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ORIGINAL ARTICLE

Association of Short-Passing Ability with Athletic Performances in Youth Soccer Players

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Abstract

Purpose: **This study was designed to examine the relationship between multiple short-passing ability [measured using the Loughborough Soccer Passing Test (LSPT)] and athletic performances in youth soccer players.**

Methods: **Forty-two young soccer players (age 14.8±0.4years) performed the LSPT, the squat-jump (SqJ), the counter movement jump (CMJ), the 30m sprints (with 5m and 20m split times also recorded), the 15m agility run (Agility-15m), the 15m ball dribbling (Ball-15m), the Illinois agility test (IAGT) and the Yo-Yo IRT Level 1 tests.**

Results: **LSPT total performance (LSPT TP) showed significant positive correlation with 5m, 20m, and 30m sprint times, Agility-15m, Ball-15m and Illinois agility test (r=0.60, r=0.58, r=0.49, r=0.75, r=0.71 and r=0.72; P<0.01, respectively). Significant negative correlation were found between LSPT TP and SqJ and CMJ (r=−0.62 and r=−0.64; P<0.01, respectively). It was determined that Agility-15m, Illinois agility test and Ball-15m were the most effective factors associated with LSPT TP among other factors in multiple regression analysis.**

Conclusion: **This study showed that LSPT TP of young elite soccer players is determined by their agility abilities, thus enabling this test to be used for talent identification purposes.**

Key Words: Technical Skills; Agility; Cognitive Function; Physical Fitness; Football

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INTRODUCTION

Technical and tactical abilities are important components of soccer performance [1]. In particular, short-passing ability is considered a relevant skill for soccer players [2]. Indeed, short-passing accuracy as measured using the Loughborough Soccer Passing Test (LSPT) is able to discriminate players of different competitive levels and to assess the multi-faceted aspects of soccer skill including passing, dribbling, control and decision-making [3,4].

In this context, Rampinini et al [5] showed that players of the best teams in the Italian Serie-A performed more short-passes during official matches than players of the worst teams, and that the number of short passes decreased in the second half with respect to the first. This probably indicates the occurrence of fatigue, which is defined as a decrease in physical performance [6]. Although soccer is one of the most researched team sports, many of the studies revolve around gathering match analysis data, physiological demands and/or characteristics of players [7]. Nevertheless, it would appear that "skilful" performances are crucial to winning soccer matches [8].

Nevertheless, Reilly et al [9] indicated that a number of physical and anthropometric prerequisites are necessary to compete at the elite level in football. Specifically, players are expected to possess well

developed aerobic fitness and anaerobic power, coupled with good agility [10] to be capable of maintaining high power during fast movements over the entire match [11]. In this context, Rampinini et al [12] showed that the deterioration in LSPT score, induced by simulation, was correlated to the players' physical fitness, as measured by the level 1 Yo-Yo Intermittent Recovery Test (Yo-Yo IRT1).

This suggests that the higher the fitness level, the lower the fatigue experienced by the players for a given absolute intensity, which in turn results in less deterioration in technical proficiency.

To our knowledge, only Helgerud et al [13] have examined the effect of an exercise training program on the passing ability of soccer players. However, in their study, they did not study the athletic determinants of the players' short passing ability. With this in mind, the main aim of the present study was to examine the relationship between LSPT performance score and athletic performances of elite soccer players.

METHODS AND SUBJECTS

Participants:

Forty-two young male soccer players, all from the first division of the Tunisian Championship participated in this study, which was conducted during the competitive season. They performed soccer training five times a week and played in one competitive match during the weekends. Each soccer training session was approximately 2 h in duration and generally consisted of warm-up, physical training, technical training, tactical training, simulated competition and cool-down. Goalkeepers were excluded from the study, as they did not participate in the same physical training program as the remainder of the squad. The study was conducted according to the Declaration of Helsinki and the protocol fully approved by the Human Research Ethics Committee before the commencement of the assessments. Written informed consent was received from all subjects and their parents after a detailed explanation about the benefits, and risks of this investigation.

