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DOES LINEAR ACCELERATION IMPACT AGILITY, VO2MAX, 30 METER SPEED AND STANDING LONG JUMP IN AMATEUR SOCCER PLAYERS?

ALI LINEARNO POSPEŠEVANJE VPLIVA NA OKRETNOST, MAKSIMALNI PRIVZEM KISIKA, ŠPRINT IN SKOK V DALJINO Z MESTA PRI NOGOMETAŠIH NEPROFESIONALCIH?

ABSTRACT

Agility and acceleration are known as high speed actions and impact soccer performance. Soccer players need MaxVO2 and standing long-jump to make high - speed actions during soccer match. The purpose of this study was to examine the prediction of the effect of acceleration on agility, endurance, long jump and 30 m-speed. Total 21 amateur male soccer players (mean ± SD: age = 20.29±1.82 yr, height = 1.81±0.37 m, and body weight = 72.10±3.71 kg) volunteered to participate in the study. Acceleration performance (10 m), sprint (30 m), agility (zigzag test), endurance (Yo-Yo intermittent recovery test 1), and jumping ability (standing long jump) were tested. Acceleration predicts MaxVO2 by 19.8 %, agility by 49.9 %, and 30 m-speed by 32.9 %. On the other hand, there is not relationship between acceleration and standing long jump. If we consider that there is a decrease in agility and subsequent increase in football players' sudden change of direction, we see that acceleration explains the decrease and increase in agility rate at the best level. It is thought that acceleration does not affect the long jump by stopping, as footballers are exposed to vertical jump rather than horizontal jump. To improve agility and speed performance, football coaches can design combined acceleration based training.

Keywords: change of direction, endurance, football, horizontal jumping

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IZVLEČEK

Okretnost in pospeševanje sta hitri dejanji, ki pomembno vplivata na nogometno igro. Nogometaši morajo dobro skočiti v daljino in morajo imeti visoko kapaciteto maksimalnega privzema kisika, da bi lahko med nogometno igro kvalitetno izvajali hitra nogometna dejanja. Namen pričujoče študije je bil preučiti napoved učinka pospeševanja nogometaša na okretnost, vzdržljivost, skok v daljino in hitrost teka na 30m. V raziskavi je sodelovalo 21 amaterskih nogometašev (starost = 20,29 ± 1,82 leta, višina = 1,81 ± 0,37 m in telesna teža = 72,10 ± 3,71 kg). Testirali smo pospeške (10 m), šprinte (30 m), okretnost (cik-cak test), vzdržljivost (Yo-Yo intermitent recovery test 1) in skakalno sposobnost (skok v daljino z mesta). Ugotovili smo, da pospešek napoveduje maksimlani privzem kisika za 19,8%, okretnost za 49,9% in hitrost teka na 30 m za 32,9%. Ugotovili smo, da ne obstajajo značilne povezave med pospešekom in skokom v daljino z mesta. Če pomislimo, da pride do zmanjšanja gibljivosti in posledičnega povečanja nenadne spremembe smeri nogometašev, opažamo, da pospešek značilno pojasnjuje tako zmanjšanje kot povečanje stopnje gibljivosti. Pospešek na zaustavitev ne vpliva na skok v daljino, saj so nogometaši bolj izpostavljeni navpičnemu kot vodoravnemu skoku. Za izboljšanje okretnosti in hitrosti nogometašev priporočamo nogometnim trenerjem oblikovanje kombiniranega nogometnega treninga, ki temelji na pospeševanju.

Ključne besede: sprememba smeri, vzdržljivost, nogomet, vodoravni skok

INTRODUCTION

Up to now, the standing long-jump, agility, acceleration, and MaxVO2 have been adopted by a variety of sports branches, both professional and amateur, to evaluate athletic success. Although coaches have examined and debated, what has not been considered is the standing long-jump, acceleration, endurance, and agility influence each other (Little & Williams, 2005; Dragijsky et al., 2017). Although coaches continually seek out new techniques and strategies to develop and test athletic performance, it is important for coaches to be aware of differential effects of various types of athletic performance on standing long-jump, acceleration, endurance, and agility performance. For this reason, several authors have suggested that the capacity to cope with high-intensity intermittent exercise is important for physical performance in soccer (Wragg et al., 2000).

