soccer players who played football in different amateur clubs, regularly practiced soccer training voluntarily participated in this study. Youth soccer players tested for speed over 10 and 30 m, CODS (T-test, 505 change-of-direction) and power (countermovement jump and squat jump). Pearson's correlation was used to determine relationships between all parameters. Players displayed a significant negative weak correlation between counter movement jump, squat jump, T-test and 505 change-of-direction speeds. When anaerobic power and agility performances were assessed, a weak negative correlation was found between countermovement and squat Gmax and T-test while a moderate correlation was found between the 505 Agility Test. There was a moderate negative correlation between the countermovement jump and 10-m acceleration test and 30-m maximal speed test. A negative weak correlation was also found between squat jump and 10-m acceleration test and moderate correlation between 30-m maximal speed test. When the relationship between anaerobic power and speed tests was examined, it was found that there was a weak negative correlation between countermovement Gmax and squat Gmax and 10-m acceleration test, while moderate negative correlation was detected between countermovement Gmax and squat Gmax and 30-m maximal velocity test. Also, a significant negative moderate correlation between 10-m acceleration test values of the athletes and 505 Agility Test and T-test was determined. There was a negative moderate to strong correlation was found between 30-m maximal speed test values of the athletes and 505 Agility Test and T-test. In conclusion, it can be said that muscle power has positive effects on sprint abilities of youth amateur soccer players.

Keywords: Soccer, agility, power, change of direction speed, linear speed

Genç Erkek Futbolcularda Farklı İki Dikey Sıçrama Testi ile Sprint ve Yön Değişim Zamanı Arasındaki İlişki

Abstract

Güç üretiminin hızlanma, maksimum hız ve çeviklik nitelikleri için bir temel sağladığına inanılmaktadır. Bu çalışma ile genç futbolcularda, aktif ve skuat sıçrama performansları ile hızlanma, maksimal hız ve yön değişim performansları arasındaki ilişki incelendi. Çalışmaya, Uşak ilinde farklı amatör spor kulüplerinde futbol oynayan, düzenli antrenman yapan, gönüllü olarak çalışamaya katılmayı kabul eden 77 sağlıklı erkek sporcu katıldı. Katılımcıların sıçrama performansları aktif ve skuat sıçrama testleri ile hız değerleri 10 m ve 30 m testi ile ve çeviklik değerleri ise 505 çeviklik ve T-test ile belirlendi. Bütün parametreler arasındaki ilişki Pearson Korelasyon Analizi ile değerlendirildi. Sporcuların aktif ve skuat sıçrama ile T-test ve 505 Çeviklik test değerleri arasında negatif yönde zayıf korelasyon tespit edildi ($p< 0.01$). Anaerobik güç ile çeviklik performansları değerlendirildiğinde, Aktif Gmaks ile Skuat Gmaks T-test değerleri arasında negatif yönde zayıf bir korelasyon tespit edilirken, 505 Çeviklik testi değerleri arasında ise negatif yönde orta bir korelasyon tespit edildi ($p< 0.01$). Aktif sıçrama ile 10 m ivmelenme testi ve 30 m maksimal hız değerleri arasında negatif yönde orta korelasyon olduğu tespit edilirken, skuat sıçrama ile 10 m ivmelenme testi değerleri arasında negatif yönde zayıf korelasyon 30 m maksimal hız testi arasında ise negatif yönde orta korelasyon tespit edildi ($p< 0.01$). Anaerobik güç ile hız testleri arasındaki ilişki incelendiğinde, Aktif Gmaks ve Skuat Gmaks ile 10 m ivmelenme testi değerleri arasında negatif yönde zayıf bir korelasyon, 30 m maksimal hız testi değerleri arasında ise negatif yönde orta bir korelasyon olduğu bulundu ($p< 0.01$). Sporcuların 10 m ivmelenme test değerleri ile 505 Çeviklik test ve T-test değerleri arasında negatif yönde orta korelasyon, 30 m maksimal hız testi değerleri ile 505 Çeviklik testi ve T-test değerleri arasında ise negatif yönde orta-güçlü bir korelasyon olduğu tespit edildi ($p< 0.01$). Sonuç olarak, bu çalışma amatör futbolcularda gücün hız yeteneği üzerinde olumlu etkileri olduğunu göstermektedir.

