

RELATION BETWEEN FITNESS TESTS AND MATCH PERFORMANCE IN JUNIOR SOCCER PLAYERS

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Abstract

Research in soccer players concerning relation of match activity and fitness tests have provided questionable results. Therefore, the purpose of this cross-sectional study was to examine the relationship between fitness tests and match activity among junior soccer players. Thirty seven junior soccer players were randomly selected using stratification criteria: age and playing role. Anaerobic fitness was measured by laboratory and field tests. In addition, total distance covered and distance covered during high-intensity actions during the match was determined. The total distance covered was significantly associated with RAST (0.53) and Wingate test (0.88). In addition, the RAST test was significantly related to HIR and sprinting. However, no significant relationship ($p>0.05$) was found between all sprint tests and match activity during soccer matches. The significant relationship between anaerobic fitness tests and high-intensity activities and total distance in elite soccer league matches demonstrates the need to adequately prepare players for the running demands of competition. The findings of this study clearly demonstrate that anaerobic fitness, as determined by commonly used field and laboratory tests, is related to physical match performance in junior male soccer players.

Key words: football, elite players, association, fitness

Introduction

Soccer falls under polistructural complex activities (sport games), where 10 players and goalkeeper try to outwisdom the opponent and score the goal (Dujmović, 1997). To achieve that, players on different playing positions have to cross determined distance for better efficiency, taking care of the opponent on the field. A game of soccer consists of sprints, as well as agility as key features in this type of sports (Sheppard & Young, 2006). Recent time-motion analysis conducted during competitive match play (Dellal et al, 2010a) showed that players cover between 10,496 to 11,779 m per official game and that 9.2% of the activities were considered high intensity (Dellal et al, 2010a; Dellal et al, 2010b; Di Salvo et al, 2009). However, there is a decline in physical efforts across playing halves and remarkably towards the end of matches (Mohr, Krstrup, & Bangsbo, 2005; Reilly, Drust, & Clarke, 2008). All movements at speeds $>14.4 \text{ km}\cdot\text{h}^{-1}$ were considered to be high-speed running (Abt & Lovell, 2009; Bradle et al., 2009; Gregson, Drust, Atkinson, & Salvo, 2010). Accordingly, the distance covered at high running speeds in professional players decreases substantially in the final third of games (Mohr, Krstrup, & Bangsbo, 2003). Research in soccer players concerning relation of match activity and fitness tests have provided questionable results. The VO_2max of elite female players was found to correlate with the amount of high intensity running ($r=0.81$, $P<0.05$, Krstrup *et al.*, 2005) whilst VO_2max was not correlated with high intensity activity in elite male players ($r=0.38$, $P>0.05$, Krstrup *et al.*, 2003). Male soccer players show strong relationship between VO_2max and the total distance covered in a match ($r=0.52$, $P<0.05$) and between Yo-Yo Intermittent Recovery Test

performance and the amount of high intensity running ($>15 \text{ km}\cdot\text{h}^{-1}$) completed during a game ($r=0.71$, $P<0.05$) (Krstrup *et al.*, 2003). However, there is no relationship between VO_2max and the total distance covered in a match in elite female players ($r=0.20$, $P>0.05$, Krstrup *et al.*, 2005). The majority of studies have focused largely on players younger than 16 – an age interval when individual differences in growth and biological maturation are perhaps at their greatest level (le Gall *et al.*, 2010). In contrast, there is little data for older or late adolescent players aged between 17 and 20 years, which is the last competitive age group before players face challenges associated with the highest competitive levels in the sport. Most of professional soccer players started their careers at this level between 17 and 20 years of age. Moreover, it is generally expected that youth players at this age and stage of development are ready to compete at the highest levels. In order to identify factors that may be relevant in the selection process it is of great importance to investigate the relationship of match activity with other players' characteristics. Therefore, the purpose of this cross-sectional study was to examine the relationship between some fitness tests and match activity among junior soccer players.

Methods

Subjects

Thirty seven soccer players (age 18.4 ± 0.1 years, height 1.67 ± 4.8 cm, body mass 53.6 ± 1.8 kg), all members of six junior National Soccer teams in Croatia ($N=50$) were randomly selected using as stratification criteria age and playing role.

The players were informed about the experimental procedures and possible discomforts associated with the study. Written informed consent was received from all players and parents after verbal and written explanation of the experimental design and potential risks of the study. Informed consent was obtained from each of the participants and their parents or legal guardians only after familiarization with the procedures used in this study. In order to improve internal validity players were blinded about the work hypothesis informing the aims of this observational study. All players agreed to provide their maximum will effort in order to perform at their best during all the field tests and competitions considered in this study. The study was approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb according to Helsinki Declaration. The participants were aware that they could withdraw from the study at any time. Selection criteria included: (1) participation at a professional (top three division leagues) level of football competition for at least 5 years, (2) all players participated in at least 75% training sessions per week and played at least 16 matches during the season, (3) no consumption of exogenous anabolic-androgenic steroids or other drugs that might have affected their physical performance or hormonal balance during the study (for at least 6 months (4) no recent history of febrile illness, muscle lesions, lower limb trauma, and metabolic diseases. Soccer players were instructed not to change their normal eating habits during the entire period of data collection. Nutritional supplements were not included in their diets. In addition, players were instructed to refrain from drinking beverages containing caffeine or alcohol and from consuming food during the 3 h before testing.