High-speed actions during soccer competition can be categorized into those requiring maximal speed, acceleration and agility. Acceleration is the rate of change of velocity that allows a player to reach maximum velocity in a minimum amount of time. Maximum speed is the maximal velocity at which a player can sprint. Agility does not have a global definition, but is often recognized as the ability to change direction and start and stop quickly (Gambetta, 1996). Some common physiological determinants of agility performance as for acceleration and maximum speed, such as fiber type proportion, may lead to the assumption that these three qualities are highly related. Moreover, aerobic capacity has beneficial effects on parameters such as total time spent on high intensity activities during the game, agility, acceleration, jumping, number of sprints and the number of contacts with the ball during the match (Little & Williams, 2005).

Acceleration is a significant feature of game-deciding situations in the various codes of soccer. The different types of horizontal jumps - a standing long jump, standing five-jumps, and standing ten-jumps were correlated differently with time and stride characteristics (stride numbers, length, and frequency) across 10 m initial acceleration, 30 m secondary acceleration, and the entire 100 m sprint, regardless of the level of sprint performance (Maćkała et al., 2015). In previous a study, the best indicator of sprint performance appears to be the magnitude of the initial acceleration and velocity (9.1- to 18.3-m interval) and the maintenance of velocity throughout the sprint, independent of sprint distance (Brechue et al., 2010). In previous studies, the acceleration and sprint performance of soccer players was evaluated using distances of 10 m (Mendez-Villanueva et al., 2011) and 30 m (Taskin, 2008).

The majority of studies which assess all-round fitness in soccer players use a test battery largely consisting of field-based protocols to measure jumping ability, linear speed, agility and aerobic endurance. Thus, the purpose of this study was to examine the prediction of the effect of acceleration on agility, endurance, long jump and 30 m-speed.

METHODS

Participants

Total 21 amateur male soccer players (mean ± SD: age = 20.29±1.82 yr, height = 1.81±0.37 m, and body weight = 72.10±3.71 kg) volunteered to participate in the study. These soccer players are playing for same soccer club in the first amateur league of Turkey. Soccer players were trained by their coach at 1.5 hours 5 days and played one football match during a week. The body height of each soccer player was measured by generally accepted methods accurate to the nearest 0.1 cm. weight was determined using an electronic scale as accuracy-0.05 kg. This was followed by the administration of standing Long Jump, zigzag Agility Test, acceleration and maximum running speed, and Yo-Yo intermittent recovery tests. Standing long jump, zigzag Agility Test, acceleration and maximum running speed tests was applied on same day with a 10-minute interval and each test was applied twice, with a 3-minute interval, and the best result was recorded. However, Yo-Yo intermittent recovery test carried out else a day after 24 hours from other tests. Soccer players were instructed as to the proper preparation prior to measurement. Soccer players signed an informed consent document according to the Helsinki Declaration.

Acceleration and maximum running speed

The running speed and acceleration of players was determined using a 30-m sprint effort with dual-beam electronic timing gates (Smart Speed Performance Equipment) with split times at 10 m for acceleration as previously used by Wilson et al. (1993) (Okur et al., 2019) and 30 m for speed as previously reported (Little & Williams, 2005). Time was measured to the nearest 0.01 s. Players were instructed to run as quickly as possible over the 30-m distance from a standing start (crouched start positioned 0.5 m behind the timing lights) and run with the signal of light in start gate. Soccer players performed two trials with at least 3 min of rest between them. The best performance of the two tests was used for analysis.

Zigzag Agility Test

Agility was tested using a zigzag course consisting of four 5-m sections set out at 100◦ angles. This zigzag test was chosen because it required the acceleration, deceleration, and balance control facets of agility, and the familiarity of the subjects with the test and its relative simplicity also meant that learning effects would be minimal (Little & Williams, 2005).

