Reliability and Factorial Validity of Agility Tests for Soccer Players

Goran Sporis, Igor Jukic, Luka Milanovic, and Vlatko Vucetic

Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

Abstract

Sporis, G, Jukic, I, Milanovic, L, and Vucetic, V. Reliability and factorial validity of agility tests for soccer players. *J Strength Cond Res* 24(3): 679–686, 2010—The purpose of this study was to evaluate the reliability and factorial validity of agility tests used in soccer. One hundred fifty ($n = 150$), elite, male, junior soccer players, members of the First Junior League Team, volunteered to participate in the study. The slalom test (ST) sprint 4 × 5 m (S4 × 5) and sprint 9-3-6-3-6-9 m with 180° turns (S180°) tests had a greater reliability coefficient ($\alpha = 0.992$, 0.979, and 0.976), whereas the within-subject variation ranged between 2.9 and 5.6%. The mentioned 6 agility tests resulted in the extraction of 2 significant components. The S4×5 test had the lowest correlation coefficient with the first component ($r = 0.38$), whereas the correlation coefficients of the other 5 agility tests were higher than 0.63. The T-test (TT) showed statistically significant differences between the defenders and midfielders ($p < 0.05$) and between the defenders and attackers ($p < 0.05$). Statistical significant differences were determined between the attackers and defenders in the sprint 9-3-6-3-9 m with backward and forward running (SBF) and $p < 0.05$. It can be concluded that of the 6 agility tests used in this study, the SBF, TT, and S180° are the most reliable and valid tests for estimating the agility of soccer players. According to the results of the study, the TT proved to be the most appropriate for estimating the agility of defenders, the SBF, and S180° for estimating the agility of midfielders, whereas the S4 × 5 test can be used for estimating the agility of attackers.

Key Words field tests, evaluation, junior players

Introduction

Agility is the ability to maintain and control correct body positions while quickly changing direction through a series of movements (22). Agility training has, for a long time, been a component of every soccer training program but it has not been well investigated scientifically. A soccer player changes direction every 2–4 seconds (23) and makes 1,200–1,400 changes (2) of direction during a game. Players and coaches alike are continually looking for ways to help athletes gain a competitive edge in soccer. Agility is believed to be an important physical component necessary for successful performance in many sports, particularly in soccer (8,10,11,19). It is also fundamental for the optimal performance of soccer players and often described as a quality possessing the ability to change direction and start and stop quickly (3,9,16,18). Improving agility is one of the most important aspects of the off-season strength and conditioning programs. In soccer, there is a strong interest present in developing a field test that could effectively measure the agility of soccer players. In a game situation, the changes of directions may be initiated to either pursue or evade an opponent or react to the moving ball. Therefore, it has been recognized that the response to a stimulus (4) is a component of agility performance. However, scientists differ on how to define agility, and only a small number of articles deal with the problem of agility tests (20). From a soccer perspective, we might add that agility is also the ability to change directions quickly and easily. Furthermore, agility, conditioning, and weight training need to be synchronized in reference to periodization. By working on agility and by improving balance and coordination, soccer players will be able to move faster and change directions more quickly while maintaining control. Enhanced power, balance, speed, and coordination are some of the objectives of their agility training. Sport scientists continually search for effective methods to identify physical characteristics that may contribute to sport performance. A common method of assessing the athletic talent is through physical ability testing (5). Agility tests can help soccer coaches and conditioning specialists diagnose specific weaknesses, screen for possible health risks due to strenuous exercise, provide data for outlining individual exercise prescriptions, and assess cycles of a training period (1). Although there is no consensus on the measurement of agility, in soccer, the T-test (TT) is very

Laboratory: Sports Diagnostic Centre of the Faculty of Kinesiology.
Address correspondence to Goran Sporis, gsporis@kif.hr.

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Table 1. General descriptive parameters of the sample at the beginning of the study ($n = 150$).

