EXAMINATION OF THE RELATIONSHIP BETWEEN THE AGILITY SKILL AND FATIGUE LEVELS OF SOCCER PLAYERS THROUGH ILLINOIS AND 5-0-5 AGILITY TEST*

Olcay Mulazimoglu, Yakup Akif Afyon*, Bahtiyar Agin

Mugla Sitki Kocman University,
Faculty of Sport Sciences, Mugla, ***TURKEY***

*Corresponding author: yafyon@mu.edu.tr

ABSTRACT

In this study, it is aimed to examine the agility skills of football players in case of fatigue. 12 male amateur trained soccer players (age=23.33±1.83 years; experience= 12.00±2.00 years) were voluntarily participated in this research. The Illinois Agility Test and 5-0-5 Agility Test, which are often used in the measurement of the agility skills, were first performed by the players without any physical strain (pre-test). The agility tests (post-test) were immediately performed after the Yo-Yo Intermittent Recovery Test 1 (YYIRT1), which caused fatigue in the players, was performed by the player. The resting, maximal, pre- and post-test heart rate frequencies of the players were recorded via a heart rate monitor (Polar RS800CX, Electro Oy, Kempele, Finland). Pearson correlation analysis and difference test (Paired-Sample t test) were used for pre-test and post-test agility test scores and heart rate values which showed normal distribution by normality test (Shapiro-Wilk.) and the results were evaluated at the level of significance 0.05. It was determined that the maximal heart rate was 90.13 ± 1.49% after YYIRT1 test. The pre-test and post-test scores of the Illinois and 5-0-5 agility tests showed a significant positive correlation between intra- and intergroup groups (p<0,05). While it was found that there was statistically significant difference between the pre- and post-test scores of 5-0-5 agility test (t=-3.74; p<0,01) in favour of the pre-test, it was found that there was no significant difference between the pre- and post-test scores of the values of the Illinois post-test (t= -0.147; p>0.05). Although significant relationship between the two tests confirms that these tests can be used to measure agility skill based on the findings of the study, it can be inferred that these tests measure the different properties of the agility skill because of different effects of fatigue on these agility tests.

Keywords*: Soccer, 505 Test, Illinois Test, Agility, Fatigue*

INTRODUCTION

The concepts of speed, velocity or agility in sports can be confused. From another perspective, is a speedy athlete also agile? Apart from the conceptual

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definitions, studying the previous researches on the relational analysis of these two motoric skills through performance measurements can provide more clear information. Conditioners believe the existence of a strong relationship between speed, which is defined as the maximal run on a straight line, and agility, which is defined as run with direction changes. However, previous scientific studies haven't reported any information in accordance with this belief. Both earlier and recent studies present the difference of these two motoric skills. Illinois agility test consists of linear sprints and multiple direction changes done against time. Draper and Lancaster (1985) reported a weak relationship (r=0.47) between Illinois test results and 20 m sprint test results. Earlier studies conducted on footballers also reported weak relationships between speed and agility (Buttifant et al., 1999). In addition to other studies with similar studies (Baker, 1999; Buttifant et al., 1999; Draper and Lancaster, 1985; Young et al., 1996), another reported finding is that speed trainings don't have a significant effect on agility development among athletes (Young et al., 2001).

Among the two most important agility tests presented in the related literature, Illinois agility test is considered as a standard agility test (Cureton, 1951; Hastad & Lacy, 1994), while 505 agility test, even not related with speed, is acknowledged as the most valid test for measuring athletes' reaching top speed, slowing, and acceleration skills (Draper and Lancaster, 1985; Sheppard and Young, 2006). Due to developed technology, recent studies could present many physical performance features of footballers with time-movement analysis methods. According to the studies presenting the importance of agility among footballers with acceleration and slowing parameters, footballers exhibit an average of 1022 m acceleration and 899 m slowing movements within an average of 10451 m distance taken during a 90 min match (Akenhead et al., 2013). Proportionally, this is 9.7m for acceleration and 8.6m for slowing per minute, which makes the 18% of the total distance taken. Besides these, the fatigue footballers experience during a 90 min match is also effective on agility. According to the findings of the previous studies, high intensity run distances present a significant declining trend at the towards the ends of both half times and also recovery times between two high intensity activities increase towards the end of the match, which shows the correctness of this fact (Mohr et al., 2003, 2005; Bradley et al., 2009).

The purpose of the present research is studying the effects of fatigue on Illinois and 505 agility test scores, which measure two different aspects of agility, which is a very important motoric skill for footballers.