Anthropometric and physiological measures:

Participants reported to the laboratory for the measurement of height, body mass, and percentage body fat (%BF). Body mass was measured to the nearest 0.1kg using electronic scales (Seca Instruments Ltd., Hamburg, Germany) and height was measured to the nearest 0.001m using a stadiometer (Holtain Ltd., Crymych, UK). Skinfold thickness at four sites (biceps, triceps, subscapular, and suprailiac) was measured using Harpenden callipers (Lange, Cambridge, MA, USA) by an experienced anthropometrist, and %BF was calculated from these measurements using the equation of During and Webster [14]. All measurements were taken in the morning from 7h30 to 8h00 a.m. by the same investigator one day before the physical tests.

Physical tests were undertaken between 16:00 and 18:00h, at least 24h after the last training session and 2h postprandial. All fitness tests were performed in the same day (temperature 27.2–29.1°C, relative humidity 55.4–61.0%; Kestrel 4000 Pocket Weather Tracker, Nielsen Kellerman, Boothwyn, PA, USA).

All jumping tests (squat-jump (SqJ) and countermovement jump (CMJ)) were performed on a concrete surface with the players wearing running shoes, whereas the LSPT, the 5m, 20m and 30m sprints, the 15m agility run (Agility-15m), the 15m ball dribbling (Ball-15m), the Illinois Agility Test, and the Yo-Yo IRT Level 1 tests were performed on a football pitch with the players wearing football boots. Each player was instructed and verbally encouraged to provide maximal effort during all tests. A 15min standardized warm-up, consisting of jogging, dynamic stretching and a series of sprints of increasing intensity, was performed before testing.

Loughborough Soccer Passing Test (LSPT):

All subjects were familiarised with the LSPT for 1-week (4 times/week) before testing. To obtain an objective measure of short-passing ability, the modified version of the LSPT was used, in which the contribution of cognitive function (decision making) was added to the original passing test [3, 4]. This version of LSPT has been shown to be a reliable and valid test of passing ability in soccer players [3]. Fig. 1 illustrates the layout of the LSPT test.

Participants started with the soccer ball by the

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central cone, and the first examiner started timing the test, using a hand-held stopwatch, from the moment the ball was played out of the inner rectangle. The second examiner was involved in calling out the order of passes; the specific colour was called out just before the participant completed the current pass. The same examiner was used in each role so as to eliminate inter-experimenter variability. The sequence of passes was determined by one of 8 trial orders that were randomly generated by the investigators so that each trial consisted of 8 long (4m; green and blue) and 8 short (3.5m; white and red) passes. Participants were informed that passes could only be executed from within the passing area between the set of marked lines. They were also told that upon retrieval from the previous pass the ball had to cross two of the inner marked lines before the next pass could be attempted. Furthermore, the players were informed that for best performance on the LSPT they would have to perform the test as quickly as possible whilst making the fewest mistakes. The second examiner stopped the watch when the last pass was completed.

A further role of the second examiner was to record penalty time points accrued during the trials. Thus, the examiner stood in such a position that all four target areas could be viewed. Penalty time was awarded for the following:

- 5s for missing the bench completely or passing to the wrong target.
- 3s for missing the target area (0.6 × 0.3m).
- 3s for handling the ball.
- 2s for passing the ball from outside of the designated area.
- 2s for the ball touching any cone.
- 1s for every second taken over the allocated 43s to complete the test.
- 1s (bonus) was deducted from the total time if the ball hit the 10-cm strip in the middle of the target.

Three indices of performance were calculated: 1) time necessary to complete the 16 passes (LSPT time: LSPT T); 2) penalties calculated from the errors committed by each player during the test execution (LSPT penalties: LSPT P); and 3) total performance (LSPT total performance: LSPT TP) consisting of the time necessary to complete the test after adjusting for penalties and/or bonus time. Participants performed two attempts, the mean of which was used as their performance score.

Vertical jumping:

Each subject performed two kinds of maximal vertical jumps: the SqJ, starting with knees bent at ~90° and without previous counter movement; and the CMJ, starting from a standing position allowing for countermovement with the intention of reaching knee flexion angles of approximately 90° just before immediate vertical impulsion.