Standing Long Jump

All subjects were instructed to perform a long jump from a standing position. Standardized instructions were given to subjects that permitted them to begin the jump with bent knees and swing their arms to assist in the jump. A line drawn on a hard surface served as the starting line. The length of the jump was determined using a tape measure, which was affixed to the floor. Each subject was given 3 trials, and the distance of the best jump was measured, to the nearest 1 cm, from the line to the point where the heel closest to the starting line landed. If the subject fell backward, the distance where the body part closest to the starting line touched the ground was measured as the jump's length. Each subject performed 3 jumps, whether or not a subject fell backward during an attempt. The longest jump was used as the test score (Almuzaini & Fleck, 2008).

Yo-Yo intermittent recovery test

Soccer players completed Yo-YoIR1 (Krustrup et al., 2003). The test was completed on days without wind. Air temperature ranged from 19 to 24C. The test consisted of 20-m shuttle runs performed at increasing velocities with 10 s of active recovery (consisting of 2x5 m of jogging) between runs until exhaustion. Yo-YoIR1 began at a speed of 10 km h-1. Audio cues for Yo-YoIR1 was recorded on a CD and broadcasted using a portable CD player. The end of the test was considered when the participant twice failed to reach the front line in time (objective evaluation) or he felt unable to complete another shuttle at the dictated speed (subjective evaluation). The total distance covered during Yo-YoIR1 was considered as the test 'score'. Before test, subjects performed a warm-up consisting of 5 min of low-intensity running followed by the first four running bouts in the test. All players were familiarized with the test procedures since the test form part of their usual fitness assessment program (Rapinini et al., 2010).

The calculation of maximum oxygen uptake was performed using the following formula:

YoYoIR1: MaxVO2 (mL/min/kg) = IR1 distance (m) × 0.0084 + 36.4 (Bangsbo et al., 2008).

Statistical analysis

SPSS 22 IBM statistical package program was used for data analysis. The data obtained were summarized as mean and standard deviation. The normal distribution of the data was tested by One - Sample Kolmogorov Smirnov test. In order to investigate the effect of acceleration on MaxVO2, agility, standing long jump, and 30 m-speed performance it was tested by linear regression analysis from parametric tests. In this study, the level of error was accepted as 0.05.

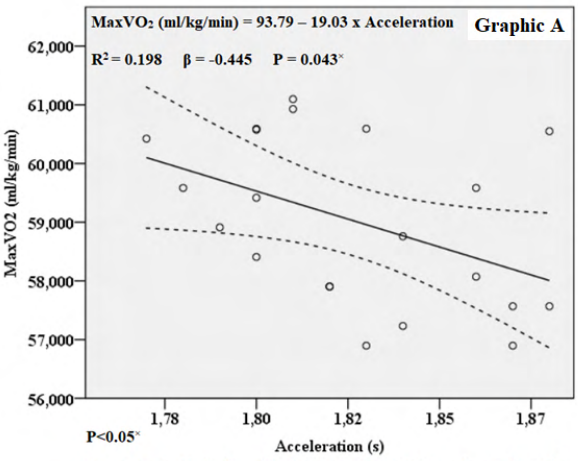
RESULTS

Table 1. Mean and standard deviation of the variables related to soccer players.

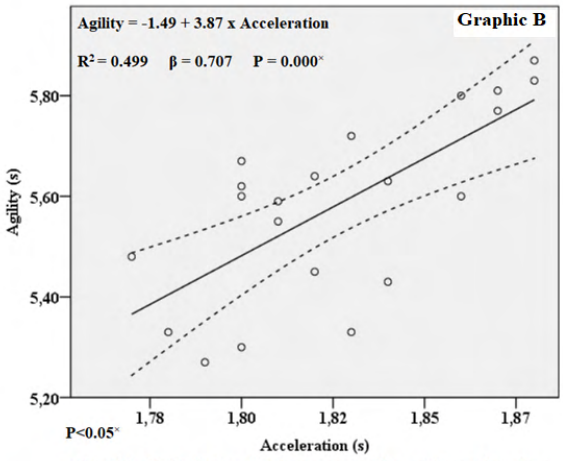
Variables	Mean±SD (N=21)
Age (years)	20.29±1.82
Weight (kg)	72.10±3.71
Height (m)	1.81±0.37
Linear acceleration (s)	1.83±0.03
30 m speed (s)	4.27±0.06
Yo Yo IR1 running distance (m)	2692.05±170.09
MaxVO2 (ml/kg/min)	59.023±1.426
Agility (s)	5.59±0.18
Standing long jump (m)	2.39±0.11