	Age	Height (cm)	Weight (kg)	Body fat (%)	HRmax (treadmill)*	$\dot{V}O_2max$ (ml·min^{-1})*	Years of training
Mean ± *SD*	19.1 ± 0.6	177.1 ± 6.3	71.2 ± 5.7	8.7 ± 2.1	181 ± 2.2	60.9 ± 2.1	9.4 ± 1.2

*The maximal oxygen uptake ($\dot{V}O_2max$) and maximal heart rate (HRmax) were measured by 1-minute incremental maximal exercise tests performed on a motor-driven treadmill (run race, Technogym), with a 1.5% inclination. The Quark b2 "breath-by-breath" gas analysis system (Cosmed) was used for monitoring respiratory gas exchange. Heart rate was monitored using a Polar Vantage NV (Polar ElectroOi) heart rate monitor.

often used as a measure of agility. The purpose of this research was to evaluate the reliability and factorial validity of agility tests used in soccer. The second purpose was to compare the validity of different tests and evaluate the agility of soccer players, whereas the third was to determine the positional differences between attackers, defenders, and midfielders in all 6 agility tests.

Methods

Experimental Approach to the Problem

Soccer coaches mostly rely on field tests to routinely monitor an athlete's adaptations to the training programs and for talent selection purposes. Although the scientific basis for speed and agility training can be explained scientifically, the effectiveness of various programs and agility tests is more difficult. Coaches have developed a variety of training methods for improving athletic performance. It is now up to the research component to explain and determine the best test for measuring the agility of soccer players. That knowledge, it is hoped, will also give a better insight into this form of training so that more specific agility tests can be developed.

Agility tests are often done indoors. This causes the problem of test validity because the tests are carried out on soccer players wearing their tennis shoes and not the regular soccer kit. Furthermore, the ground reaction force is different when the tests are done on a natural grass soccer pitch. In the previous studies, the reliability of agility tests was calculated from a sample of mostly college students, not soccer players (17). These are the questions that need to be addressed: are these tests reliable and valid and which tests are the most valid for evaluating the agility of soccer players? For this purpose, the subjects participating in the study took different agility tests: TT, slalom test (ST), sprint 4 × 5 Meters (S4 × 5), sprint with 90° turns (S90°), sprint 9-3-6-3-9 m with 180° turns (S180°), and sprint 9-3-6-3-9 m with backward and forward running (SBF), and statistical analyses were conducted to assess the reliability and factorial validity of the tests to determine which agility tests are most adequate for different soccer positions (midfielder, defender, and attacker). The study was financed by the Croatian Football Federation and the Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia.

Subjects

One hundred fifty ($n = 150$), elite, male, junior soccer players, members of the First Junior League Team, volunteered to participate in the study. Twenty-five of the subjects were also members of the Junior Croatian National Team, and the remaining players played in 12 clubs, members of First Croatian Junior League. All the participants provided written consent after being informed of the test protocol but not of the aim of the study. The protocol of the study was approved by the Ethical Committee of the Faculty of Kinesiology, University of Zagreb and according to the revised Declaration of Helsinki. Each player had at least 9 years of training experience, corresponding to 2-hour training sessions, and at least 1 competition per week. The duration of the training program, technical-tactical preparation, and the intensity and extensity of those in training were strictly controlled. Heart

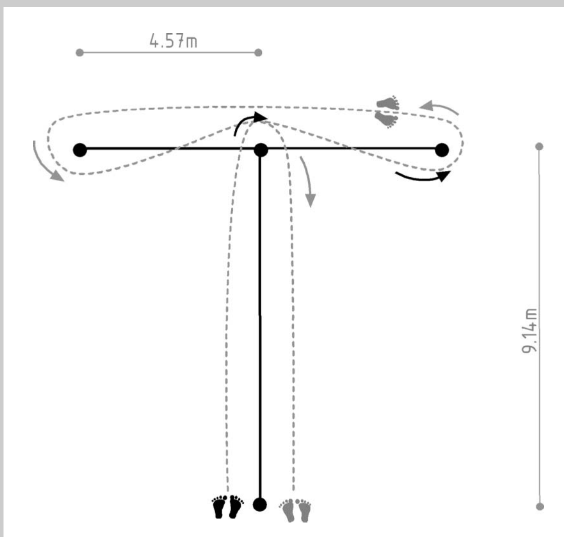

Figure 1. Layout of the T-test (TT).

rate monitors (Polar S-610; Polar Electro, Kempele, Finland) controlled the set intensities. Subjects were given advice about the diet. All subjects had a similar diet (55% of the calories were derived from carbohydrates, 25% from fat, and 20% from protein). In the period of 24 hours before the testing, the subjects did not participate in any prolonged exercise.

