Progress in Nutrition 2020; Vol. 22, Supplement 1: 80-87 DOI: 10.23751/pn.v22i1-S.9791 © Mattioli 1885

Original article

Impact of functional speed training on speed-related parameters and performance in youth basketball players

Buse Ersoy[1], *Murat Bilge*[2], *Emine Caglar*[3], *Lars Bojsen Michalsik*[4]

[1]Dr. Nurettin Beyhan Elbir Secondary School, Ankara, Turkey; [2]Faculty of Sports Sciences, Kırıkkale University, Kırıkkale, Turkey - E-mail: muratbilge@gmail.com; [3]Faculty of Sports Sciences, Hacettepe University, Ankara, Turkey; [4]Department of Sport Science and Clinical Biomechanics Muscle Physiology and Biomechanics Research Unit, University of Southern Denmark, Denmark

Abstract. Study Objectives: The purpose of this study was to examine the impact of functional sprint training on the movement components affecting speed in youth basketball players. Methods: The subjects in this study consisted of three groups; a research group ($RG,_{age}$ = 12,5 ± 0,3, n = 16), a basketball group ($BG,_{age}$ = 12,5 ± 0,3, n = 16), and a control group ($CG,_{age}$ = 12,2 ± 0,4, n = 16). In addition to normal basketball training RG performed functional sprint training known as A-B-C training while. BG performed only basketball training. CG did not perform any kind of training. The subjects in the RG and BG carried out a total of 24 training sessions during in eight-week period with 3 times × 45 min´s training per week. All three groups were tested before and after the functional sprint training intervention using a group of well-known agility and sprint tests (Illinois, T-drill, 505 agility test, and a 20-m acceleration test). Results: Differences were found between BG and CG in the percentage of developmental values in 10-20 m ($p < 0.05$) in favor of BG, between RG and both BG and CG in the T-drill and Illinois agility test percentage of developmental values ($p < 0.01$) in favor of RG and between CG and both RG and BG in the 505 agility test percentage of developmental values ($p < 0.05$) against CG. Conclusion: The present findings show that 8 weeks of functional sprint training performed 3 times × 45 min per week had a marked effect on some movement components influencing speed ability in youth basketball players.

Key words: Agility, balance, coordination, sprint technique and mechanics, basketball

Introduction

Speed is one of the motor skills determining in ball games and the player can move himself or an extremity from one place to another at the highest speed. Speed in ball games is a complex movement that includes the ability to perceive and make decisions as quickly as possible and to react quickly to unforeseen situations. In addition, it is correlated with the construction and technique of specific movements, in ball games, it is also important to perform powerful changes in direction while moving quickly over short distances. Thus, speed is directly related to explosive muscle strength (rate of force development), and full recruitment of motor units and high firing rate of the nervous system and under certain conditions to perform motoric movements at the highest intensity and in the shortest possible time (1-2).

The motion components of sprint running include good coordination of the motion, mechanical smoothness, and motion efficiency. Sprint running like the 100m run includes reaction speed, acceleration, maximum speed, and the maintenance of the speed (3). The technique and mechanics of both sprint and agility include the properties needed for motion competence and technique. Acceleration, change of direction, and maximal velocity variables are the three variables related to the sprint technique (1). Agility is a physical skill that includes dynamic balance, coordination, and explosiveness that allows optimal performance of deceleration, deflecting, and accelerating movements in a very short time (1-4). These agility movements are unique challenging techniques (1). Bilge and Caglar (2016) examined the effect of agility parameters on sprinting skills in basketball and handball where linear velocity is actively used, and they observed that agility parameters contributed positively to velocity (5). Lockie et al. (2014) examined the effects of a traditional speed and agility training program and an enforced stopping program that includes deceleration on multilateral speed and athletic functions (6). It was observed that the traditional training group improved in most of the speed, agility, and strength tests, and the deceleration group improved all values other than the 0-10 and 0-20m sections.

Sprint A-B-C exercises are an integral part of every athlete's warm-up program and are used for coordination and technical training of the athletes. Sprint A-B-C exercises include an athletic training program, technical development, preparation training, increased speed-coordination, improvement of running rhythm, and an increase in required concentration (3-7).

Agility and speed are among the important characteristics of team sports players (8). Ballplayers rarely use straight running in the game, but they often perform movements requiring fast forward, backward, and sideways speed changes. Furthermore, change of direction moves are also applied to react against movements such as ball movements, constantly changing game, and competitor interaction (7). Haugen et al. (2014) studied the role and development of sprinting speed in another ball sport - soccer. They observed that short sprint runs are frequently used in soccer games, especially the movement which is used mostly by assisting and scoring players is a linear sprint run. They emphasized that the sprint training regime similar to the athletics in the world would benefit the players (9).