The mean (SD) age was 20.29±1.82 years, weight was 72.10±3.71kg, height was 1.81±0.37, Linear acceleration was 1.83±0.03 sec, 30 m speed was 4.27±0.06 sec, Yo Yo IR1 running distance was 2692.05±170.09 m, VO2Max was 59.023±1.426 ml/kg/min, agility was 5.59±0.18 sec, and standing long jump was 2.39±0.11 m for the 21 soccer players (Please see Table 1).

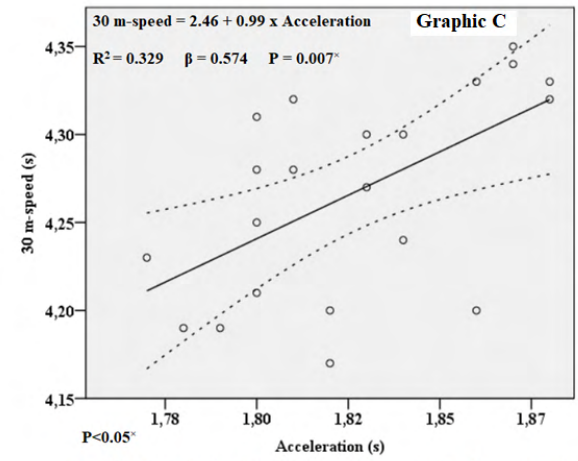
Figure 1. Relationship between acceleration and MaxVO2, agility, 30 m speed, standing long jump.



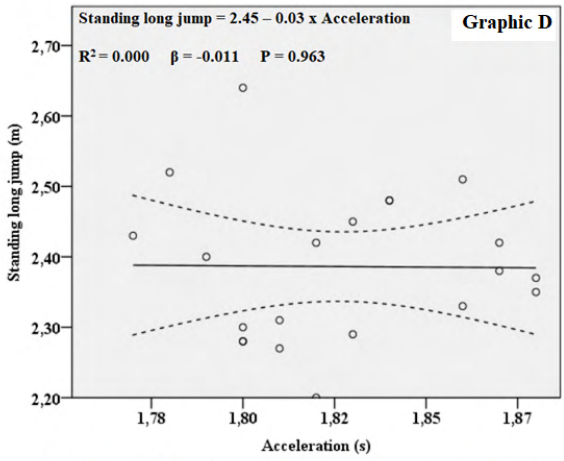
Graphic A. Relationship between $MaxVO_2$ and acceleration



Graphic B. Relationship between agility and acceleration



Graphic C. Relationship between 30 m-speed and acceleration



Graphic D. Relationship between standing long jump and acceleration

Acceleration predicts MaxVO2 by 19.8 % (Graphic A), agility by 49.9 % (Graphic B), and 30 m-speed by 32.9 % (Graphic C). One unit change in acceleration affects MaxVO2 performance by 19.03 percent, agility by 3.87 percent, and 30 m-speed 0.99 percent. There is positive relationship between acceleration with agility and 30 m-speed (Graphic B and C). Additionally, there is negative relationship between acceleration and MaxVO2 (Graphic A). On the other hand, there is not relationship between acceleration and standing long jump (Graphic D).

DISCUSSION

This study investigated the prediction of the effect of acceleration on agility, endurance, long jump and 30 m-speed for amateur soccer players. It was hypothesized that players who were

exposed to a lot of movement to other players' movements during a match (i.e., the agility, acceleration, sprint, jumping). After the player starts moving in the match, a sudden change in movement speed occurs. How does this change in speed (i.e., acceleration) affect other performance parameters (i.e., the agility, endurance, speed, jumping)? The performances on the 10-m test for acceleration, the flying 30-m test for maximum speed, Yo Yo IR1 test for endurance, and the zigzag test for agility were all correlated at levels of statistical significance ($p<0.05$). On the other hand, there is not relationship between acceleration and standing long jump. The coefficients of determination show that acceleration predicts endurance by 19.8 %, agility by 49.9 %, and 30 m-speed by 32.9 %.