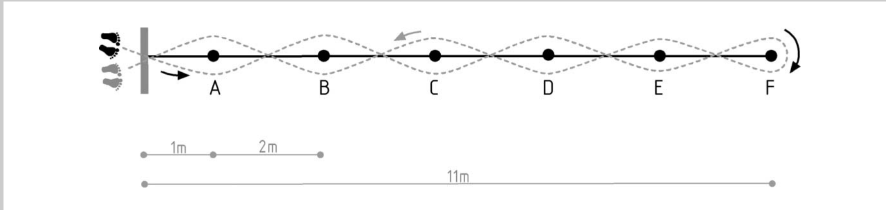

Figure 2. Layout of the slalom test (ST).

The team's main conditioning and the second conditioning coach conducted the training sessions in strict accordance with the designed detailed plans and programs of scheduled activities, intensities, and frequencies of training stimuli. In the process, the players were not informed about the purpose of the study and were unaware of the other team's participation in the study. Consent was obtained from the team leadership and from the main technique-tactics coach. The main characteristics of the sample are presented in Table 1.

Procedures

The study was carried out in 2 phases: at the beginning of the 2006/2007 summer preparations and at the beginning of the 2006/2007 competitive season. In both phases, the testing period was 2 weeks, and it was conducted by experienced professionals, members of the Sport Diagnostic Centre at the Faculty of Kinesiology. Every day, the testing was carried out in a different club. It always began at 10 AM and finished by 1 PM. Every player was instructed and verbally encouraged to give the maximum. The tests were performed on a natural grass soccer pitch; the subjects were wearing a soccer kit, and the times were recorded in hundredths of a second by an electronic timekeeping device (Photo-cell system by RS, Croatia). Before the actual testing, the subjects were questioned about their playing experience, playing position, and any recent injuries because only the healthy players were allowed to participate in the study. During the testing period, the air temperature ranged from 21 to 27°C. Before being tested, the players did a general warm-up and lightly jogged for 5–10 minutes around the pitch. They did 5 minutes of static and dynamic stretching. The purpose of the warm-up was to increase the heart rate, blood flow, core temperature, and respiration. The warm-up was followed by a dynamic flexibility exercise, which lasted from 7 to 10 minutes. It was employed for its positive effect because it improves a player's coordination, balance, proprioception, and movement speed. After the dynamic flexibility exercise, the players performed ten 5-m sprints, followed by 10-m sprints. All 6 tests were carried out in 3 trials. The subjects always started after a signal (beeping sound). These were the 6 tests used for the estimation of soccer players' agility in this study.

T-Test. The TT was administered using the protocol outlined by Semenick (20). The subject began the exercise with both of his feet behind starting point A (Figure 1) and after the sound signal. First, he sprinted 9.14 m forward to point B and touched the cone. Then, he shuffled 4.57 m to the left and touched cone C. After that, he shuffled 9.14 m to the right and touched cone D and then 4.57 m to the left, back to point B. Then, the players ran backward passing the finish line at point A. Two electronic time sensors (Photo-cell system by RS, Croatia) were set 0.75 m above the grass and positioned 3 m apart facing each other on either side of the starting line. The clock started when the players passed the electronic sensors, and it stopped the instant the players crossed the sensors' plane. In all 6 agility tests, the electronic time sensors were positioned in the same way. All 6 tests were performed 3 times (3 trials).

Slalom Test. They all started with both feet behind starting point A (Figure 2). Six cones were set up 2 m apart, the first cone 1 m away from the starting line. Every player stood still facing the starting line, with his feet apart and the cone

