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Original article

The roles of some agility performance parameters on the linear, single sprint skills of young male basketball and handball players

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Abstract. *Study Objectives:* This study aimed to examine the roles of some agility parameters on the linear, single sprint skills among young male basketball and handball players. *Methods:* The participants in this study were male basketball players (BP) (n = 15, ±SD= 15.30 ± 0.48) and handball players (HP) (n = 32, ± SD = 16.81 ± 1.63) who trained regularly, and a control group (CG) (n = 31, ± SD = 15.87 ± 0.80). They participated in 0 to 30 m linear speed tests, a T test, a 505 agility test, and an Illinois agility test. Changes in direction, side stepping, reversing direction, and running backward were the main sub-parameters of agility performance that constituted the independent variables. A multiple regression analysis was conducted if these independent variables predicted the 0 to10 m, 10 to 30 m, and 0 to 30 m sprint performances separately. One way ANOVA was performed to determine group differences in all the independent variables. *Results:* The ANOVA revealed statistically significant differences between groups for the independent variables ($p < 0.001$). The Tukey HSD test indicated that all three groups significantly differed from each other. *Conclusion:* As a result, it can be concluded that agility parameters contributed to speed skills. It is recommended that the exercises that include agility parameters should be used when designing training, especially in team sports.

Key words: Agility Parameters, Speed, Illinois Agility Test, 505 Agility Test, T Test, Team Sports

Introduction

Because agility is almost the pinnacle of all the physical abilities of an athlete, it cannot easily be defined, but it is a performance parameter that combines speed, strength, coordination, and flexibility skills. Generally speaking, agility is a skill in which reversing, accelerating, and decelerating movements are simultaneously applied in forward–backward–lateral–angular directions in an optimal time (1-4).

Classical agility is defined simply as “the ability to change direction rapidly” (5) or “the ability to change direction rapidly and accurately” (6). Others define agility as “the ability to maintain or control body position while quickly changing direction during a series of movements” (7). Recently, scientific papers from some authors have tried to extend the agility definition by adding “a whole body change of direction as well as rapid movement and changing the direction of body parts” (8).

Speed is a skill where success is traditionally determined by muscle fiber type and innate characteristics, and where training factors partially contribute to its improvement (2). Coordination between the active intramuscular and intermuscular effectiveness in motion is very important in the development of linear speed as a motor characteristic (9). In other words, coordination parameters should not be ignored in speed training to improve linear speed. To that end, speed and agility should be trained together.

Although speed is a component of agility, it must not be confused and be considered equal to agility. Agility should be considered superior to speed, reactions, and coordination abilities. Past researchers defined agility as the ability to change direction, and start or stop movement quickly (9, 10). Newer investigations claim that speed and agility represent independent physical abilities and that their development requires a high degree of muscular specificity (11).

Agility skills have different moving mechanisms than those used by track sprinters, and they are employed more in games of sport and martial arts (12). Agility is needed for changes in direction and is different from straight line speed performance (13). The correct form for evaluating agility must take into consideration rapid changes of direction, acceleration, and stopping quickly. Other components of agility are the acceleration and deceleration movements that involve changes of direction and help improve performance, so they are specific skills that should be trained separately (14).

In reaction speed, acceleration, and continuation of speed sub-forms, a change of direction and reversing direction exercises for agility – and other exercises applied in different directions – are essential, especially for team sports (1,11,15). Sports research concluded that speed is an important component in agility skills, but the old definition of agility is too basic and simplistic. Agility skills have more fundamental components like balance, coordination, the ability to adapt and react to a change in the environment (16). Some specialists consider agility as a complex motor skill and classify agility among mixed physical capabilities (17).

The speed and agility requirements for team sports have been greatly studied in basketball, handball, volleyball, and especially soccer, and significant associations have been found in terms of the performance of related motor skills and their relation to each other (3,18-21). Most researchers consider speed and agility to be complex psychomotor skills (22). Those skills imply moving the whole body as fast as possible, so agility has the extra characteristic of changing direction. When defining speed, most researchers refer to the shortest time required for an object to move through a fixed distance; the definition resembles the definition of velocity but without mentioning the direction of movement (23).

There have been little studies regarding the effect of agility parameters on linear speed in team sports. Therefore, this research was conducted to determine how much the agility performance can predict sprint performance in basketball and handball, where the linear speed effect is profound. In this regard, determining how much the agility parameters contribute to the sprint performance will provide valuable information on guiding the content of training programs.