Agility and speed are crucial to achieving success in many sports (10). Basketball is one of those sports that need speed and acceleration for many features it contains, where different movements need to be utilized in coordination with each other (11–12). The development of an athlete's speed and agility characteristics plays a crucial role to achieve success (13). Sprint A-B-C training is to improve these features and it is noteworthy that these trainings are not given many place in training programs and that there are few studies in the literature investigating the effects of Spring A-B-C training. Therefore, with this study, it is emphasized that sprint A-B-C is important not only for sprinters but also for ball sports players.

Especially in ballplayers training, the application of programs involving speed components followed by agility parameters, which are important components of the anaerobic capacity, will positively affect the overall performance as well as the fitness components (3-13-14). In this study, it is stated that the improvement of the ability of speed and agility of the age of young groups is faster (12).

This study aims to examine the impact of functional sprint training on the movement components affecting speed in youth basketball players.

Material and Methods

Before undertaking the investigation, ethical clearance was obtained from Kırıkkale University Clinical Research Ethics Committee (No: 01/12, 2017).

Participants

Participants of this study consisted of three groups; research group with the mean sports age is 5,18 ± 1,6 ($RG,_{age}$ = 12,49 ± 0.26, n = 16), basketball group with the mean sports age is 4,87 ± 1,5 ($BG,_{age}$ = 12,46 ± 0,34, n = 16) and control group ($CG,_{age}$ = 12,18 ± 0,4, n = 16). RG attended to functional sprint training in addition to the regular basketball training. BG only participated in regular basketball training. The control group (CG) was not trained at all.

Experimental Design

Each test started with a standardized warm-up period before the tests. Then the Illinois agility test, T-drill agility test, 505 agility test, and 20 m acceleration (0-10 m, 10-20 m, 0-20 m) test were performed. All participants received a test in turn and after everybody completed that particular test, the next test was performed. Each test was performed twice and the better score was used for the analyses.

Illinois Agility Run Test

The edge length is 10 m and the horizontal distance between start and finish is 5 m. Four safety cones are placed horizontally at the region between the start and endpoints and 2 more cones are placed at the two turning points. The distance between the cones is 3.3 m. The athlete started from the starting point and followed the path shown in Figure 1 to the finish point, and the running time was recorded (15). The application of the test is shown in Figure 1.

T-Drill Agility Test

Four cones are placed as shown in Figure 1. The distance between A and B is 10 m and the distance between C and B and B and D is 5 m. The participant ran from point A to point B. Then, the participant shuffled sideways from point B to point C, from point C to point D, and from point D to point B. Finally, the participant ran backward from point B to point A. The total duration was recorded (15). The procedure is depicted in Figure 1.

505 Agility Test

The distance between the start point and point B is 10 m and the distance between points B and C is 5m. The participant sprinted from the starting point to point C and ran back to the starting point from after turning around the cone at this point. The total duration was recorded. The test was administered twice and the better result was recorded (15). The application of the test is depicted in Figure 1.

20 Meter Acceleration Test

A photo sensor is placed at 10 m and 20 m distances from the start point. The participant sprinted and the time recorded at 10 m and 20 m. The test was administered twice and the better result was recorded (15). Figure 1 depicts the test procedure.

The training intervention period lasted 8 weeks. RG regularly performed both basketball and functional sprint trainings. Functional sprint training was performed three days a week for 45 minutes a day for eight weeks. The daily training period of the athletes was 90 minutes, half of which was allocated for functional sprint training and the other half was for basketball training. BG performed only basketball training. The training period was 90 minutes which was completely allocated for basketball training. CG did not perform any training program. Pre-tests and post-tests were performed.

Six different groups of materials were used in the preparation of the functional sprint training program.