Anahtar Kelimeler: Futbol, çeviklik, güç, yön değişimi, doğrusal hız.

1 Introduction

Soccer is a sport which involves various activities including specific motor features as sprint, running, dribbling, jumping and kicking during a competition (Stølen et al., 2005). Performance levels of soccer players are based on many variables as aerobic capacity, speed, lower extremity strength, power and acceleration (Reilly et al., 2001). High-intensity movements in soccer are categorized as the acceleration, maximum speed or agility (Gambetta, 1996). Speed and agility are considered as the two physical skills that have great importance in soccer (Reilly et al., 2001). During the soccer matches, players perform approximately 1300 changes in activity including 220 high-intensity efforts (Stølen et al., 2005; Vigne et al., 2010) and 2-4 accelerations for every 90 seconds in near maximum speed (McFarland et al., 2016). Consequently, skills as jumping, acceleration and change of direction are the features which are often evaluated in soccer (Hoff, 2005).

Relationship between the jump performance, sprint performance and change of direction skills of the players were examined in many studies (McFarland et al., 2016; VolpiBraz et al. 2017; Meylan et al. 2009; Wisloff et al., 2004; Los Arcos et al., 2017; Little & Williams, 2005). Hori et al. (2008) found a significant relationship between countermovement jump and sprint speed (20-m) and change of direction performance (5-0-5) in a study conducted with Australian semi-professional male soccer players. Yanci et al. (2014) reported in their study on young amateur male players that there was a weak negative correlation between countermovement and squat jump tests and sprint (10-m) performance while it was a moderate negative correlation for change of direction skills (5-0-5). It is observed in the same study that size of correlations between changing direction, sprint speed and jumping performance vary from 0.09 to 0.69. In another study by Little and Williams (2005) on a group of professional male players, it was indicated that acceleration (10-m sprint time), maximum speed (20-m sprint time) and agility are different motor features. Also, it was stated that although the skills as sprint and jumping, which are commonly used in sports, have similarities in terms of biomechanics and kinematics (Zajac, 2002), it is hard to determine the relationships between these motor skills (Vescovi et al., 2008).

Countermovement jump (CMJ) and squat jump (SJ) tests are the frequently preferred field-tests used for evaluating the lower-extremity strength (Cardinale et al., 2011). Although CMJ and SJ are not a direct measurement of strength, the height of jump is a measurable result of power development which can be applied to various branches and they are used by coaches as an easy and cost-free evaluation method. To illustrate, Shalfawi et al. (2014) found in a study conducted with highly trained female players that there is a strong correlation between SJ performance and acceleration speed (0-20 m) and CMJ and maximum sprint speed (20-40 m). The results obtained from the studies illustrate the difficulty of detecting relationships between various field-tests. In addition, it might be said that there is no consensus on the relationship between these three capabilities.

It is known that the performance, which is measured with vertical jump and sprint tests is essential in terms of soccer performance evaluation (Bangsbo, 1994). Additionally, it is reported that basic movement patterns require a great agility (Ellis et al, 2000). The aim of this study is to examine the relationship between the power development which is measured with countermovement and squat jump and acceleration, maximum speed and change of direction performance among youth male soccer players.

