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ANALYSIS OF THE RELATIONSHIP BETWEEN CHANGE OF DIRECTION ABILITY, SPEED AND POWER IN ADOLESCENCE

Gürkan Diker[1], Raif Zileli[2], Hüseyin Özkamçı[3], Sadi Ön[4]

ABSTRACT

Sprint, change of direction, jump performance plays a major role in success of field-based team sports such as football. This study aims to indicate the relationship between linear sprint (10m, 30m), change of direction (HUFA with and without ball), vertical jump (CMJ) and power (peak power, peak average) parameters in 11-12 years old football players. Thirty-six male football players (average of age 12.55±0.50 years, standing height average 155.63±9.34 cm, body weight average 46.57±8.15, average of years of training 3.58±0.96) from U12 and U13 categories of a football team in Turkish Super League participated in this study. Normality of the data was analysed with the Shapiro-Wilk test and homogeneity of variance was analysed with the Levene test. Statistical analysis of the data obtained were carried out by Pearson Correlation Test as the data was parametric. Statistical significance was accepted as $p<0.05$. According to the findings, a highly negative significant correlation was found between 10 m and 30 m linear sprint with peak power and average power ($p<0.01$). There was a moderate, negative significant correlation between change of direction without ball performance and average power ($p<0.05$). Moderate, negative significant correlation between HUFA change of direction with ball performance and average power was also found ($p<0.05$). Consequently, leg strength is important and trainings should include drills to improve the leg strength, if sprint speed, maximal speed and quick change of direction speed of the football players in this age group are desired to be improved.

Key words: Young. Male football players. Anaerobic process. Adolescence.

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RESUMO

Análise da relação entre habilidade de mudança de direção, velocidade e potência na adolescência

Sprint, mudança de direção, desempenho de salto desempenha um papel importante no sucesso de esportes de equipe baseados em campo, como o futebol. Este estudo tem como objetivo indicar a relação entre os parâmetros de sprint linear (10m, 30m), mudança de direção (HUFA com e sem bola), salto vertical (CMJ) e potência (potência de pico, média de pico) em jogadores de futebol de 11 a 12 anos. Trinta e seis jogadores de futebol do sexo masculino (idade média 12,55±0,50 anos, estatura média 155,63±9,34 cm, peso corporal médio 46,57±8,15, média de anos de treinamento 3,58±0,96) das categorias U12 e U13 de um time de futebol turco A Super Liga participou deste estudo. A normalidade dos dados foi analisada com o teste de Shapiro-Wilk e a homogeneidade da variância foi analisada com o teste de Levene. A análise estatística dos dados obtidos foi realizada pelo Teste de Correlação de Pearson, pois os dados eram paramétricos. A significância estatística foi aceita como $p<0,05$. De acordo com os achados, foi encontrada uma correlação significativa altamente negativa entre o sprint linear de 10 me 30 m com a potência de pico e a potência média ($p<0,01$). Houve uma correlação moderada, significativa negativa entre mudança de direção sem desempenho de bola e potência média ($p<0,05$). Também foi encontrada correlação moderada, significativa negativa entre a mudança de direção do HUFA com o desempenho da bola e a potência média ($p<0,05$). Consequentemente, a força das pernas é importante e os treinamentos devem incluir exercícios para melhorar a força das pernas, se a velocidade de sprint, a velocidade máxima e a velocidade de mudança rápida de direção dos jogadores de futebol nessa faixa etária são desejadas.

Palavras-chave: Jovens. Jogadores de futebol masculino. Processo anaeróbico. Adolescência.

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INTRODUCTION

Today, football brings a highly compelling load as a result of long distance covered and high intensity of the activities. Studies report that the work load in the football matches may be related with the age of the football players (Buchheit et al., 2010; Mendez-Villanueva et al., 2013) and that the physical performance required by football increases together with the growth, especially for kids (Buchheit et al., 2010; Castillo et al., 2019).

In a collected study by Taylor et al., (2017), researchers reported that young football players covered an average of 2186-9900 meters during a match. They stated that 114-325 meters of the distance covered is sprint and there are 7-61 sprint activities during the match. Another study demonstrates that young football players perform 0.9-3.6 jumps on average during a game (Stroyer et al., 2004).

Many researchers point out that qualities like repetitive sprint ability (Dellal and Wong, 2013), quick change of direction ability like speed up - slow down (Benvenuti et al., 2010), linear sprint ability (Murr et al., 2018) play key role in the success in football. Essential character lying beneath the activities with such explosive character is stated to be power and speed (Stolen et al., 2005).