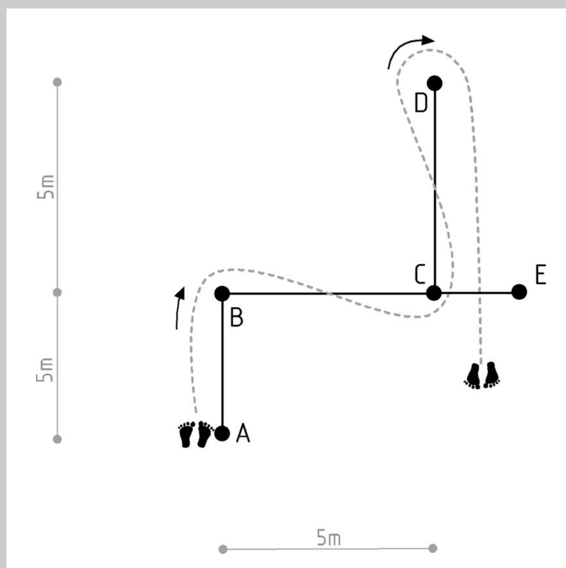

Figure 3. Layout of the sprint 4 × 5 m (S4 × 5).

between his legs. He started after the signal and ran from point A to point B. The player at point B had to be passed on his right-hand side. The player continued to run as fast as possible constantly changing the direction from right to left, until he reached the player standing at point G. After point G, the player made an 180° turn and went on running the slalom to the starting line (form point G to the starting line, i.e., point A).

Sprint 4 × 5 m (S4 × 5). The test consisted of constant direction changes that players had to make. Five cones were set up 5 m apart (Figure 3). The players stood with their feet apart and the cone between their legs. Every player started after the sound signal and ran 5 m from point A to point B. After reaching point B, he made a 90° turn to the right and then shuffled 5 m to point C. At point C, he made a 90° turn and ran to point D, where he made an 180° turn and ran on to point E (the finish line).

Sprint With 90° Turns (S90°). The players began with both of their feet behind starting point A (Figure 4). They started from point A after the signal, ran as fast as possible to point B, and made a 90° turn to the right. After reaching point B, they continued to run to point C where they made a 90° turn to the left. At point D, they made another 90° turn to the left and ran on to point E, where they made a 90° to the right. Point F had the same direction and turning angle (90° turn to the right). At point G, they made a turn to the left and ran on to the finish line–point H.

Sprint 9-3-6-3-9 m With 180° Turns (S180°). The players started after the signal and ran 9 m from starting line A (Figure 5) to line B (the lines were white, 3 m long, and 5 cm wide). Having touched line B with one foot, they made either an 180° left or right turn. All the following turns had to be made in the same direction. The players then ran 3 m to line C, made another 180° turn, and ran 6 m forward. Then, they made another 180° turn (line D) and ran another 3 m forward (line E), before making the final turn and running the final 9 m to the finish line (line F).

Sprint 9-3-6-3-9 m With Backward and Forward Running (SBF). The distance that the players had to cover was the same as in the previous test (S180°). The only difference was that instead of making a turn, the players shifted from forward to backward running. After the starting signal, they ran 9 m from starting line A (Figure 6) to line B (the lines were white, 3 m long, and 5 cm wide). Having touched line B with one foot, the players shifted from running forward to running backward. Then, they ran 3 m to line C and changed from backward running to forward running. After 6 m, the players made another change (line D) and ran another 3 m backward (line E) and then made the final change and ran the final 9 m forward to the finish line (line F).

Each test was carried out 3 times with the pause of around 3 minutes in between the trials. The pause between 2 tests was around 7.5 minutes.

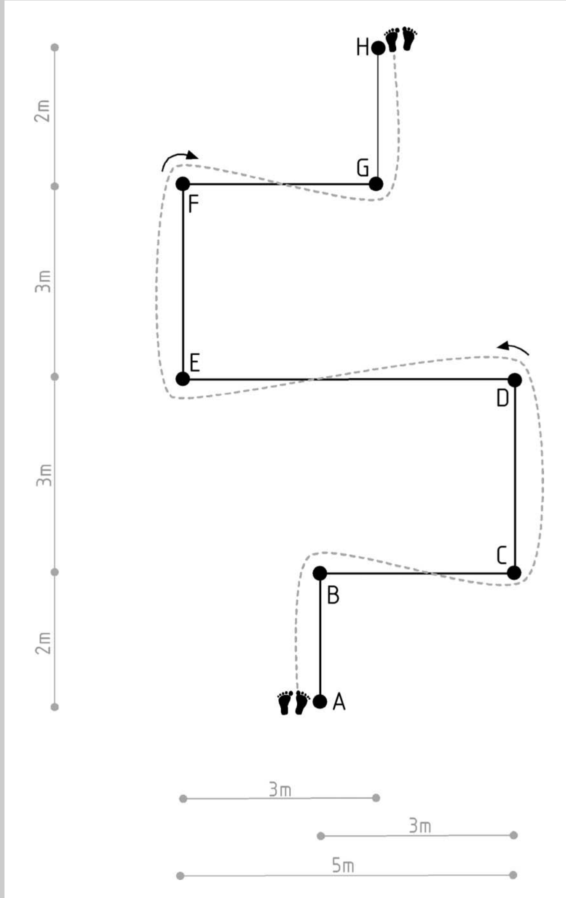

Figure 4. Layout of the sprint with 90° turns (S90°).