Material and Methods

Participants

A purposive sampling strategy was adopted whereby basketball and handball players were targeted. Participants of the study consisted of three groups including male athletes aged between 16-18 years old. These groups were a) basketball players (BP; n = 15) who regularly attend to basketball training, b) handball players (HP; n = 32) who regularly attend to handball training, and c) control group (CG; n = 31) who do not attend to any training session (Table 1). Ethical approval for the study was granted from the institutional ethics committee (Decision No: 06/02). Written parental permission was also sought for all participants as they were all under 18 years of age. Only participants who returned written consent forms signed by themselves and their parents or guardians participated in the study.

Experimental Design

Participants were subjected to a 15-minute warm-up protocol before the test, including active stretching, jogging, ABC sprint drills, and incremental running. Subsequently, participants were requested to perform a 30-meter maximal sprint performance twice with a five-minute interval in between.

The participants were asked to perform the Illinois agility test, 505 agility test, and T test twice, with five-minute intervals in between. When evaluating trials with a short duration, time measurements were made with an electronic time measurement system (Microgate REI2, Version 2.2058).

Table 1. Characteristics of the participants

	Basketball (n = 15)		Handball (n = 32)		Control (n = 31)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	15.30	0.48	16.81	1.63	15.87	0.80
Sports Age (years)	3.80	0.56	6.78	1.89		-
Height (cm)	176.07	7.29	181.66	7.11	174.61	6.25
Body Weight (kg)	69.80	14.00	75.86	11.79	62.92	14.90
Body Fat Ratio (%)	13.36	6.34	11.29	4.54	12.61	6.82
Body Mass Index	22.36	3.25	22.93	2.63	21.66	3.70

Data collection

0 to10m, 10 to 30 m, and 0 to 30 m sprint tests

Three transition gates were placed at the start, and at 10 m and 30 m distances on the racetrack. The best 0 to 10 m, 10 to 30 m, and 0 to 30 m sprint ratings of participants were evaluated (24,25).

Illinois agility test

In addition to the start and finish transition gates on the racetrack, a third gate was also placed at the initial point of slaloms (Figure 1). Participants were assessed for initial sprint-reverse ratings, slalom ratings, then second sprint-reverse ratings, and the total Illinois agility test ratings (24,25).

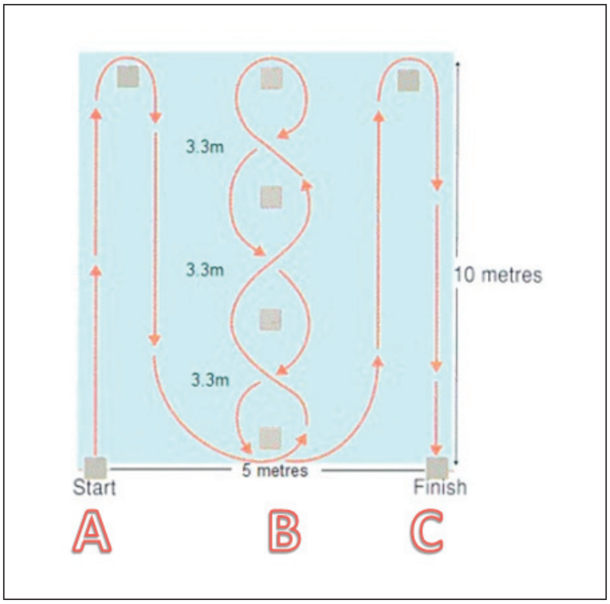

Figure 1. Transition gate locations in the Illinois agility test (A–B–C)

505 agility test

In addition to the single start–finish gate that was available on the original racetrack, a second gate was located at the return point (Figure 2). Participants were assessed first for a sprint transition, then stop, and reverse times and the total 505 test rating (24,25).

T test

In addition to the single start–finish gate that was available on the original racetrack, a second gate was located at the point where participants started side-step movements (Figure 3). Participants were evaluated first for sprint transitions, then side step times, and times for running backward and the total T test rating (24,25).

