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ORIGINAL RESEARCH

Is Vertical Jump Associated with Change of Direction Ability in Soccer Players? A Pilot Study

Sümer ALVURDU
Kader Ceylan KESKİN
Mehmet KOÇAK
Ömer ŞENEL
Mehmet GÜNAY

Coaching Education Department, Sports Science Faculty, Gazi University, Ankara, Turkey.

Corresponding author: S. Alvurdu

e-mail: sumeralvurdu@gazi.edu.tr

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Abstract

The aim of this study was to evaluate the relationship between vertical jump and change of direction ability with different agility test performances of soccer players. Twenty-six male soccer players (age=9.4±0.5 years, height=138.8±8.7 cm, weight=31.1±5.6 kg, body mass index=16.0±2.0 kg.m-2) from U9-U10 age categories of a first division team in Turkish Professional Soccer League were tested for vertical jump (countermovement jump) and change of direction ability (CODA) with, Hexagon, 505 and Illinois agility tests. Relationship between these agility tests and vertical jump (VJ) were assessed by Spearman's rho correlation coefficient test. There was no significant relationship between VJ and any measure of CODA tests. In conclusion, it can be said that VJ is not associated with CODA performance of soccer players. Despite the fact that there have been many studies supporting these results in the literature, these cross-sectional relationships should be investigated longitudinally with the larger research groups for different age categories and sport-specific research design for different jumping directions.

Keyword: Change of direction ability, agility, vertical jump, soccer players.

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INTRODUCTION

Many diverse activities such as jogging, sprinting, and jumping performed by the players are basic movement patterns of many field sports such as handball, basketball, rugby and soccer. In this type of sports, players are required to accelerate, decelerate, and change of directions (COD) throughout the game in the reduced field (Sheppard & Young, 2006; Bloomfield, Polman, & O'Donoghue, 2007).

Recently, soccer has been characterized by dynamic movements of players during the game. In addition, there are unpredictable movement patterns that occur at different intensities during the competition. For this reason, players should be able to move different parts of their body quickly depending on the varying intensity of the game and be able to respond to these unexpected situations (Popowczak et al., 2019). Because of this reasons, acceleration at short distances, frequent stopping and repeated COD movements (forward, lateral, back and multi-directional movements) are the mostly important parameters that players continuously perform during the game (Gonçalves et al., 2015). These multi-direction and short-term rapid movements are essential in soccer and classically defined as agility (Zouhal et al., 2019). Because agility actions are thought to involve a combination of these movements (Brughelli et al., 2008; Meylan et al., 2009).

Agility is a very complex concept that requires interactions of physiological and biomechanical components (Simonek et al., 2016) and a great interest exists for developing field tests and specific training programs that can effectively measure agility. The majority of tests supported to assess agility are tests based on the change of direction speed [e.g., the T-test (Pauole et al., 2000), the Illinois agility test (Hastad & Lacy, 1994), the 505 test (Draper, 1985), the L-run test (Meir et al., 2001), and the zigzag test (Little & Williams, 2003)]. Because of number and direction of changes demanding by the test protocol, a wide variety of tests of change of direction performance exist that differ in terms of both test duration and complexity (Brughelli et al., 2008).

Moreover, various physical components such as leg strength, power, and reactive strength are also thought to be associated with the motor component of successful agility performance (Marković et al., 2007; Brughelli et al., 2008; Young & Farrow, 2006). It was predicted that a strong relation between jump performance and agility performance would be observed but the strongest association would be for the lateral jumps.

On the other hand, many researchers have investigated the relationship between jump capacity (vertical, lateral, and horizontal direction) and CODA in many sports. However, the results are contradictory (Salaj & Markovic, 2011; Wisløff et al., 2004). In fact, jumping and CODA could be considered as independent abilities (Salaj & Markovic, 2011).

The results from these studies illustrate the difficulty in identifying how performances on various field tests can be related to one another. Because of this reasons, the relationship between these two cross-sectional components was evaluated in the current pilot study in terms of selected different CODA tests mostly used for soccer players and countermovement jump for VJ performances.

METHOD

Experimental Approach to the Problem

In accordance with the information of the introduction above, the physical and physiological aspects of CODA components have been evaluated in many studies and it has been observed that these studies are mostly discussed in terms of anthropometric features, reactive strength and leg power variables. In addition, the relationship between jumps applied to different directions and CODA performance were evaluated by numerous studies but it was seen that consistent and certain results could not be achieved.

Subjects

Twenty-six male soccer players (age=9.4±0.5 years, training age=2.7±0.8 years, height=138.8±8.7 cm, weight=31.1±5.6 kg, body mass index=16.0±2.0 kg.m-2) including fifteen U9 and eleven U10 age categories from a first division soccer club in Turkish Professional League participated in the study voluntarily. The athletes did not have any injuries that preventing maximal effort during performance testing. All participants received a written information form with explaining the potential risks, and benefits of participation of the study. Also, the study was conducted with the consent of the team to which they belonged and according to the Declaration of Helsinki (2013).