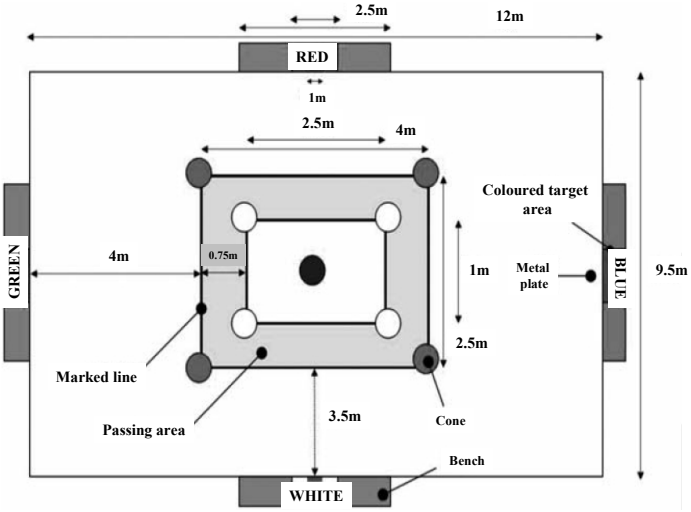

Fig.1: Schematic representation of the Loughborough Soccer Passing Test (LSPT)

The forces generated during these jumps were estimated with an Optojump photocell system (Microgate, Bolzano, Italy). Each player performed 3 SJ and 3 CMJ interspersed with 1-min rest in-between, and the best (highest) jump of each type was used for analysis [15].

Sprint tests:

The participants performed three maximal 30m sprints (with 5m and 20m split times also recorded). During the 3min recovery periods in-between, the participants walked back to the starting line and then passively waited for the next sprint. Time was recorded using three photo-cell gates (Brower Timing Systems, Salt-Lake City, UT, USA, accuracy of 0.01 s) positioned 5, 20 and 30m from the starting line at a height of 1 m [16]. The participants commenced the sprint when ready from a standing start 0.5m behind the first timing gate. Stance for the start was consistent for all participants. The best (fastest) 30m sprint time and the associated 5m and 20m sprint times were selected for analysis.

15m agility run (Agility-15m):

In this test players' time in an Agility-15m [17] was measured using the same photocell gates as above. Players started running 3m behind the initial photocell gate. After 3m of line running, players entered a 3m slalom section marked by three sticks 1.6m of height and placed 1.5m apart, and then cleared a 0.5m-height hurdle placed 2m beyond the third stick. Players finally ran 7m to break the second photocell gate, which stopped the timer. Each player performed two maximal Agility-15m runs interspersed with 3min of passive recovery, and the fastest time achieved was recorded.

15-m ball dribbling (Ball-15m):

This test was similar to the Agility-15m, but players were required to dribble a ball while performing the test [17]. After the slalom section of the test, the ball was kicked under the hurdle while the player cleared it. The player then freely kicked the ball towards either of two small goals placed diagonally 7m on the left and the right sides of the hurdle, and sprinted to the finish line. Each player performed two maximal Ball-15m interspersed with 3min of passive recovery, and the fastest time achieved was kept for analysis.

Illinois Agility Test:

Agility was assessed using the Illinois agility run [18]. On the command "Go", subjects sprinted 9m, and turned back to the starting line. After returning to the starting line, they swerved in and out of four markers, completing two 9m sprints to finish the agility course. The fastest value obtained from two trials with 3min recovery in-between was used as the agility score.

Yo-Yo Intermittent Recovery Test Level 1:

The Yo-Yo IRT Level 1 test was performed according to the procedures described by Krustrup et al [19]. The players performed a series of 20m shuttle runs at a pace set by a calibrated audio metronome with a 10s standard rest interval between shuttles. The time allowed for the shuttles was progressively decreased, that is, the speed was increased. The test was terminated when the player was unable to maintain the required speed. The distance covered in the shuttles was recorded for analysis.

The reliability of Yo-Yo IRT1 was established in a previous study (intraclass correlation coefficient [ICC] = 0.98, $P< 0.0001$ with a coefficient of variation [CV] of 3.5%; [20]).

Statistical Analyses:

Data are expressed as mean ± SD. Before using parametric tests, the condition of normal variation was verified using the Shapiro-Wilk W-test. Pearson product–moment correlations were used to examine the relationship between LSPT and anthropometric and physiological variables. The magnitude of the correlations was determined using the modified scale by Hopkins [21]: r < 0.1, trivial; 0.1–0.3, small; > 0.3–0.5, moderate; > 0.5–0.7, large; > 0.7–0.9, very large; > 0.9, nearly perfect; and 1 perfect.