Vertical jump performance, one of the most common methods of determining lower extremity strength, which is very important for football, can be used in power measurement (Harman et al., 1991; Banda et al., 2019; Moreno et al., 2019; Lockie et al., 2020).

Football players should have advanced speed-up, slow-down (Little and Williams, 2005) and quick change of direction (Faude et al., 2012) abilities during the football match. In addition to these, linear sprint ability is among the qualifications that turn the balance. In a study which analyses the actions before the goal, linear spring was determined to be the most important activation before the goal (Faude et al., 2012).

There is no consensus built among the studies carried out up to the present on which parameters are associated with sprint and change of direction abilities and the level of the relationship.

Struzik reported (Struzik et al., 2017) that vertical jump is not significantly correlated with linear sprint and COD (change of direction) performance in 12-year-old children. In another study with similar results, vertical jump performance was found to be not correlated with 10-30 m linear sprint and quick change of direction ability (Popowczak et al., 2019).

Nevertheless, the most important finding of the study is the relation between 30 m sprint and COD. However, these studies are about revealing the relationship through vertical jump distance.

Negative correlation was found in a study which seeks for the relationship of vertical jump with 20 m linear sprint and change of direction performance (respectively r= -0.53- 0.54).

The same study concluded that leg strength attained from vertical jump is not correlated with linear sprint and change of direction performance (Lockie et al., 2020).

Mc Farland et al., (2016) expressed that change of direction test and leg strength attained from vertical jump performance are related (r=-0.76). Another study found significant relation between change of direction speed and 10 m sprint performance (r= -0.77-0.82).

As there is more than 700 returns in a football match (Bloomfield et al., 2007), one can understand how the change of direction performance is important. Specific counter movement jump (CMJ) performance factors are used to estimate a series of kinematical and kinetical variables (for instance, jump height, peak power, average power, relative power and etc.) (Claudino et al., 2017).

Leg strength is important in football. It is considered to be effective in sprint and quick change of direction.

However, the importance of leg strength in change of direction and linear sprint speed of football players in U12 and U13 categories is not quite clear.

A better understanding of branch-specific acceleration would increase performance, especially in sports such as football where acceleration and agility are in the forefront.

From this point of view, this study aims to discover the relationship between sprint (10m, 30m), change of direction (HUFA) with and without ball), vertical jump (CMJ) and power (peak power, peak average) parameters in 11-12 years old football players.

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MATERIALS AND METHODS

Participants

Thirty-six male football players (average of age 12.55±0.50 years, standing height average 155.63±9.34 cm, body weight average 46.57±8.15, average of years of training 3.58±0.96) from U12 and U13 categories of a football team in Turkish Super League were involved in this study. At the beginning of the study, the players were informed about the study, including the purpose, method, possible contributions, and possible risks and inconveniences that may occur during the study.

Informed volunteer consent forms were signed by the families of the football players who took part in the study. Football players were asked not to use caffeine, ergogenic substances and avoid doing heavy exercises 24 hours prior to the tests. The study was approved University, University Ethics Committee before obtaining the data (2021/11032).

Research Design

This study was conducted with U12 and U13 teams during the season. First of all, body weight and standing height of the players were recorded.

Body weight and standing height of the players were measured by scales (Seca 217, Birmingham, UK). Sprint and jump test was performed in one session and change of direction with and without ball test was performed in another session. Before the tests, accompanied by their trainers, all the players warmed up for 10 minutes including 2 minutes of jogging, 2 minutes of static stretching (for the lower and upper extremity muscles), and then 3 minutes of running following jump and finally short sprints.

Newtest 1000 test battery and mat on which the players jump were used for the vertical jump measurements. Vertical jump was recorded in cm as the player squatted quickly from the upright position, with the hands on the waist, and then jump upwards with maximal strength.

Test was performed twice and the best score was recorded for evaluation. The equation developed by Harman et al., (1991) (average strength; measured in watts [w]) = 21.2 x jump height (cm) + 23.0 x body mass (kg) –1391 and peak power (peak power; measured in watts [w])= 61.9 x jump height (cm) + 36.0 x body mass (kg) + 1822) was used to calculate the leg strength obtained from the jump height of the vertical jump.

Newtest 1000 battery and photocell devices were used to calculate 10m and 30 m pass time of the players on a 30-meters track set up on a grass pitch that the players are accustomed to. Players displayed performance by stepping on the line put one meter away from the start photocell. Every player were given two tries and the best test scores were recorded.

Hacettepe University Change of Direction Test (HUFA) (validity r=0.85 and reliability r=0.94) was used for 30 m parameter (Özkara, 2002).