Statistical analysis

Besides descriptive statistics, One Way ANOVA was performed to determine group differences for all independent variables. A multiple regression analysis was conducted to test if stop and reverse, side stepping, running backward and changes in the direction predicted the linear speed (0 to 10 m sprint), (10 to 30 m sprint), and total sprint (0 to 30 m) performances separately. Firstly, data were screened for multiple regression assumptions. The standard residual analyses were carried out, which showed that the data contained no

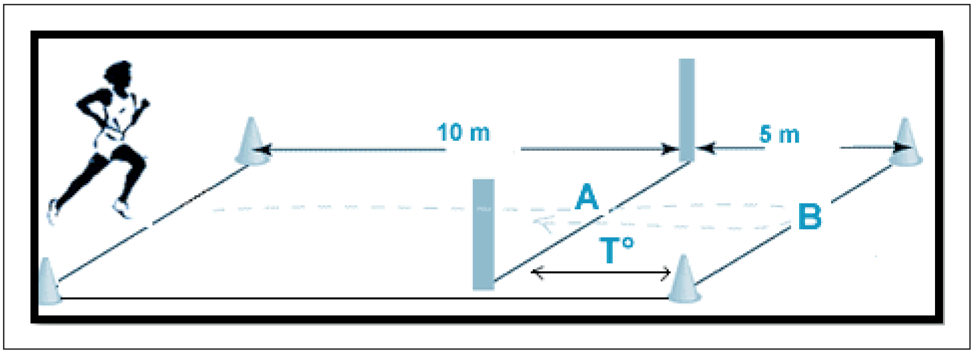

Figure 2. Transition gate locations in the 505 agility test (A–B)

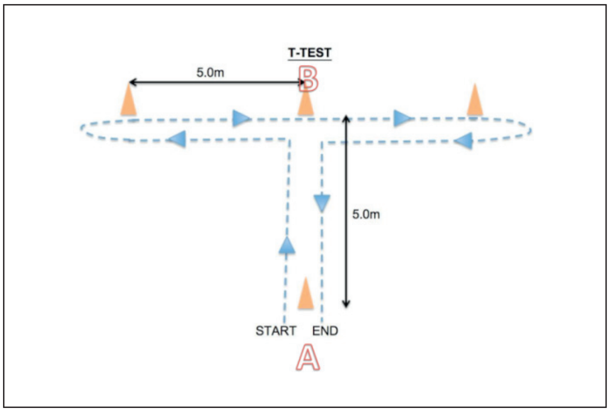

Figure 3. Transition gate locations in T test (A-B)

outliers (Std. residual minimum values ranged from −1.90 to −2.67, Std. residual maximum values ranged from 1.44 to 2.23 for all variables). Both linearity and homoscedasticity assumptions were acceptable according to a scatterplot of the residuals. The ranges for Tolerance (TOL) and the Variance Inflation Factor (VIF) for all independent variables were between 0.32 to 0.71 and 1.40 to 3.09, respectively, and they showed no collinearity. We also found that there was no autocorrelation (*Durbin-Watson* values ranged from 1.72 to 1.99).

Results

Table 2 represents the means and standard deviations of the independent variables, namely stopping and reversing, side stepping, running backward, and change of direction by groups. One Way ANOVA tests revealed statistically significant differences between groups for the independent variables ($p < 0.001$). Post hoc comparisons using the Tukey HSD test indicated that all three groups were significantly different from each other. Inspection of the means showed that handball players had better scores for almost all independent variables except for the change of direction variable in which basketball players were faster than the other two groups. Also, the control group had slower scores than both basketball and handball players.

Multiple regression results indicated that independent variables did not contribute to the prediction of 0 to 10 m, 10 to 30 m, and total sprint (0 to 30 m) performances in the control group (see Table 3, 4, and 5). As seen in Table 3, independent variables explained 69% and 52% of the variance in 0 to 10 m sprint performances for basketball and handball players, respectively ($F_{(4, 10)} = 5.68$, $p < 0.05$; $F_{(4, 27)} = 7.44$, $p < 0.01$). But it was found that only running backward in basketball players ($\beta = 0.53$, $p < 0.05$) and changes of direction in handball players ($\beta = 0.39$, $p < 0.05$) significantly predicted the 0 to 10 m sprint performance.