METHODS

Participants

The total of 12 male amateur footballers (age=23.33±1.83 years; sport age=12.00±2.00 years) voluntarily participated in the present research. All athletes signed the consent form, which provides information on the benefits and risks of the tests. The athlete group, who did regular training during competition season, didn't do any physical activities on the day of tests. Tests were conducted on a standard synthetic grass football field, where official matches are played.

Rested, maximal, pre-test and post-test heart beat rates of the athletes were recorded with a heart beat monitor (Polar RS800CX, Electro. Oy, Kempele, Finland).

Yo-Yo Intermittent Recovery Test 1 (YYIRT1)

YYIRT1, is a test conducted on a 2*20m track with start, turn and finish lines, consisting of forward and backward runs with gradually increasing pace done in accordance with time-adjusted alerts from a sound equipment (beeps) (Bangsbo, 2008), (Image 1). Between each run period (2*20m), athletes do active recovery on the 2*5m jogging field created near the running track. When the athlete can't make it to the finish line on time twice, the test is ended and the distance the athlete makes is recorded. Intermittent recovery run test consists of two levels with different run paces. The present study utilized Level 1 YYIR. Gradually increasing run paces are 10-13 kph-1 (0-160 m) for the first 4 run periods, 13.5-14 kph-1 (160-440 m) for the next 7 run periods and increased at 0.5 kph-1 for each following 8 run periods (760, 1080, 1400, 1720m, etc.) until fatigue. The test course is marked as 2 m wide and 20 m long with cones. An additional 5 m recovery field is marked near the start and finish line of the course. Before the test, all athletes must do a 4-period warm-up period. The test takes 6-20 minutes. All athletes do a trial to understand the test (Krustrup, 2003).

505 ility Test (505AT)

This is a reliable test used to measure athletes' capacity for changing directions quickly (Ellis et al., 2000; Alves at al., 2010). As presented in Image 2, 10+5 m sized course is marked on the field. The first 10 m part from the start line of the course is for acceleration run. When the athletes reach the beginning of the following 5 m part the time starts, and after athletes do 1800 turn and re-acceleration, the time stops and is recorded when the athletes reach at the finish line of the second 5 m distance. At the end of first 5 m run, athletes must set one foot on the turn line (Ellis et al., 2000). The photocell placed at the start of first 5 m enabled the automatic start and stop of the start and finish times.

Illinois Agility Test (IAT)

This was developed as a standard agility test to measure the run speed with turns and has been used on test courses of different sizes (Cureton, 1951; Hastad and Lacy, 1994; Hachana et al., 2013). Test method applied in some of the previous studies (Roozen, 2004; Jarvis et al., 2009; Wilkinson et al., 2009; Hachana et al., 2013) was also used in the present research. The test course is formed with four cones placed on to form a rectangle of 5m wide and 10 m long, and additional four cones places on a straight line in the middle with 3.3m intervals, as presented in Image 3. Test performance time is recorded with two photocells placed at the start and finish lines. The test consists of 10 m straight run, turn back around the cone, run straight back towards the start line, forth and back slalom around four cones in the middle, straight run towards the cone across the start line and straight run to the finish line. After the course is introduces, the athletes try the course. They are asked to turn around the cones, without jumping over, touching or knocking them down.

Experimental Design

After athletes warmed up, they did practice on the agility tests. All athletes took the 505 and Illinois agility tests before, and their scores were recorded as pre-test scores. After that, the athletes took YYIRT1 until fatigue level or end of the test to form fatigue on athletes. Right after the athletes did the YYIRT1 they re-took 505 and Illinois agility tests without resting. These scores were recorded as post-test scores.

Statistical Analyses

The correlations and differences between pre-test and post-test scores and heart beat rates were analysed with Pearson Correlation and Paired-Sample T test at 0.05 significance level. The size of the effect of fatigue on agility test scores was tested with Cohen's d, the results of which were interpreted as d≤0.20 small effect size; d≥0.50 medium effect size; and d≥0.80 large effect size (Cohen, 1988).

RESULTS

For the 12 male amateur footballers, who participated in the present research, (average ± standard deviation) age was found as 23.33±1.85; sport age as 12.00±2.00 years; rested heart beat rate as 69.17±5.56 bpm; maximal heart beat rate as 192.67±6.16 bpm; heart beat rate after YYIRT1 done for fatigue as 173.67±6.88 bpm; and fatigue heart beat rate percentage was found as 90.13±1.49% (Table 1).