A forward stepwise multiple linear regression analysis was performed with LSPT TP as the dependant variable. The effect size (ES) was calculated to assess meaningfulness of differences. Effect sizes of > 0.8, 0.8–0.5, < 0.5–0.2, and < 0.2 were considered as large, moderate, small, and trivial, respectively [22]. The reliability of each test was assessed by intra-class correlations coefficients (ICCs). Statistical analysis was performed using SPSS version 18.0 (SPSS Inc.,

Table 1: The anthropometric and physiological characteristics of the soccer players (mean±SD)

Test	Performance	ICCs
Age (years)	14.8 (0.4)	---
Height (cm)	175.6 (6.1)	0.98
Body mass (kg)	64.1 (4.3)	0.99
Body fat (%)	13.4 (3.1)	0.97
LSPT T (s)	45.8 (3.9)	0.92
LSPT P (s)	16.8 (6.9)	0.89
LSPT TP (s)	62.6 (9.1)	0.93
Yo-Yo IR1 (m)	2648 (633)	0.97
5m (s)	1.08 (0.09)	0.96
20m (s)	3.14 (0.13)	0.97
30m (s)	4.36 (0.19)	0.97
Agility-15m (s)	3.41 (0.2)	0.97
Ball-15m (s)	4.35 (0.39)	0.95
Illinois agility test (s)	17.7 (0.62)	0.98
squat-jump (cm)	35.21 (4.22)	0.93
Counter Movement Jump (cm)	40.13 (4.89)	0.91

ICCs: intraclass correlations coefficients; LSPT TP: Loughborough Soccer Passing Test total performance (s); LSPT T: Loughborough Soccer Passing Test time (s); LSPT P: Loughborough Soccer Passing Test penalty (s)

Chicago, IL, USA). The level of significance was set at $P< 0.05$.

RESULTS

The data for all physical test performances and ICC are presented in Table 1. The results show that these tests were highly repeatable.

A mean of the LSPT performance scores for all participants is presented in Table 1. The performance score (LSPT TP) consists of two variables, the time taken to complete the LSPT (LSPT T) and any accrued penalty time (LSPT P) for poor control or inaccurate passing.

LSPT T:

Significant positive correlations were found between LSPT T and body mass (large), %BF (moderate) and Ball-15m (large). The LSPT T was significantly negatively correlation (moderate) with Ball-15m. No correlations were found between LSPT T and other parameters (Table 2).

LSPT P:

LSPT P was positively correlated (moderate to large) with body mass, % BF, Ball-15m, Illinois agility tests and 5m, 20m, and 30m sprint times. A very large positive correlation was found between LSPT P and Agility-15m. In addition, LSPT P was largely negatively correlated with SqJ, and CMJ. LSPT P was not significantly related to Yo-Yo IRT-1 distance (Table 2).

LSPT TP:

Table 2 shows a large positive correlation between LSPT TP and body mass and %BF. Large significant positive correlations were found between LSPT TP and 5m, 20m, and 30m sprint times. Large significant negative correlations were found between LSPT TP and SqJ, and CMJ. Very large significant positive correlations were found between LSPT TP and Agility-15m, Ball-15m, and Illinois agility tests. Yo-Yo IRT-1 distance was not significantly related to LSPT TP (Table 2).

Table 3 shows that according to multiple stepwise regression models the predictors of LSPT TP were times measured during Agility-15m, Illinois agility test and Ball-15m.

DISCUSSION

Soccer is a complex sport, requiring the repetition of

Table 2: Correlations between Loughborough Soccer Passing Test (LSPT) performance scores and soccer players' anthropometric characteristics and physical performances

Variables (units)	LSPT T		LSPT P		LSPT TP	
	r	*P*	*r*	*P*	*r*	*P*
Height (m)	0.13	0.51	0.35	0.16	0.15	0.21
Body Mass (kg)	0.51	0.00	0.57	0.00	0.64	0.00
% Body Fat (kg)	0.49	0.01	0.41	0.01	0.59	0.00
Yo-Yo IR1 (m)	0.16	0.15	-0.29	0.11	-0.35	0.12
5m sprint time (s)	0.18	0.12	0.54	0.00	0.60	0.00
20m sprint time (s)	0.22	0.11	0.51	0.00	0.58	0.00
30m sprint time (s)	0.36	0.13	0.32	0.01	0.49	0.00
Agility-15m (s)	0.39	0.23	0.71	0.00	0.75	0.00
Ball-15m (s)	0.51	0.00	0.62	0.00	0.71	0.00
Illinois agility test (s)	0.18	0.11	0.65	0.00	0.72	0.00
Squat jump (cm)	-0.38	0.03	-0.53	0.00	-0.62	0.00
Counter-movement jump (cm)	-0.32	0.30	-0.57	0.00	-0.64	0.00