Results showed that independent variables explained a significant amount of the variance in the values for the 10 to 30 m sprint performance ($F_{(4, 10)} = 7.54$, $p < 0.01$, $R^2 = 0.75$ for basketball players; $F_{(4, 27)} = 11.78$, $p < 0.01$, $R^2 = 0.63$ for handball players (Table 4). Only running backward significantly predicted the 10 to 30 m sprint performance in basketball players ($\beta = 0.59$, $p < 0.02$). Both stopping and reversing ($\beta = 0.29$, $p < 0.05$) and changes of direction ($\beta = 0.35$, $p < 0.05$)

Table 2. Descriptive statistics and One Way ANOVA results for the independent variables

	Basketball (n = 15)		Handball (n = 32)		Control (n = 31)		F
	M	SD	M	SD	M	SD	
Stop and reversing (s)	1.84	0.16	1.69	0.10	2.08	0.16	59.06**
Side stepping (s)	7.06	0.43	6.21	0.36	8.27	0.68	119.81**
Running backward (s)	3.29	0.23	2.91	0.22	3.83	0.51	49.64**
Change of direction (s)	5.91	0.39	6.32	0.35	6.82	0.43	28.77**

**$p < 0.001$

Table 3. Multiple regression results predicting the 0 to10 m sprint performance for independent variables

Independent Variables	Basketball					Handball					Control				
	B	*SEB*	*β*	*t*	*p*	*B*	*SEB*	*β*	*t*	*p*	*B*	*SEB*	*β*	*t*	*p*
Stopping and reversing	0.25	0.18	.29	1.33	.21	0.13	0.12	.17	1.05	.30	0.17	0.19	.18	0.90	.37
Side stepping	0.10	0.08	.32	1.25	.24	0.01	0.03	.05	0.30	.76	0.01	0.05	.07	0.27	.78
Running backward	0.32	0.12	.53	2.55	.02	0.09	0.05	.28	1.71	.09	−0.01	0.05	−.03	−0.17	.86
Change of direction	−0.07	0.07	−.20	−0.98	.34	0.08	0.04	.39	2.15	.04	0.15	0.09	.44	1.55	.13
R^2			.69					.52					.32		
Adj R^2			.57					.45					.22		
F			5.68* (df: 4.10)					7.44**(df: 4.27)					3.13*(df: 4.26)		

Notes. SEB: Standart error of Beta, df: degrees of freedom, *$p < 0.05$, **$p < 0.01$

Table 4. Multiple regression results predicting the 10 to 30 sprint performance for independent variables

Independent Variables	Basketball					Handball					Control				
	B	*SEB*	*β*	*t*	*p*	*B*	*SEB*	*β*	*t*	*p*	*B*	*SEB*	*β*	*t*	*p*
Stopping and reversing	.08	.31	.05	0.26	.79	.42	0.12	.17	1.05	.30	0.17	.04	.28	1.51	.14
Side stepping	.21	.13	.35	1.53	.15	.02	0.03	.05	0.30	.76	0.01	.60	.22	0.92	.36
Running backward	.67	.21	.59	3.15	.01	.17	0.05	.28	1.71	.09	−0.01	.05	.12	0.72	.47
Change of direction	.03	.12	.04	0.25	.80	.13	0.04	.39	2.15	.04	0.15	.03	.28	1.13	.26
R^2			.75					.63					.46		
Adj R^2			.65					.58					.38		
F			5.68* (df: 4.10)					11.78**(df: 4,27)					5.61**(df: 4,26)		

Notes. SEB: Standart error of Beta, df: degrees of freedom, *$p < 0.05$, **$p < 0.01$

Table 5. Multiple regression results predicting total sprint (0 to 30 m) performance for independent variables

Independent Variables	Basketball					Handball					Control				
	B	*SEB*	*β*	*t*	*p*	*B*	*SEB*	*β*	*t*	*p*	*B*	*SEB*	*β*	*t*	*p*
Stopping and reversing	.40	.40	.17	1.02	.33	.55	.30	.25	1.82	.07	.84	.57	.27	1.46	.15
Side stepping	.42	.17	.49	2.40	.03	.04	.08	.06	0.47	.64	.14	.17	.20	0.83	.41
Running backward	.87	.27	.53	3.23	.00	.27	.13	.29	2.01	.05	.08	.17	.08	0.46	.64
Change of direction	-.20	.16	-.21	-1.30	.22	.22	.09	.38	2.32	.02	.38	.29	.33	1.30	.20
R^2	.80					.63					.45				
Adj R^2	.72					.57					.37				
F	10.31** (df: 4,10)					11.43**(df: 4,27)					5.44**(df: 4,26)				

Notes. SEB: Standart error of Beta, df: degrees of freedom. **p < 0.01

were significant predictors of 10 to 30 m sprint performance in the handball players. Also, the ability to run backward in predicting the 10 to 30 m sprint performance among handball players approached acceptable levels of statistical significance ($p = 0.05$).