Acceleration, as indicated by 10 m sprint times is proven to be a relevant measure in soccer, having been shown to distinguishing between amateur and professional players (Cometti et al., 2001). Relationships between repeated-sprint ability and other fundamental fitness tests (acceleration, agility, explosive power, and aerobic conditioning), vary substantially through the age groups of U11 to U18 in highly trained youth soccer players (Spencer et al., 2011). The increased velocity of the game may be attributed to interplay of influences. It has been proposed that speed and agility are two performance characteristics that positively correlate with the intensity of the game (Buttifant et al., 1999).

A previous study comprised 106 professional soccer players who were assessed for 10-m sprint (acceleration), flying 20-m sprint (maximum speed), and zigzag agility performance. Although performances in the three tests were all significantly correlated ($p<0.0005$), coefficients of determination (r2) between the tests were just 39, 12, and 21% for acceleration and maximum speed, acceleration and agility, and maximum speed and agility, respectively (Little & Williams, 2005). In a study, during the 36.6-m sprint, acceleration increased and peaked at 9.1 m and was maintained at the 18.3-m interval, decreased to a negative value at 27.4-m, but increased to a low positive value at 36.6-m. Velocity increased at 9.1 m and peaked at 18.4 m. acceleration and velocity at the 9.1 and 18.3-m intervals were significantly negatively correlated with sprint interval times and the final 36.6-m sprint time. It has been found that there is a positive relationship between standing long jump and acceleration (9.1 m) (Brechue et al., 2010). The magnitude of the correlation coefficients among the three motor abilities (jumping, acceleration, and agility) extracted was $r<0.56$ (Los Arcos et al., 2017).

A previous examined the specific strength and power characteristics that correlate with greater performance on the 40-yard dash in elite collegiate football players preparing for the National

Football League Scouting Combine. There was a significant negative correlation ($r = -0.894$; $n = 14$, $p < 0.05$) between acceleration and standing long jump. Also, there was a significant positive correlation ($r = 0.930$; $n = 14$; $p < 0.05$) between acceleration and speed (O'Brien, 2009). Besides, Wisloff et al. (2004) determined that jumping height of elite soccer players measured in conjunction with a force platform significantly correlates with the 10 m sprint ($r = .72$, $p < .001$) and 30 m sprint ($r = .68$, $p < .001$). Else a study found the standing long jump exercise is a significant contributor ($p < .05$) to female and male acceleration, and male maximum velocity (Settle, 2010). In a previous study, it is found that there is relationship between acceleration and maximal jump squat which requires maximum concentric power (Sleivert & Taingahue, 2004).

YoYoIR results significantly correlates ($p<0.05$) with 10 m (acceleration) and 30 m sprint times, ball-shooting speed, and vertical jump height (Wong et al., 2010). In a study, it was found that soccer players with enhanced acceleration ability had shown better performance in maximal aerobic speed which is associate with MaxVO2 (Nikolaidis et al, 2015). However, according to results of another study, there was no significant correlation between acceleration and aerobic power (İdrizovic & Raickovic, 2013).

Our study has some limitation. First we have amateur soccer players as study population, because only one amateur club allowed for tests. Another limitation is the choice to evaluation the some motor and physiological parameters. However, performance in soccer includes technical, tactical and psychological components. In limitation of the present study was the absence of more physiological assessments to better understand the acceleration induced adaptations in amateur soccer players.

CONCLUSION

In conclusion, acceleration predicts the most agility and at least predicts MaxVO2. On the other hand, it is seen that acceleration does not predict standing long jump. If we consider that there is a decrease in agility and subsequent increase in football players' sudden change of direction, we see that acceleration explains the decrease and increase in agility rate at the best level. It is thought that acceleration does not affect the long jump by stopping, as footballers are exposed to vertical jump rather than horizontal jump. To improve agility and speed performance, football coaches can design combined acceleration based training.

Declaration of Conflicting Interests

The authors declare that they have no conflict of interest.

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