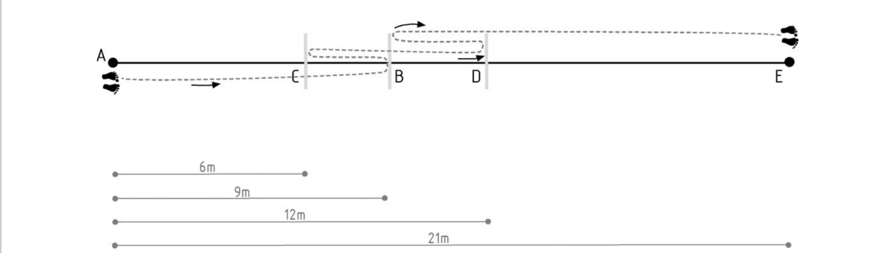

Figure 5. Layout of the sprint 9-3-6-3-9 m with 180° turns (S180°).

Statistical Analyses

SPSS (v13.0; SPSS, Inc., Chicago, IL, USA) was used for statistical analysis. The standard statistical parameters (mean, *SD*, and range) were calculated for each trial of the mentioned agility tests. The Kolmogorov-Smirnov test was used for testing the normality of distribution, whereas the homogeneity of variance was tested by the Levene's test. The statistical power and effect size were calculated using GPOWER software (Bonn FRG, Bonn University, Department of Psychology) (6,7). An analysis of variance with repeated measures and the correction for sphericity were used to detect a possible systematic bias between the trials for each agility test. A Tukey post hoc test was used when appropriate. The average intertrial correlation coefficient (AVR), interclass correlation coefficient (ICC) (21), test-retest method, and Cronbach's alpha reliability coefficients (α) were used to determine the between-subject reliability of agility tests. The within-subject variation for all the tests was determined by calculating the coefficient of variation (CV) as outlined by Hopkins (12). To determine the factor validity of new agility tests used in soccer (ST, S4 × 5, S90°, S180°, SBF), an intercorrelation matrix of 6 agility tests was factorized using a principal component factor analysis. The number of significant factors was determined by the Kaiser-Guttman criterion (15), which retains the principal components with eigenvalues of 1.0 or greater. The structure matrix was used to determine the factor validity. The factorial validity is 1 from construct validity and was identified in the test showing the highest correlation with the extracted factor (15). A TT for independent samples was used to determine the differences between the defenders, midfielders, and attackers in all 6 agility tests. The significance was set at $p \leq 0.05$.

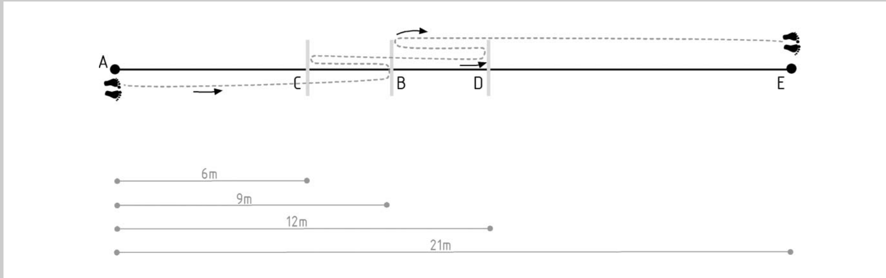

Figure 6. Layout of the sprint 9-3-6-3-9 m with backward and forward running (SBF).