LSPT: Loughborough Soccer Passing Test; LSPT TP: LSPT total performance (s); LSPT T: LSPT time (s); LSPT P: LSPT penalty (s); Yo-Yo IR1: Yo-Yo intermittent recovery test level-1 (m); Agility-15m: 15m agility run, Ball-15m: 15m agility with ball dribbling; I AG T: Illinois Agility test

many disparate actions, and several tests are currently being used to assess the physical prowess of players [5]. Bate [23] suggested that all sports, to varying extents, involve the application of cognitive, perceptual or motor skill. As it is performed under a rapidly changing environment, Bate [23] claimed that soccer involves all three types of skills. Indeed, soccer is categorized as a free-flowing game requiring the execution of many aspects of skill in a dynamic context [24]. Sprint ability over short distances has also been reported to be a key fitness prerequisite for professional footballers [9, 7].

Short-passing accuracy, as measured by the LSPT is able to distinguish elite players from their counterparts by analysing various aspects of soccer-skill performance (gross motor performance with the time only score and accuracy using penalty time). In this context, it appears that passing ability is most probably influenced by agility, as passing requires balance and motor skill control [3,4].

Due to the few studies that have used the LSPT in young players, it is difficult to compare our findings. In our study, time scores were 45.8s and global performance was 62.6 s and in the study of Impellizzeri et al [25] with 26 junior soccer players (mean age 17.8 years), time score was 44.7 s and global performance was 60.7 s. The LSPT T and the LSPT TP corresponded to our sub-elite players but no information was provided concerning the playing-level of subjects in the study of Impellizzeri et al [25].

Nevertheless, results of LSPT TP in our study were higher than those of Ali et al [4], implying that the players of the present study possibly had lower technical level.

Table 3: Results of stepwise multiple regression analysis of factors that influenced the Loughborough Soccer Passing Test total performance (dependant variable)

Step		Regression Coefficients	SE	*β*	*P*
Step 1	(Constant)	-68.60	24.15		0.01
	Agility-15m	38.08	7.12	0.76	<0.001
Step 2	(Constant)	-172.15	31.81		<0.001
	Agility-15m	25.95	6.23	0.52	<0.001
	Illinois agility test	7.99	2.00	0.49	<0.001
Step 3	(Constant)	-163.37	26.65		<0.001
	Agility-15m	15.07	6.24	0.30	0.01
	Illinois agility test	7.26	1.68	0.45	<0.001
	Ball-15m	9.40	3.00	0.37	<0.001

A previous study [12] showed that the deterioration in LSPT score, observed after a 5min high-intensity simulation, was correlated to the players' physical fitness, as measured by the Yo-Yo IRT level-1 test. This suggested that higher the fitness level, the lower the fatigue experienced by the players for a given absolute intensity, which in turn resulted in less deterioration in technical proficiency. The present study's findings showed that LSPT score performance was strongly correlated with motor speed, agility and leg power. However, the LSPT score performance was not correlated with aerobic capacity assessed using the Yo-Yo IRT level-1 test.

In soccer, players' physical performance is reduced in the second half as demonstrated by the decrease in sprinting and high-intensity activity compared with the first half [26, 5]. Indeed, Rampinini et al [12] showed a decline in LSPT performance throughout the match. Nevertheless, it is possible that similar physiological mechanisms causing a deterioration in physical performance may have altered the mechanics of kicking performance and hence, passing ability [27].

During soccer, as players are confronted with a complex and rapidly changing environment, cognitive and perceptual skills are important determinants for playing ability [28]. The assessment of skill is rarely included when the fitness of players is monitored [29]. Indeed, there is a dearth of studies on skill performance within the research literature, which seems remarkable when it is readily acknowledged that the successful execution of skill is one of the most important aspects of soccer play.

CONCLUSION

In conclusion, the LSPT score performance was positively correlated with sprinting and agility performances and negatively correlated with SqJ and CMJ performances. This study showed that the LSPT performance is highly determined by agility with or without the ball. As the LSPT was able to distinguish players according to their playing-level, this opens up the possibility of using this test to improve objectivity of the talent identification process and decision-making concerning the recruitment of young soccer players.

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Conflict of interests: None

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