2 Material and Methods

Approval 2017/1 by the Health Sciences Research Ethics Committee of Uşak University was received on 08.02.2017 prior to the study and the athletes were informed about benefits and risks before participation and signing volunteer consent form. The study was carried out in accordance with the principles of the Declaration of Helsinki. All tests were performed during the competition season 2017/2018 and sessions were planned to be 48 hours later from competition or an intense exercise. Athletes were asked to wear clothes and shoes which would not restrict their movements during the measurements. The order of the tests was organized as preventing one from affecting the others' performance. All the tests were performed in a single session in an indoor basketball court on the purpose of maintaining a consistent test surface and eliminating the factors as rain and wind. After personal information, anthropometric measurements and height and weight measurements were received for each athlete, 10 min warm-up including 5 min jogging, high knees and dynamic stretching exercises as Frankenstein and sprint running were performed under the supervision of the researcher (Avila et al., 2015). Participants were allowed to have 10 sec break for each test and perform 2-3 submaximal testing before the sessions.

After the trials, athletes were given a 2-minute passive rest and they randomly performed CMJ and SJ tests at the same time before 505 agility and T-test. All athletes participated in a 30 m sprint running test after completing the others. 30 sec rest between two measurements and 5-minute rest between two different tests were allowed to minimize any fatigue resulting from the previous measurements (Murtagh et al., 2018). Each participant was tested twice and the best rating was recorded as agility rating.

2.1 *Participants*

77 healthy male soccer players (age, 18.3±0.29 years; height 176.2±0.79 cm; weight, 67±0.95 kg, body mass index, 21.6±0.25 kg/m2 and start age, 5.1±0.36 years) from different amateur clubs and training 5 or 6 times a week (~ 90 minutes) voluntarily participated in the study. Goalkeepers were not included in the study as they perform different movement patterns by comparison with the other players (Bishop et. al., 2011).

2.2 Measurements

Anthropometric Measurements: Athletes' standing height measurements in meters were performed using a ruler over their heads, parallel to the ground as they leaning back on the wall. Measurements were performed with barefoot, heels together, body and head looking straight ahead (Özer, 1993). Athletes were asked to breath deep and stand erect during the measurements. The data obtained were recorded as centimeters (cm). Body weights of the athletes were measured feet naked, in their shorts and a t-shirts (Özer, 1993) using a scale (Tanita) with an accuracy of ± 0.01 kg.

Countermovement and Squat Jump Tests: Jumping performance was evaluated using a SmartJump (Jump/Timing Device) and two different tests as CMJ and SJ. The athletes were warned about looking straightly to a point in order to provide falling on the same spot of the mat during jump assessments. CMJ and SJ tests were repeated twice and the best rating was taken into consideration (Lockie et al., 2017). During squat jump, athletes were asked to jump vertically in squat position (knee ~90°) on the map as placing their hands on the hips and applying maximal strength without a downward movement. During countermovement jump, they were asked to make an immediate downward movement starting from upright standing position with maximal strength in order to isolate lower extremity and eliminate the contribution of the technique and arm swing (Hara et al., 2008). Measured jump heights were recorded in centimeter after the tests.

After the best height ranging were determined, anaerobic power (Gmax) of the athletes were calculated in kilogram/meter using the following formula (Rogers, 1990).

Gmax (kg m/s): √ 4.9 x body weight (kg) x √ jump height (cm)

505 Agility Test: 505 Agility test which includes five meters sprint with a turn (180°) and a further sprint after a ten meter run up was used in order to evaluate the agility (Lockie et al., 2017). Photocells were placed in 10. and 15. meters of the 15-meter track. After participants made the flying start, they ran back to the first photocells with a 180° turn from 15. meter and the time was recorded. Each participant was tested twice and the best rating was recorded as agility rating.

T-Test of Agility: Three of the cones were placed on a line standing 4,57 m apart from each other. The cones were placed in the shape of a "T" in 9,17 m distance. The test was applied as shuffling to the left, right and backwards running. Athletes had a straight body position as placing one leg behind the starting line (0 meter). They were asked to make a slight forward lean for 3 seconds at least before the start. Measurement results were recorded in seconds. The best ranging obtained in the two tests was recorded (Pauole et al., 2000).

10 m and 30 m: Sprint speed (10 m and 30 m) was measured with photocells in a closed area. The first, second and third timers were placed respectively as 0 m, 10 m and 30 m apart from the starting line. When times for 10 m provided an acceleration criteria, times for 30 m was recorded as the maximum sprint speed (McFarland et al., 2016). Each athlete had two testings and the best ranging was taken into evaluation.