Results

All the variables had normally distributed data. A study of the kurtosis values in the 6 agility tests showed that their distribution tends to be leptokurtic. Levene's test showed no

Table 2. Descriptive (mean ± *SD*, range) and Reliability (AVR, α, CV) Statistics for All the Agility Tests.*

	Mean ± *SD*	Range	AVR	ICC	α	CV%
1. TT	8.20 ± 0.27	1.27				
2. TT	8.09 ± 0.26	1.40				
3. TT	8.09 ± 0.28	1.32				
T-test	8.12 ± 0.27	1.33	0.786	0.928	0.932	3.3
1. ST	7.96 ± 0.20	2.86				
2. ST	7.79 ± 0.24	3.00				
3. ST	7.82 ± 0.26	2.85				
ST	7.85 ± 0.23	2.90	0.944	0.992	0.992	2.9
1. S4 × 5	6.01 ± 0.29	1.94				
2. S4 × 5	5.94 ± 0.25	1.70				
3. S4 × 5	5.94 ± 0.26	1.71				
S4 × 5	5.96 ± 0.26	1.78	0.887	0.978	0.979	4.3
1. S90°	7.85 ± 0.21	3.64				
2. S90°	7.71 ± 0.26	3.25				
3. S90°	7.75 ± 0.23	2.88				
S90°	7.77 ± 0.23	3.25	0.866	0.975	0.948	2.9
1. S180°	7.46 ± 0.39	2.20				
2. S180°	7.44 ± 0.40	2.36				
3. S180°	7.44 ± 0.36	1.94				
S180°	7.44 ± 0.38	2.16	0.738	0.945	0.976	5.1
1. SBF	7.86 ± 0.45	2.40				
2. SBF	7.81 ± 0.45	2.66				
3. SBF	7.78 ± 0.44	2.31				
SBF	7.81 ± 0.44	2.45	0.738	0.946	0.949	5.6

*AVR = average intertrial correlation; ICC = interclass correlation coefficient; α = Cronbach's alpha reliability coefficient; CV = coefficient of variation; TT = T-test; *SD* = standard deviation; ST = slalom test; S4 × 5 = sprint 4 × 5 meter; S90° = sprint with 90° turns; S180° = sprint 9-3-6-3-9 meters with 180° turns; SBF = sprint 9-3-6-3-9 meters with backward and forward running.

Table 3. Intercorrelation matrix of all agility tests.*†

	TT	S90	ST	S4 × 5	SBF	S180
TT	1					
S90°	−0.117	1				
ST	−0.125	0.464‡	1			
S4 × 5	−0.064	0.124	−0.028	1		
SBF	−0.115	0.427‡	0.328‡	0.175†	1	
S180°	−0.205	0.181†	0.243‡	0.276‡	0.554‡	1

*TT = T-test; ST = slalom test; S4 × 5 = sprint 4 × 5 m; S90° = sprint with 90° turns; S180° = sprint 9-3-6-3-9 m with 180° turns; SBF = sprint 9-3-6-3-9 m with backward and forward running.
†The correlation is significant at the 0.05 level (2 tailed).
‡The correlation is significant at the 0.01 level (2 tailed).

Table 4. Eigenvalues (λ) and percentage of explained variance for all principal components.

Component	Total (λ)	Percentage of variance	Cumulative Percentage
1	**2.291***	**38.191***	**38.191***
2	**1.128***	**18.804***	**56.995***
3	0.948	15.804	72.799
4	0.713	11.877	84.676
5	0.565	9.409	94.085
6	0.355	5.915	100.000

*Significant principal components extracted.

Table 5. Correlation coefficients of all agility tests with the extracted principal components, eigenvalues (λ), and the percentage of explained variance (λ%).*

	Component	
	1	2
TT	**−0.730**	−0.090
S90°	**0.677**	−0.315
ST	**0.643**	−0.334
S4 × 5	0.386	**0.729**
SBF	**0.786**	0.064
S180°	**0.737**	0.357

*TT = T-test; S90° = sprint with 90° turns; ST = slalom test; S4 × 5 = sprint 4 × 5 m; SBF = sprint 9-3-6-3-9 m with backward and forward running; S180° = sprint 9-3-6-3-9 m with backward and forward running. Values in bold are only those with a correlation that are larger then 0.5.