HUFA test (Figure 1) is a 30-meter long, football-specific, maximal speed change of direction test with 6 different change of direction points between zero line and finish line.

Measuring platform was used by the players as a trial, for two times, without ball at moderate heaviness to accommodate. Pass times were determined by locating photocells to the zero and finish lines. Measurement was done both with and without ball.

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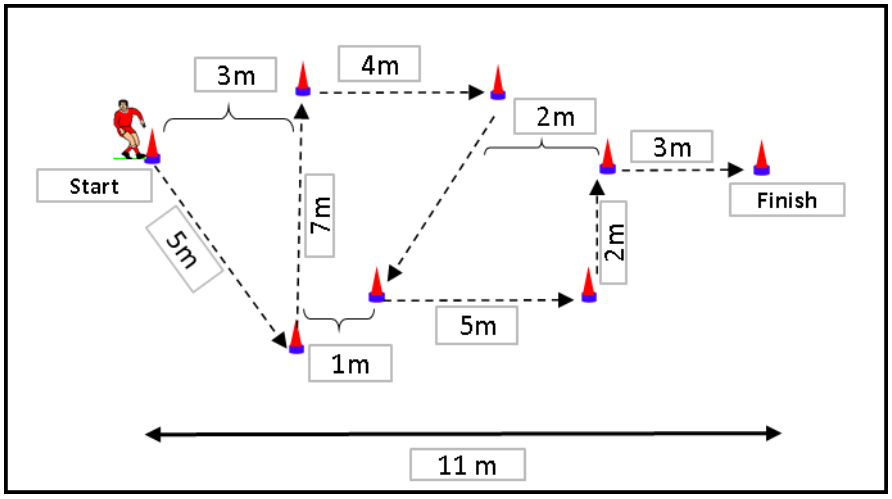

Figure 1 - HUFA Test.

Statistical Analysis

Normality of the data was analysed with the Shapiro-Wilk test and homogeneity of variance was analysed with the Levene test. Statistical analysis of the data obtained were carried out by Pearson Correlation Test as the data was parametric. Statistical significance was accepted as $p<0.05$.

RESULTS

Findings of the study is presented below

Table 1 - Vertical Jump, Power, Sprint and Change of Direction Parameters Descriptive Data of the Players.

Variables	$\bar{x}$ ± sd
Vertical jump (cm)	25.94±3.27
Peak average (watt)	209.04±193.47
Peak power (watt)	5071.46±339.88
10 m sprint (sec)	1.82±0.06
30 m sprint (sec)	4.70±0.18
HUFA without ball (sec)	10.07±0.37
HUFA with ball (sec)	13.15±0.90

Legenda: $\bar{x}$: mean, sd: standard deviation.

Analysing Table 1, we can see that vertical jump (cm) parameter is 25.94±3.27; peak average (watt) parameter is 209.04±193.47; peak power (watt) parameter is 5071.46±339.88; 10 m sprint (sec) parameter is 1.82±0.06; 30 m sprint (sec) parameter is 4.70±0.18; HUFA without ball (sec) parameter is 10.07±0.37; HUFA with ball (sec) parameter is 13.15±0.90.

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Table 2 - Relationship Among the Vertical Jump, Power, Spring and Change of Direction Parameters of the Players

Variables		Vertical jump (cm)	Peak average (watt)	Peak power (watt)	10 m sprint (sec)	30 m sprint (sec)	HUFA without ball (sec)	HUFA with ball (sec)
Vertical jump (cm)	r	1	.263	.511**	-.240	-.183	.142	.030
	p		.122	.001	.158	.285	.410	.860
Peak average (watt)	r	.263	1	.964**	-.727**	-.764**	-.372*	-.352*
	p	.122		.000	.000	.000	.026	.035
Peak power (watt)	r	.511**	.964**	1	-.714**	-.732**	-.292	-.305
	p	.001	.000		.000	.000	.084	.070
10 m sprint (sec)	r	-.240	-.727**	-.714**	1	.909**	.330*	.411*
	p	.158	.000	.000		.000	.049	.013
30 m sprint (sec)	r	-.183	-.764**	-.732**	.909**	1	.316	.270
	p	.285	.000	.000	.000		.060	.112
HUFA without ball(sec)	r	.142	-.372*	-.292	.330*	.316	1	.511**
	p	.410	.026	.084	.049	.060		.001
HUFA with ball (sec)	r	.030	-.352*	-.305	.411*	.270	.511**	1
	p	.860	.035	.070	.013	.112	.001	

Legenda: **. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.05 level.