Procedures

Testing procedures were performed during the last stage of the competitive season (April- May 2014). Height and body weight were measured before breakfast and all other measurements were taken at the same time of day (between 8:00AM and 10:30AM), within the last two weeks of the competitive season period. Height was measured to the nearest 0.1 cm using a portable stadiometer (Holtain Ltd, Crymych, U.K.), and body weight to the nearest 0.1 kg using an electronic balance scale (Tanita TBF 401A, Japan), with the players wearing no shoes and only light clothing. Match activities were determined according to Castagna, D'Ottavio, & Abt, (2003) as follows:

1. Walking (0.4 to 3.0 km/h-1);
2. Jogging (3.0 to 8.0 km/h-1));
3. Medium Intensity Running (MIR; 8.0 to 13.0 km/h-1);
4. High-intensity Running (HIR; 13.0 to 18.0 km/h-1);
5. Sprinting (>18.0 km/h-1).

Data was collected with System 3D tillé sport analyzer that measures distance travelled in different intensities running.

This way, it was determined the total distance covered during the match, as well as the distance travelled by walking, jogging, running and sprinting.

Table 1. Match analysis data (n=37)

Match activity	mean±SD	min	max
Walking (0.4-3.0 km/h) (m)	5535.41±225.78	5120.00	5850.00
Jogging (3.0-8.0 km/h) (m)	1602.70±328.34	1100.00	2200.00
MIR (8.0-13.0 km/h) (m)	1726.43±333.85	1200.00	2300.00
HIR (13.0-18.0 km/h) (m)	683.51±134.52	500.00	890.00
Sprinting (>18.0 km/h) (m)	402.97±170.85	200.00	700.00
Total distance (m)	9951.03±1132.63	8360.00	11710.00

HIR= High Intensity Running; MIR= Medium Intensity Running.

Competitive matches (11 vs. 11, n=3) were played at the same time of the day (15.30 pm) on a regular sized synthetic-grass soccer pitch over two halves each lasting 45 min. Match air temperature and relative humidity were 22.8±1.8 C° and 40±9.8% respectively. In order to avoid dehydration, drinking was allowed to players. A minimum of 6 and a maximum of 9 players were observed during the same competitive match. Each player was observed for a minimum of two and a maximum of three competitive matches (within 10 days) and physical match performance categories were reported as mean of the observed games.

Speed

The sprints over 5, 10, and 30 m (SP5, SP10, and SP30, respectively) were performed from a standing start and measured by means of infrared photocells using a telemetric system (RS Sport, Zagreb, Croatia). Time was recorded in 100ths of a second. All tests were performed on an indoor synthetic pitch. Subjects performed two trials of each test, with at least 2 minutes of rest between all trials and tests. The best performances in each test were used for analysis. All tests were conducted in 48 hours following a competition or hard physical training to minimize the influence of fatigue on test performance.

Running Anaerobic Sprint Test (RAST)

Initially, the body mass was measured with all clothes used in the RAST test. The RAST was applied with the participants performing six 35-m maximal sprints with a 10-second interval between each sprint. The time for each run was measured by two photocells (CEFIS standard photocells,

Brazil) and the start for each sprint (10-second interval) occurred with a beep from the photocell equipment. Power output and fatigue indexes were calculated by the following equations: 1) Power: weight (kg) x distance (m²) / time (s³); 2) Fatigue Index: (maximum power - minimum power) / total time for 6 sprints (s).

30-second Wingate Test

Anaerobic work responses were obtained using a Monark 834k cycle ergometer (Monark, Stockholm). Seat height was adjusted to each participant’s satisfaction, and toe clips with straps were used to prevent the feet from slipping off the pedals. During the warm-up, participants pedaled at a constant pace of 60 rpm for 5 minutes against a light load of 1 kg. This was followed with 2 run-up practices of 3 seconds, during which the actual test load was imposed to accustom the participants to the resistance. For the actual test, each participant cycled as fast as possible for 30 seconds against a constant resistance of 0.075 kg per kilogram of body weight. The participants were instructed before the test that they should pedal as fast as possible throughout the 30-second test period. Participants were also verbally encouraged during the test to maintain their maximum pedal rate.

Statistical analyses

The data obtained in the research was processed using the application statistics program SPSS 20.0, adjusted for use on personal computers. The descriptive statistics were expressed as a mean (SD) for each variable. Data sets were checked for normality using the Kolmogorov–Smirnov test of the normality of distribution. Relationships between variables were assessed using Pearson’s product moment correlation. Significance was set at 0.05.

Results

During the match players covered 9951,03±1132,63m (8360,00-11710,00m) of which 683,51±134,52m, (500,00-890,00m) were performed at HIR. Details of match activities are presented in table 1.