violation of homogeneity of variance. The statistical power for all the statistical tests was 0.95. The effect size for the correlation coefficient was large (0.50), but for the TT (0.50) and Tukey post hoc (0.25) was medium. The average values of all the trials recorded during the agility tests showed a very small unsystematic variation. A relatively small systematic increase in the average values was observed among the TT trials. A significant difference ($p < 0.05$) was found among the mean of the TT and S4 × 5 test. A Tukey post hoc analysis also subsequently established the differences between the mean for trials 1 and 3 in the TT, S4 × 5, and SBF tests. The reliability α coefficients of the mentioned agility tests, carried out 3 times, were very high and varied between 0.92 and 0.99. The test-retest methods reliability coefficients varied between 0.89 and 0.97. Of all the agility tests, the ST, S4 × 5, and S180° had the greatest reliability α (α = 0.992, 0.979, and 0.976). The ST and S4 × 5 also had the greatest AVR and ICC (Table 2).

The within-subject variation ranged between 2.9 and 5.6. The lowest value of CV was found between the TT and ST. Low to moderate statistically significant correlation coefficients (Table 3) were found between all measured agility tests.

It was observed that the greatest correlation coefficients exist between the SBF and S180° ($r = 0.55$) and between the ST and S90° ($r = 0.46$). Statistically significant correlation coefficients were also observed between the ST and S90° ($r =$ 0.42). The principal component factor analysis of the 6 agility tests resulted in the extraction of 2 significant components. The first component explained the 38.19%, whereas the second component explained the 18.80% of the total variance of the 6 tests (Table 4).

Both principal components explained the 56.99% of the total variance of the 6 agility tests. The correlation coefficients with the first component varied between 0.38 and 0.78. The S4 × 5 had the lowest correlation coefficient with the first component ($r = 0.38$), whereas all the other 5 agility tests had the correlation coefficients higher than 0.63, and they varied between 0.64 and 0.78. The S4×5 had the highest correlation between the second significant component ($r = 0.72$); all the other 5 agility tests had lower values of correlation coefficients, which varied between 0.06 and 0.35 (Table 5).

In the TT, statistically significant differences were determined between the defenders and midfielders ($p <$ 0.05) and between the defenders and attackers ($p < 0.05$).

Table 6. Positional differences between attackers, defenders and midfielders.

Variable	Defenders ($n = 36$)	Midfielders ($n = 84$)	Attackers ($n = 32$)
TT	8.06 ± 0.27*†	8.35 ± 0.26	8.38 ± 0.28
S90°	7.85 ± 0.21	7.71 ± 0.26	7.75 ± 0.23
ST	7.97 ± 0.24	7.82 ± 0.26	7.85 ± 0.23
S4 × 5	6.00 ± 0.25	5.93 ± 0.26	5.96 ± 0.26
SBF	7.80 ± 0.35	7.78 ± 0.41‡	7.94 ± 0.43
S180°	7.42 ± 0.39	7.30 ± 0.36‡	7.66 ± 0.38

*Statistically significant at $p < 0.01$ for defenders vs. midfielders.
†Statistically significant at $p < 0.01$ for defenders vs. attackers.
‡Statistically significant at $p < 0.01$ for midfielders vs. attackers.

The differences were in favor of the defenders (Table 6). The significant differences were determined between the attackers and defenders in 2 agility tests: the SBF and S180° ($p < 0.05$). The differences were in favor of the midfielders (Table 6).