Data Collection

A standardized 10–15 min warm-up protocol that included jogging, shuffling, multi-directional movements, and dynamic stretching exercises was used. Testing was performed with three trials on artificial turf in the following order: countermovement jump, hexagon, 505 and Illinois agility test. Each test was performed three times with the minimum of three minutes of rest intervals between trials and approximately 6–7 minutes of rest intervals between tests to prevent fatigue and the best score was recorded.

Vertical Jump Height

Countermovement jump test was conducted to determine vertical jump height (VJH) using an electronic timing mat (Newtest Powertimer 300, Finland). This system determines flight time (sec), which is converted to jump height using the following equation: 9.81x (flight time)2/8. The participants keep their hands on hip for the entire movement to avoid any influence of arm swing.

Change of Direction Ability

In order to evaluate the relationship between VJH and Change of direction ability (CODA), different agility tests (Hexagon, 505 and Illinois) were selected. A photocell gate system (Newtest Powertimer 300, Finland) was used to record the time (sec) for 505 and Illinois agility tests.

The Hexagon Agility Test is performed as follows:

- The athlete stands in the middle of the hexagon, facing line A
- At all times throughout the test, the athlete is to face line A
- On the command "Go" the watch is started and the athlete jumps with both feet over line B and back to the middle, then over line C and so on
- When the athlete jumps over line A and back to the middle this counts as one circuit
- The athlete has to complete three circuits

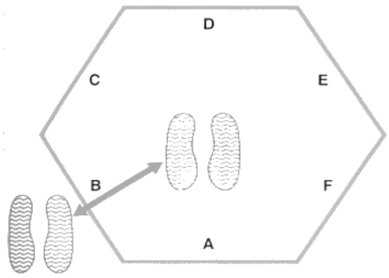

Figure 1. Schematic illustration of the hexagon agility test.

- On completion of three circuits, the time is recorded in seconds

The 505 Agility Test is performed as follows:

- The distance from A to B is 10m and from B to C is 5m
- The athlete runs from the start line (A) towards the 10m line (B)
- The athlete runs on to the 15m line (C), turns 180° and runs back towards the start line
- The test completes when the athlete passes through 10m line on his return.
- The time between start and finish line is recorded in seconds

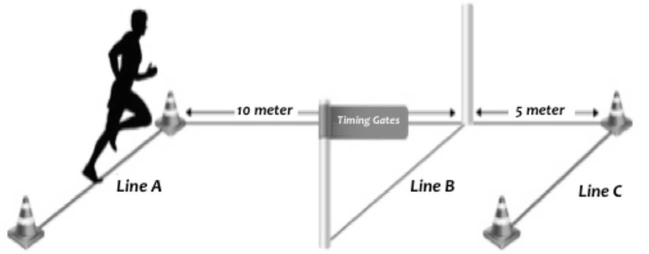

Figure 2: Schematic representation of the 505 agility test

The Illinois Agility Test is performed as follows:

- The length of the course is 10 meters and the width is 5 meters.
- Four cones are placed down the center an equal distance (3,3 meters) apart.
- The athlete lies face down on the floor at the start point
- On the "Go" command, the athlete gets up as quickly as possible and runs around the course in the direction indicated, without knocking the cones over, to the finish line.
- The time between start and finish line is recorded in seconds

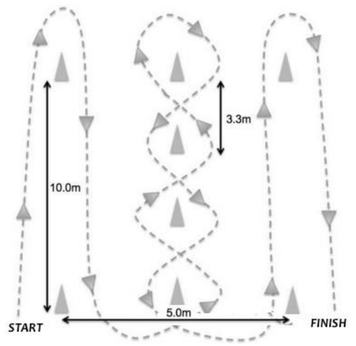

Figure 3. Schematic illustration of the Illinois agility test.

Statistical Analysis

All statistical analyses were performed using SPSS Version 22.0 (SPSS Inc., Chicago, IL, USA). The relationship between all variables was assessed by Spearman's rho correlation coefficient. An alpha level of p◎0.05 was used for statistical significance.

FINDINGS

Mean and SD for physical characteristics of soccer players are presented in Table 1.

Table 1. Physical Characteristics of Soccer Players

	Min.	**Max.**	**Mean ± SD**
Age (years)	9.0	10.0	9.4 ± 0.5
Training age (years)	2.0	4.0	2.7± 0.8
Height (cm)	125.0	166.0	138.8 ± 8.7
Weight (kg)	23.0	41.0	31.1 ± 5.6
Body mass index (kg.m^{-2})	13.2	21.8	16.0 ± 2.0

Mean, SD, and the correlations between VJ and CODA tests performances are presented in Table 2. VJH and different CODA tests performances (Hexagon, 505, and Illinois test) are 24.1±5.1 cm; 22.1±5.5 sec.; 3.0±0.3 sec.; 20.0±1.3 sec. respectively.