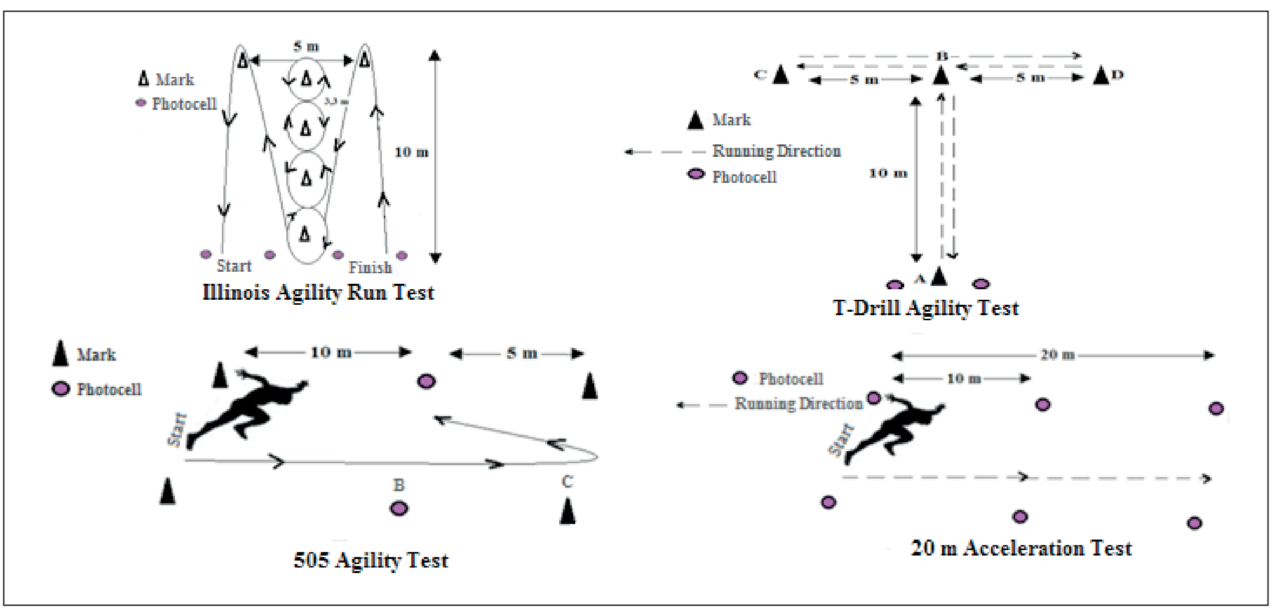

Figure 1. Agility and Acceleration Tests (15)

The materials used were grouped as hoops, obstacles, chocks-step boards, funnels-slalom bars, balls, and without material. For each day of training, a material group was selected predominantly. A total of 12 different daily training programs were prepared, including two different training programs with each material group. Six educational games were designed for warm up at the beginning and one game was played at the beginning of each training session according to the material used. These programs were performed; a different set of programs each day, for the first 4 weeks, and the same program was followed again for the second 4-week period. After the eight week-training program was completed, post-tests were carried out following the same procedure as in the pre-test.

Statistical Analysis

Descriptive statistics were used to describe the obtained data. In addition, normally distributed data were analyzed by one-way ANOVA and non-normally distributed data were analyzed by Kruskal Wallis variance analysis to test the differences between groups. The difference between the pre-test and post-test values of the groups was analyzed by paired samples t-test in normally distributed data, and by Wilcoxon test in non-normally distributed data. The percentages change between pre and post-tests in the agility tests were calculated for each group as there were significant group differences in T-drill, Illinois, and 505 agility pre-test values. These percentage values were used to examine group differences in the dependent variables. One Way ANOVA was conducted to test group differences in normally distributed data and Kruskal Wallis ANOVA was performed in non-normally distributed data. For post-hoc comparisons, Tukey and Dunn's Post-hoc tests were used in normally and non-normally distributed data, respectively.

Results

Wilcoxon test results revealed significant differences between pre-test and post-test values of T-drill, Illinois, and 505 agility tests in RG and BG (Table 1). The post-test values of both groups were significantly lower than those of the pre-test values. No significant differences were found between pre-test and post-test values of T-drill, Illinois, and 505 agility tests in CG.

In the acceleration test of the RG, 10–20 m pre-test and post-test results were significantly different (Table 2). The post-test value was found to be signifi-

Table 1. Wilcoxon test results of the agility pre- and post-test values of the groups

Agility Tests (s)	RG (n = 16)						BG (n = 16)						CG (n = 16)					
	Pre-test		Post-test				Pre-test		Post-test				Pre-test		Post-test			
		Sd		Sd	*z*	*p*		Sd		Sd	*z*	*p*		Sd		Sd	*z*	*p*
T-drill		0.69	10.94	0.60	−3.51	**.000***	12.41	0.88	11.76	0.96	−3.41	**.001***	14.45	1.05	14.11	1.00	−2.50	.072
Illinois		0.78	16.63	0.97	−3.40	**.001***	18.56	0.78	17.67	0.99	−3.51	**.001***	19.77	0.86	19.62	0.81	−1.68	.093
505		0.16	2.59	0.13	−3.09	**.002***	2.97	0.54	2.71	0.20	−3.18	**.001***	3.15	0.17	3.15	0.14	−0.25	.798