Results indicated that independent variables accounted for a significant amount of the variance in the value of total sprint (0 to 30 m) performance ($F_{(4, 10)} = 10.31$, $p < 0.01$, $R^2 = 0.80$ for basketball players; $F_{(4, 27)} = 11.43$, $p < 0.01$, $R^2 = 0.63$ for handball players (Table 5). Both side stepping ($\beta = 0.49$, $p < 0.05$) and running backward ($\beta = 0.53$, $p < 0.01$) were significant predictors of total sprint (0 to 30 m) performance in the basketball players. Change of direction was the only predictor for total sprint performance for the handball players.

Discussion and Conclusion

This research was conducted to determine how much the agility parameters predicted the sprint performance in basketball and handball where the linear speed effect was profound. In agility tests, the relationships of the sub-parameters of agility – change of direction, stopping and reversing, side stepping and running backward – with linear speed values were investigated by excluding the total duration.

Examining the statistically significant differences between the groups, in terms of the relevant agility sub-parameter values, handball players had the best values for all parameters except for changes in direction. For the change of direction parameter, basketball players were significantly faster than the other two groups.

For 0 to 10 m sprint performance, it was found that how well basketball players can run backward, and how well handball players can change direction were found to be significant predictors. It was observed that agility sub-parameters were a significant predictor for 10 to 30 m sprint performance, and significant predictors for handball players were found to be the change of direction, stopping and reversing, and running backward, while only running backward was a significant predictor for basketball players. For the 0 to 30 m sprint performance, running backward and side stepping skills determined the performance of basketball players, while change of direction skill was the determining factor for handball players.

Young et al. (1996) could not find a significant relationship between the change of direction and linear speed in soccer players (26-28). Negrete and Brophy (2000) emphasized that acceleration and deceleration differences during the sprint performance before a change of direction were due to the running technique (29).

It was emphasized in some studies in the literature that linear speed and agility performance were not very strongly related, but that speed and agility training must include the requirements specific to the branch of sports involved (26,30-33).

For the same age group as our study, Köklü et al. (2015), performed a study with football players and found a moderately significant relationship between the zig-zag agility test and the 10 and 30 m sprint performance (34).

Chaouachi et al. (2014), in their study carried out with young footballers, emphasized that the relationship between the agility parameters and sprint skill in different directions were improved through game training (35).

In conclusion, it can be said that agility parameters made a positive contribution to speed skills. Particularly in team sports, it is suggested that exercises are employed that include these sub-parameters in training regimes. For high individual performance in team sports in the future, the effect of agility parameters on linear speed should be studied in more depth.

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Conflicts of interest: The authors declare that there is no conflict of interest about this manuscript.