2.3 *Data Analysis*

Statistical analyses of the obtained values were performed using IBM SPSS (Ver. 23). Primarily, arithmetic mean of the data, standard deviation values and a 95% confidence interval for each variable were calculated. Measures of Skewness and Kurtosis were examined to reveal whether data are in accordance with the normal distribution. In order to determine the relationship between variables, CMJ, SJ, acceleration, maximum speed and agility speed, Pearson correlation analysis was applied. Significance level was interpreted as $p \leq 0.05$ for all calculations and r-values were interpreted as weak (≤ 0.39), moderate (≤ 0.40-0.69) or strong (≥ 0.70) (Cohen et al., 2014).

3 Results and Discussion

The athletes' performance characteristics were given in Table 1.

A weak negative correlation was found between CMJ, T-test and 505 Agility tests while it was the same for SJ and T-test and 505 Agility tests, respectively. When anaerobic power and agility performances were evaluated, a weak negative correlation was found between Countermovement Gmax and T-test values while a moderate negative correlation was found for 505 Agility test. Similarly, a weak negative correlation was found between Squat Gmax and T-test values while a moderate negative correlation was found for 505 Agility test. A moderate negative correlation was found between CMJ and 10 m acceleration and 30 m maximal speed values while it was a weak negative correlation between SJ and 10 m acceleration test values and a moderate negative correlation between SJ and 30 m maximal speed test. A weak negative correlation was also found between Countermovement Gmax and 10 m acceleration test results while it was a moderate correlation for 30 m maximal speed tests. A weak negative correlation was also found between Squat Gmax and 10 m acceleration test results while it was a moderate correlation for 30 m maximal speed (Table 2).

A medium negative correlation was found between 10 m acceleration test and 505 and T-test agility test values. Also, a medium-strong negative correlation is determined between and 30 m maximal speed performance and 505 and T-test agility test values (Table 3).

Table 1. Performance characteristics of the participants (n=77).

Variables	Mean ± Sd.	95% Confidence Interval [CI]
10 m Acceleration (s)	1.6 ± 0.02	1.57 – 1.64
30 m Maximum Speed (s)	4.26 ± 0.03	4.2 – 4.31
505 Agility Test (s)	2.66 ± 0.02	2.62 – 2.7
T-test (s)	10.4 ± 0.08	10.2 – 10.5
CMJ (cm)	38.9 ± 0.64	37.6 – 40.1
SJ (cm)	36 ± 0.6	34.8 – 37.2
Active G_{max} (kgm/s)	75.4 ± 0.81	73.8 – 77
Squat G_{max} (kgm/s)	72.7 ± 0.76	71.2 – 74.2

Table 2. Participants jump, anaerobic power, agility, acceleration and maximum speed correlations (r-values) (n = 77).

	Agility (s)		Speed (s)	
Power	T-Test	505	10 m	30 m
CMJ (cm)	- 0.20	- 0.38**	- 0.40**	- 0.44**
SJ (cm)	- 0.19	- 0.30**	- 0.30**	- 0.47**
Active G_{max} (kgm/s)	- 0.37**	- 0.46**	- 0.31**	- 0.46**
Squat G_{max} (kgm/s)	- 0.37**	- 0.42**	- 0.25*	- 0.50**

*** p<0.01; *p<0.05*

Table 3. Correlation between speed and agility (r-values) (n=77).

	Agility (s)	
Speed	505 Agility	T-test
10 m (s)	0.44**	0.40**
30 m (s)	0.57**	0.64**

*** p<0.01*

4 Conclusion

In conclusion, when the obtained results are evaluated it can be concluded that field-tests might be useful and specific research method for soccer players. Additionally, although jump performances are not a power measurement directly, jumping height is a measurable result of power development which can be applied to various branches and it is recommended to be used in further studies as an easy, cost-effective evaluation method for coaches.

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