Table 2 also shows that there is not any correlation between VJ and Hexagon agility test (r=0.11; p>0.05), VJ and 505 agility test (r=-0.12; p>0.05), and VJ and Illinois agility test (r=-0.03; p>0.05) performances.

Table 2. Mean ± SD and Correlations between VJH and CODA

		Mean ± *SD* (n=26)	**Correlation co-efficient (*r*)** Hexagon	505	Illinois	VJ
CODA tests	Hexagon (s)	22.1 ± 5.5	_____			
	505 (s)	3.0 ± 0.3	0.19#	_____		
	Illinois (s)	20.0 ± 1.3	0.43*	0.03#	_____	
	VJH (cm)	24.1 ± 5.1	0.11#	-0.12#	-0.03#	_____

VJH= Vertical Jump Height; CODA= Change of Direction Ability
**p<0.05 # p>0.05*

DISCUSSION

The current study has been carried out to examine the relationship between VJH and various agility tests (hexagon, 505, and Illinois) performances in 9-10-year-old soccer players. According to the findings of the study, there is no significant correlation between VJH and these agility tests performances.

While there was a relation among jump tests, no relation was reported between jump and CODA performances according to the following studies. Henry et al. (2016) investigated the relationship between vertical, horizontal, and lateral jump performances and agility movement time on soccer players. They found that between each of the jumps were strong correlation but between the jumps and CODA the relationship were weak so, they have stated that other motor performance (skill, balance and coordination), cognitive and decision-making factors are more important. Similarly, Markovic et al. (2007) examined the relationship between VJ test and different agility tests performances (lateral stepping, 20-yard shuttle run and slalom run) on physical education students (age=21±2 years) and no relation was reported. Vescovi et al. (2008) researched the relationship between VJH and two agility tests performances (Illinois and pro agility) in three groups (high school soccer, college soccer, and college lacrosse between the ages of 15-20 years) and it was reported that there was a weak negative relationship. Meylan et al. (2009) stated that different jumps tests (single leg lateral, horizontal and vertical) are not sufficient to predict the sprint and CODA for physical education students. Nimphius et al. (2010) found that while there was a strong relation between relative strength and agility test performance and no relation between VJH and agility test performance of female softball players (age=18.1±1.6 years). Peterson et al. (2006) examined the 18-21 year old collegiate athletes and they reported a significant correlation between T-test and VJ in women but not in men. The relationship between horizantal and VJ test and CODA studied in soccer players (age=22.9±2.8 years) by Yanci et al. (2014). They found that horizantal jump and CODA has moderate correlation whereas VJ and CODA has not any correlation.

Even though there are studies having similar findings with the current study in literature, there are also contrast studies. Alemdaroğlu (2012) examined the relationship between different jump tests (CMJ and SJ) and CODA in basketball players (age=25.1±17. years) and he found that CODA has moderate correlation with both jump tests. Köklü et al. (2014) reported that no correlation was found between VJ test and zigzag agility with the ball but the VJ was strongly correlated with the zigzag agility without the ball in young soccer players (age=16.0±0.8 years). Sassi et. al (2009) found a relationship between VJ and agility test for the female group but not for the males. Swinton et al. (2014) conducted the study on rugby players (age=24.2±3.9 years) and reported a relationship between VJ test and CODA (5-0-5 agility test) performances. Conlon et al. (2013) performed the study on males and females from various sporting disciplines (soccer, swimming, gymnastics, tennis, squash, track and field, wrestling, weightlifting, karate, judo, diving, cycling, climbing, water skiing, table tennis or fencing) and found a significant relation between VJ test and agility test performances. They also reported that VJ velocity is the determinant of agility and sprint performances.

Barnes et al. (2007) conducted the study on female collegiate volleyball players and indicated that VJ test performance is a predictor of agility performance. Additionally, individuals with higher VJ performance have quicker agility times and performing vertical domain through training might improve the various type of agility performance. Erikoglu and Arslan (2016) performed the study on 14-year-old soccer players and found out a negative relationship between VJ and zigzag agility without ball test performance. Hermassi et Al. (2011) revealed that there was a significant correlation between VJ and agility test (agility T-test) performance by the study conducted with 17 year-old handball players. Chaouachi et al. (2012) investigated that the affecting variables of CODA vary according to the test characteristics for 19 year-old elite soccer players, and Brughelli et al. (2008) exposed that the differences found among studies may be due to both the populations evaluated and the different characteristics of the tests applied.

CONCLUSIONS

With the current knowledge of the literature, we can estimate that the relationship between VJ and agility tests is not clear yet. Moreover, the studies related to the subject may vary with sporting disciplines, gender, and training age of individuals.

As a result of the current study with 9-10-year-old soccer players, we determined no correlation between VJ and agility tests performance. In order to fully understand the relationship between VJ and agility performance, these cross-sectional relationships should be investigated longitudinally with the larger research groups for different age categories and sport-specific research design for different jumping directions.

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