References

1. Brown L, Ferrigno V. Training for Speed, Agility, and Quickness, 3E. Human Kinetics. 2014; 83–117.
2. Sheppard JM, Young WB. Agility literature review: Classifications, training and testing. Journal of Sports Sciences 2006; 24(9): 919–932.
3. Paul DJ, Gabbett TJ, Nassis GP. Agility in Team Sports: Testing, Training and Factors Affecting Performance. Sports Medicine 2016; 46(3): 421–442.
4. Raya MA, Gailey RS, Gaunaurd IA, et al. Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. J Rehabil Res Dev 2013; 50(7): 951–60.
5. Blanksby B, Bloomfield J, Ackland T et al. *Athletics, Growth and Development in Children*. Harwood Academic Publishers 1994; 117–120.
6. Barrow HM, McGee R. A Practical Approach to Measurement in Physical Education. Philadelphia, Lea and Febiger 1979; 356–360.
7. Twist PW, Benicky D. Conditioning lateral movements for multi-sport athletes: Practical strength and quickness drills. Strength and Conditioning 1996; 18(5): 10–19.
8. Draper JA, Lancaster MG. (). The 505 test: A test for agility in the horizontal plane performance. Exerc Sport Sci Rev 1985; 31: 8–12.
9. Gambetta V. Athletic development. Champaign, IL: Human Kinetics 2007; 215.
10. Parsons LS, Jones MT. Development of speed, agility, and quickness for tennis athletes. Strength & Conditioning Journal 1998; 20(3): 14–19.
11. Sheppard JM, Young WB, Doyle TLA et al. An evaluation of a new test of reactive agility and its relationship to sprint speed and change of direction speed. Journal of Science and Medicine in Sport 2006; 9(4): 342–349.
12. Sayers M. Running techniques for field sport players. Sports Coach, Autumn 2000; 26 27.
13. Little T, Williams AG. Specificity of acceleration, maximum speed, and agility in professional soccer players. Journal of Strength and Conditioning Research, 2005; 19: 76–78.
14. Jeffreys I. Motor learning - Applications for agility, part 1. Strength and conditioning journal, 2006; 28(5): 72.
15. Gamble P. Training for sports speed and agility: an evidence-based approach. Routledge, 2011; 142–154.
16. Plisk SS. Chapter 17 speed, agility, and speed-endurance development. Essentials of Strength Training and Conditioning. Baechle TR, Earle RW, eds. Champaign, IL: Human Kinetics 2008: 458–462.
17. Sabin SI, Marcel P. Testing agility skill at a basketball team (10-12 years old). Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health 2016; 16(1):103–109.
18. Shalfawi SA, Haugen T, Jakobsen TA et al. The effect of combined resisted agility and repeated sprint training vs. strength training on female elite soccer players. The Journal of Strength & Conditioning Research 2013; 27(11): 2966–2972.
19. Farrow D, Young W, Bruce L. The development of a test of reactive agility for netball: a new methodology. Journal of Science and Medicine in Sport 2005; 8(1): 52–60.
20. Archer DT, Drysdale K, Bradley EJ. Differentiating technical skill and motor abilities in selected and non-selected 3–5year old team-sports players. Human movement science 2016; 47: 81–87.
21. Delextrat A, Grosgeorge B, Bieuzen F. Determinants of performance in a new test of planned agility for young elite basketball players.Int J Sports Physiol Perform 2015; 10(2): 160–165.
22. Verkhoshansky YV. Quickness and Velocity in Sports Movements. New Studies in Athletics 1996; 11(2–3): 29–37.

23. Harman E, Garhammer J. Administration, Scoring, and Interpretation of Selected Tests. In: Essentials of Strength Training and Conditioning, 3rd ed., Edited by T.R.Beachle, and R.W. Earle, Champaigh, IL: Human Kinetics 2008: 457–473.
24. Mackenzie B. 101 Performance evaluation tests. London: Electric Word plc 2005:60-62-70.
25. Hoffman J. Norms for fitness, performance, and health. Human Kinetics 2006: 107–115.
26. Young WB, Hawken M, McDonald L. Relationship between speed, agility, and strength qualities in Australian rules football. Strength and Conditioning Coach 1996; 4(4): 3–6.
27. Young WB, Willey B. Analysis of a reactive agility field test. Journal of Science and Medicine in Sport 2010; 13(3): 376–378.
28. Young WB, Miller IR, Talpey SW. Physical qualities predict change-of-direction speed but not defensive agility in Australian rules football. The Journal of Strength & Conditioning Research 2015; 29(1): 206–212.
29. Negrete R, Brophy J. The relationship between isokinetic open and closed kinetic chain lower extremity strength and functional performance. Journal of Sports Rehabilitation 2000; 9: 46–61.
30. Milanović Z, Sporiš G, Trajković N et al. Effects of a 12 week saq training programme on agility with and without the ball among young soccer players. Journal of sports science & medicine 2013; 12(1): 97.
31. Baker D. A comparison of running speed and quickness between elite professional and young rugby league players. Strength and Conditioning Coach 1999; 7(3): 3–7.
32. Buttifant D., Graham K, Cross K. 55 Agility and speed in soccer players are two different performance parameters. Science and football IV 2001: 4.
33. Tsitskarsis G, Theoharopoulus A, Garefis A. Speed, speed dribble and agility of male basketball players playing in different positions. Journal of Human Movement Studies 2003; 45:21–30.
34. Köklü Y, Alemdaroğlu U, Özkan, A et al. The relationship between sprint ability, agility and vertical jump performance in young soccer players. Science & Sports 2015; 30(1), 1–5.
35. Chaouachi A, Chtara M, Hammami R et al. Multidirectional sprints and small-sided games training effect on agility and change of direction abilities in youth soccer. The Journal of Strength & Conditioning Research 2014; 28(11): 3121–3127.

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