Table 2 presents a highly negative significant correlation [25] was found between 10 m and 30 m linear sprint with peak power and average power ($p < 0.01$). A moderate, negative significant correlation between change of direction without ball performance and average power ($p < 0.05$) can be seen in the table. Moderate, negative significant correlation between HUFA change of direction with ball performance and average power was also found ($p<0.05$).

Cohen's Correlation Table

Correlation	Negative	Positive
Low	-0,29 to -0,10	0,10 to 0,29
Moderate	-0,49 to -0,30	0,30 to 0,49
High	-0,50 to -1,00	0,50 to 1,00

Cohen, (1998).

DISCUSSION

The aim of this study was to present the relationship between sprint (10 m, 30m), change of direction (HUFA with and without ball), vertical jump (CMJ) parameters and power (peak power, peak average) parameter among U12 and U13 players of a professional football team at elite level.

The most important finding of this study is that almost all the tests are statistically correlated with peak power and average power acquired from vertical jump performance ($p<0.05$) (Table 2).

Surprisingly, there is no statistically significant relation between 10-30 m linear spring speed, change of direction performance (with and without ball) and maximum height that the players reached up to in vertical jump test ($p>0.05$).

10 meter linear spring is the indicator of an athlete's speed-up ability, 30 m linear sprint speed, on the other hand, is the the indicator of the maximal speed (Lockie et al., 2011).

The relationship between 10 m, 30 m sprint and leg strength found in this study share similarity with some studies in the literature. For instance, Lockie et al., (2016)

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found influential relationship (r= -.77) between leg strength score acquired from the vertical jump and 10 m linear sprint speed. Another study reports significant relationship between peak power acquired from vertical jump and 10 m (r= -,49) 30 m (r= -.48) linear sprint speed (Mc Farland et al., 2016). Similar relationship were observed between 40 m sprint speed and vertical jump peak power (r= -.43) in elite female football players (Shalfawi et al., 2014).

There are also studies that do not show similarity with the findings of our study. Banda et al., (2019) found a positive relationship between the average power obtained from vertical jump and 10 m linear sprint in their study held with basketball players.

Basketball players with greater body mass were reported to produce greater power but to be unable to move faster. In another study with female volleyball players, no relationship was found between peak power obtained from vertical jump and 10 m sprint performance (Lockie et al., 2020).

The differences among the studies might be by virtue of several reasons. First reason may be that the studies are about different branches. The adaptation of the athletes' to the branch-specific characteristics might bring along different mechanisms developed.

Another reason is that the studies conducted with different age categories. Structural, neural and metabolic changes which occur during growth may affect the feistiness of skeletal muscles, neuromuscular activation and contractile properties, muscle tendon hardness, and also the ability to store and use elastic energy.

Another prominent point when reviewing the findings of the present study is the relation of 10 m linear sprint which is the speed-up run and average power performance obtained from the vertical jump with change of direction ability with and without ball (Table 2).

Change of direction ability is accepted as starting and stopping quickly (Little and Williams, 2005).

Speed and power have not yet fully been proven as the main indicators of the ability to change direction. In some of the studies, the relationship between speed, power parameters and the performance of the ability to change direction is reviewed as very low (Young et al., 2002; Markovic et al., 2007; Salaj and Markovic, 2011).

On the contrary, some studies report that key determinant of ability to change direction is the speed and power (Tramel et al., 2019; Mc Farland et al., 2016). Main reason of these discrepancies among the studies might arise from the differences in test methods (T-Test, Zig-Zag test, 505 pro, HUFA and etc.), differences in branches (football, basketball, volleyball) or training circumstances. However, when the literature is reviewed, it is seen that the determiner of the ability to change direction becomes speed and power as the age of the athletes is lower (Köklü et al., 2015) reported that ability to change direction with ball is moderately associated with 10-30 m sprint speed performance in the study conducted with 16.0±0.8 years old football players.

While 10 m sprint performance is correlated with change of direction performance, 30 m performance is not statistically correlated with the change of direction performance in the present study.

This might be due to the fact that there is not enough distance to provide the maximal speed-up in the change of direction test.

CONCLUSION

When the findings of this study is considered, among 12-13 years old kids who play football, jump height is not determinant in change of direction and linear sprint speed. It is observed that leg strength plays an important role in 10 m speed-up and 30 m maximal speed performance, while speeding-up and average power capacities are determinant in change of direction performance.

In this age group of kids who play football, leg strength can be considered as fairly important and determiner in performance.

Training methods to be applied to the young should be different from the methods to be applied to grown-ups as it will provide basis for their further sport lives. If the sprint speed, maximal speed and quick change of direction is desired to be improved, particularly for this age group kids who play football, the importance of the leg strength should be noted and there should be drills to work up leg strength.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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