Table 2. Correlation matrix of the relationship between fitness tests and match activities

	HIR	Sprinting	Total distance
S5	-0.09	-0.01	-0.18
S10	-0.19	-0.12	-0.31
S30	-0.24	-0.19	-0.30
RAST	0.92*	0.82*	0.53*
Wingate test	0.41*	0.32	0.88*

* Significant correlation p < 0.05 between variables; HIR= High Intensity Running

There were several relationships between the physical fitness tests and physical match performance variables (Table 2). In general, the tests of physical fitness were positively associated with a match with high intensity running variables, as well as with total distance covered. The total distance covered was significantly associated with RAST (0.53) and Wingate test (0.88). In addition, the RAST test was significantly related to HIR and sprinting. Wingate test performances were significantly related to HIR (0.41). Conversely, an inverse relationship (p>0.05) was found between all sprint tests and match activity during soccer match (Table 2).

Discussion

This study aimed to investigate the relationship between fitness tests and match activity in elite junior soccer players. The results of this study demonstrate a significant relationship between anaerobic fitness and match activity in elite junior soccer players. RAST and Wingate test showed large to very-large association with several physical match activities that have been demonstrated to be soccer-specific dependent variable. Also, tests for anaerobic fitness has positive and significant correlation with total distance covered (0.53-0.88, p<0.05). Castagna et al, (2010) showed large to very-large association of Yo-Yo IR1 and MSFT with several physical match activities that have been demonstrated to be soccer-specific dependent variables. However, aforementioned authors found that Hoff test demonstrated a large association with only the distance covered whilst sprinting. Strong relationship was found between High intensity activity and Yo-Yo IR1 performance (Castagna, Impellizzeri, Cecchini, Rampinini, & Alvarez, 2009) for male young soccer players (r=0.77, p<0.001) and by Krusturup et al, (2003), and Krusturup et al., (2005) for adult male (r=0.71, p<0.05) and female (r=0.76, p<0.05) soccer players.

However, in contrast to previous studies no significant relationship was observed between Total distance and Yo-Yo IR1 (r=0.42, p=0.14) (Castagna,et al., 2009;;Krusturup et al, 2003; and Krusturup,et al., 2005). In contrast to the Yo-Yo IR1, Castagna et al, (2010) found that the Multistage Fitness Test performance was largely related to total distance (r=0.62, p=0.02). This study’s results are in-line with previous studies that examined relation between field and laboratory tests and match performance. However, no significant relationship was observed between speed tests with match performance. This finding is in contrast with others (Rampinini et al, 2007) who have found a strong relationship between repeated-sprint ability and the amount of very high-speed running and sprinting distance performed in soccer. The lack of association between speed tests and physical match performance in this study may be explained by the relative homogeneity of our cohort. These findings suggest that sprint ability and high-intensity effort during match are two distinct qualities and demonstrate the need for a

test for soccer players to assess their preparedness for competition. In conclusion, the results of this study demonstrate a significant relationship between tests of anaerobic fitness ability and the total distance and distance covered in high-speed running during elite soccer league match play. However, no relationships were found between tests of sprint abilities and other match performance variables.

The significant relationship between anaerobic fitness tests and high-intensity activities and total distance in elite soccer league matches demonstrates the need to adequately prepare players for the running demands of competition. The findings of this study clearly demonstrate that anaerobic fitness, as determined by commonly used field and laboratory tests, is related to physical match performance in junior male soccer players.

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POVEZANOST IZMEĐU FITNES TESTOVA I IZVEDBE UTAKMICE KOD NOGOMETAŠA JUNIORA

Istraživanje u vezi povezanosti aktivnosti utakmice i fitnes testova kod nogometaša pokazalo je upitne rezultate. Stoga, ovo je istraživanje kao presjek područja imalo svrhu proučiti odnos između fitnes testova i aktivnosti utakmice među nogometašima juniora. Trideset i sedam nogometaša juniora je nasumično odabrano koristeći stratifikacijske kriterije: uzrast i ulogu u igri. Anaerobni fitnes je izmjeren od laboratorija i terenskih testova. Zatim, utvrđena je ukupna pokrivena udaljenost i pokrivena udaljenost tijekom visokointenzivnih radnji za vrijeme utakmice. Ukupna pokrivena udaljenost bila je značajno vezana za RAST (0.53) i Wingate test (0.88). Zatim, RAST test bio je značajno povezan s HIR-om i šprintom. Međutim, nije pronađena značajna povezanost ($p > 0.05$) između svih šprint testova i aktivnosti utakmice tijekom nogometnih utakmica. Značajna povezanost između anaerobnih fitnes testova i visokointenzivnih aktivnosti te ukupne udaljenosti kod utakmica elitnih nogometnih liga demonstrira potrebu za adekvatnom pripremom igrača za trkaće zahtjeve natjecanja. Pronalasci ovog istraživanja jasno demonstriraju da je anaerobni fitnes, kao što utvrđuju korišteni terenski i laboratorijski testovi, povezan s fizičkom izvedbom utakmice kod nogometaša juniora.

Ključne riječi: nogomet, elitni igrači, povezanost, fitnes

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