Discussion

Having taken into account the coordinative demands of the agility tasks and the specifics of the population tested in the study, we can conclude that the variability was very low. There were small unsystematic variations in the average values of the trials of all agility tests. The results of the first trial in all agility tests were the greatest, so we can state that during agility performance a certain motor learning effect was present. To avoid the motor learning effect, at least 1 maximal agility test trial should precede the testing. In this study, the subjects had 1 test trial but they were not told to give the maximum. Markovic et al. (13) reached the same conclusion when interpreting the descriptive statistics data of explosive power tests gained on students. Regardless of the population tests and the tested ability, one maximal test trial should precede the testing, its purpose being to reduce certain motor learning effect. All agility tests have high AVR, ICC, and α reliability coefficient, the reliability values being the greatest in the ST and S4 × 5 tests (Table 2). The within-subject variations (CV) in all 6 agility tests are acceptable. The CV values for the ST and S90° obtained in this study are the lowest (Table 2). When comparing the results of our study with the results from previous studies in which the TT was used, we can conclude that junior soccer players are on average 1 second faster than college athletes and 2 seconds faster than recreational athletes (17). When comparing the variation (*SD*) gained on junior soccer players in our study and the variation gained on college athletes and recreational athletes (17), we can witness the differences, all in favor of the professionals (junior soccer players have a lower data variability). The lower data variability of professional athletes can be explained as a logical consequence of the selection process. The authors believe that the professional soccer players should be tested using a more specific test (by being given a football or by being obliged to perform a specific soccer task) to increase the data variability. This increase would then shift the data distribution from leptokurtic to normal. If we compare the correlation coefficients among all agility tests (Table 3), we can observe that a higher relationship exists only in the tests with the same movement procedure used. Thus, it can be concluded that there is a specificity of the measurement among all agility tests. The highest correlation values were identified between the SBF and A180° tests ($r = 0.55$), which was expected because both tests were carried out in a similar way (the distance that the players had to cover was the same and the places where they had to change direction). The factor analysis resulted in the extraction of 2 significant principal components, which extracted 56.99% of the total variance of all 6 agility tests (Table 4). Of the 2 significant principal components, only the first one was interpretable. Five of 6 tests had the highest correlation with the first principal component ($r = 0.64$–0.78). Only the S4 × 5 test had the highest correlation with the second significant principal component ($r = 0.72$). The first factor can be interpreted as a general agility factor. The SBF test showed the highest relationship with this factor. Because the correlation between the test and the extracted agility factor, it is evident that the SBF test ($r = 0.78$) has the best factorial validity among all analyzed agility tests. A similar but lower factorial validity was found in the TT ($r = 0.73$) and S180° ($r = 0.73$) test. The second factor was not interpretable because at least 3 tests had to have had a correlation higher than 0.50 (15) with the second principal component to make a factor. When using tests to evaluate athletes' agility, it is important to be aware of the complexity of this motor ability. Metikos et al. (14) conducted a component analysis on 32 agility tests in their study and were able to extract 7 statistically significant principal components (eigenvalues greater than 1, by the Kaiser-Guttman criterion). Of the 7 principal components, only 5 were interpretable. This finding speaks in favor of agility as a complex motor ability. Statistically significant differences were determined between the defenders and midfielders and between the defenders and attackers in the TT (Table 6). The TT demanded from the players to run the last 9.41 m backward. Because of their specific role in the team, the defenders had to run backward quite often (23). Having had to adapt to a specific position task, they were more successful in the TT than the players in other positions (midfielders and attackers). Other statistically significant differences were determined between the midfielders and attackers in the SBF and S180° tests (Table 5). These tests created a realistic game situation where players had to change direction every

2–4 seconds (23) and make 1,200–1,400 changes (2). The midfielders made the most changes of direction during a game (23,24). Because they also have a specific role in the team, they proved to be more successful in the tasks that require rapid changes of direction.

It can be concluded that of the 6 agility tests used in this study, the SBF, TT, and S180° are the most reliable and valid tests for estimating the agility of soccer players. When constructing a test with this aim, it is wise to take into consideration the game specifics and the positional tasks of soccer players. According to the results of our study, the TT would be the most appropriate to estimate the agility of defenders. The agility of midfielders should be estimated with SBF and S180° tests, whereas the agility of attackers could be estimated with an S4 × 5 test (Table 6).

Practical Applications

Agility is one of the main determinants of performance in soccer. It can be successfully developed if the training is based on the changes of direction, which are done quickly and easily. By working on agility and improving the balance and coordination, soccer players will be able to move faster and change directions more quickly while maintaining control. Some objectives of agility training are enhanced power, balance, speed, and coordination. The results of this study have the following implications for the assessment of agility in soccer: (a) all agility tests used in this study have an acceptable between- and within-subject reliability and they can be used to estimate the agility of soccer players; (b) the SBF and S180° tests are the most reliable and valid agility tests for the estimation of agility of professional soccer payers; (c) regardless of the population tests, 1 maximal test trial should always precede an agility test so that the motor learning effect could be reduced; and (d) according to the results of our study, a TT would be the most appropriate for estimating the agility of defenders. The agility of midfielders should be estimated with SBF and S180° tests, whereas the agility of attackers could be estimated with an S4 × 5 test.

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