Table 1. *Descriptive statistics for participants*

Variables	N	Min.	Max.	Mean	Sd
Age (years)	12	19	25	23.33	1.85
Sport Age (years)	12	7	14	12.00	2.00
HRrest (bpm)	12	63	82	69.17	5.56
HRmax (bpm)	12	182	202	192.67	6.16
HRpost-YYIRT1 (bpm)	12	163	184	173.67	6.88
HRmax%	12	87.77	91.79	90.13	1.49

According to the findings of the present research, there are positive strong correlations between participants' 505 agility test (r=0.88) and Illinois agility test (r=0.79) rested and fatigue scores ($p<0.01$). There is a positive correlation between rested 505 agility test and Illinois agility test scores ($p<0.05$). As presented in Table 2, there are positive correlations between the scores from two tests in both rested and fatigue conditions.

Table 2. *Correlations between pre-test and post-test scores from agility tests*

Paired Variables (sec)	N	Mean	Sd	r	p
505AT pre-test	12	2.54	0.19	0.88**	0.000
505AT post-test	12	2.64	0.18		
IAT pre-test	12	15.17	0.59	0.79**	0.002
IAT post-test	12	15.19	0.56		
505AT pre-test	12	2.54	0.19	0.74**	0.006
IAT pre-test	12	15.17	0.59		
505AT post-test	12	2.64	0.18	0.73**	0.007
IAT post-test	12	15.19	0.56		
505AT pre-test	12	2.54	0.19	0.58*	0.047
IAT post-test	12	15.19	0.56		
IAT pre-test	12	15.17	0.59	0.65*	0.022
505AT post-test	12	2.64	0.18		

*Significance level; *p<0.05, **p<0.01*

Pre-test=before YYIRT1, Post-test=after YYIRT1, 505AT=505 Agility Test, IAT=Illinois Agility Test

According to the findings, there is a significant difference between rested (2.54±0.19 sec) and fatigue (2.64±0.18 sec) condition scores from 505 agility test (t= -3.74; p<0.01) and the size of the effect of fatigue on participants' 505 agility test performance is medium (d=0.54).

Additionally, there isn't a significant difference between rested (15.17 sec) and fatigue (15.19 sec) condition scores from Illinois agility test (t= -0.15; p<0.05) and the size of the effect of fatigue on participants' Illinois agility test performance is insignificant (d= -0.03).

Table 3. *The differences between pre-test and post-test scores from agility tests and the effect sizes*

Paired Variables	Mean	Sd	Mean Diff. (sd)	t	df	p	ES
505AT pre-test	2.54	0.19	-0.099	**-3.74****	11	0.003	Medium
505AT post-test	2.64	0.18	(0.092)				(d=0.54)
IAT pre-test	15.17	0.59	-0.016	-0.15	11	0.886	non
IAT post-test	15.19	0.56	(0.374)				(d=-0.03)

***p<0.01, ES=Effect Size (Cohen's d)*

DISCUSSION

According to the findings of the present research, agility skills of amateur footballers are affected from fatigue. In 505 agility test, which requires swifter slowing, direction change and accelerations, athletes did better scores in rested condition. Fatigue had a negative effect on participants' 505 agility test scores,

while there wasn't a significant difference between rested and fatigue condition scores from Illinois agility test.

Some of the previous studies focused on the comparison of speed performances in linear run and run with direction changes (Little and Williams, 2005; Young et al., 2001). Little and Williams (2005) reported that there were strong correlations between acceleration (10 m. sprint test), maximal speed (20 m. accelerated sprint test) and agility (zigzag test) features among elite footballers. However, they also reported that the highest correlation coefficient between these three different features was between acceleration and maximal speed (39%), therefore these features could be affected from different factors. Many previous studies have reported relationships between acceleration and maximal speed (Delecluse, 1997) and linear sprint speed and agility features (Buttifant, 1999; Draper and Lancaster, 1985; Mayhew et al., 1989; Young et al., 1996). The findings of the present research on the significant correlations between rested and fatigue condition 505 and Illinois agility test scores are in agreement with these findings. However, the findings that 505 agility test performance was affected from fatigue and Illinois test performance didn't indicate differences in the qualities of these two tests.

Identifying the kind of agility footballers need more is very important. Defining which kinds of agility these two agilities measure can contribute to meeting of this need, since some previous long-term studies reported that linear sprint training improved athletes' acceleration and maximal speed performances, while this didn't have any effect on speed with direction changes and similarly, agility training didn't improve linear sprint speed (Young et al., 2001).

CONCLUSIONS

Fatigue has a negative effect on 505 test performance among footballer, as in many other performance features (Mohr, 2005). However, this is not the case for Illinois agility test. In 505 agility test, athletes need higher acceleration and slowing skills compared to Illinois agility test. Therefore, fatigue affects footballers' 505 agility test performances. The use of both tests in measuring agility skills is important. However, footballers moves in a football match are more like the characteristics of 505 agility test. Accordingly, measuring agility skills of footballers in different conditions like fatigue with 505 test will provide more accurate information.

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