*p < 0.01

Table 2. Paired samples t-test results regarding the acceleration pre- and post-test values of the groups

20m acceleration test	RG (n = 16)						BG (n = 16)						CG (n = 16)					
	Pre-test		Post-test				Pre-test		Post-test				Pre-test		Post-test			
		Sd		Sd	t	p		Sd		Sd	t	p		Sd	M	Sd	t	p
0–10m (s)	2.10	011	2.12	0.14	−0.50	.621	2.10	0.12	2.16	0.10	−2.95	**.010***	2.30	0.08	2.36	0.13	−1.78	.094
10–20 m (s)	1.63	0.09	1.58	0.10	3.01	**.009***	1.66	0.10	1.60	0.11	3.06	**.008***	1.80	0.13	1.79	0.13	0.39	.701
0–20 m (s)	3.76	0.19	3.72	0.21	1.36	.194	3.77	0.21	3.77	0.19	−0.20	.842	4.11	0.20	4.17	0.22	−1.61	.127

*p < 0.01

Table 3. Kruskal Wallis test results for the percentage change test values of the groups

Tests	RG (n = 16)		BG (n = 16)		CG (n = 16)			
		Sd		Sd		Sd	χ^2	p
0–10 m (s)	−0.90	6.39	−3.14	4.30	−2.45	5.36	0.63	.728
10–20 m (s)	2.99	3.91	3.42	4.34	0.22	2.88	6.87	**.032****
0–20 m (s)	1.19	3.65	−0.19	2.66	−1.51	3.63	3.56	.169
T-Drill Agility Test (s)	12.41	3.39	5.27	4.36	2.34	3.28	26.89	**.001***
505 Agility Test (s)	4.97	4.46	7.25	10.46	0.04	4.93	8.53	.014

*$p < 0.01$, **$p < 0.05$

cantly lower than the pre-test value. As for the BG, 10–20 m, and 0–10 m pre-test and post-test values were significantly different. It is seen that the 0–10 m post-test value was higher than the pre-test value, and the 10–20 m post-test value was lower than the pre-test value. There was no significant difference between pre-test and post-test values of CG in the acceleration test.

Kruskal Wallis test results showed significant group differences in the percentage change values of 10–20 m, T-drill agility, and 505 agility tests (Table 3). Dunns' post-hoc comparison test, indicated a significant difference between BG and CG in the percentage change values for the 10–20 m section. These values of BG were found to be higher than those of CG. In addition, a significant difference was found between RG and both BG and CG in the percentage change values of the T-drill agility test. It was observed that the highest change was in RG, whereas there was little change in BG and CG. Furthermore, there was a significant difference between CG and both RG and BG in the percentage change values of the 505 agility test. There was a greater change in RG and BG than that in CG.

One-way ANOVA revealed that there was a significant difference between the three groups in the percentage change of the Illinois agility test results (Table 4). The Tukey test indicated that there was a difference among all three groups. Inspection of the means showed that the highest percentage change was in RG and the lowest one was in CG.

Table 4. ANOVA results for the percentage change values of Illinois Agility test

Group		Sd	F	P
RG (n = 16)	10.27	4.20	36.30	**.001***
BG (n = 16)	4.82	2.50		
CG (n = 16)	0.74	2.49		

*$p < 0.01$

Discussion and Conclusion

The aim of the present study was to examine the effect of functional sprint training performed in 12–13-year-old basketball players on the components of movement affecting speed. The present study found that there was a significant improvement in the post-test values of agility and 10–20 m part of the 20 m acceleration tests after sprint A-B-C trainings in both RG and BG. However, inspection of percentage changes indicated that RG exhibited greater improvement in T-drill and Illinois agility test values than BG. This finding broadly supports the work of other studies in this area linking agility with sprint. For example, Asadi (2016) examined the relationship between leaping ability, agility, and sprint running of young basketball players, and reported that there were strong links between sprint and agility, leap and agility, and leap and sprint performances (16). Also Bilge and Caglar (2016) investigated the effect of agility parameters on sprinting skills in basketball and handball where linear movements are effectively used, and found that agility parameters contributed positively to speed performance (5).

The exercise program and Sprint A-B-C exercises utilized in the present study included exercises that are included in various training programs, such as ladder drills, coordination training, or plyometric training, and these exercises may have been influential in their improvement values. Suna et al. (2016) examined the effect of coordination training on speed, balance, and agility characteristics of children tennis players (17). Before and after the training, the Illinois agility test, Flamingo balance test, and 5 and 10 m sprint tests were performed, and as a result, they reported that coordination training significantly improved all three features. Kusnanik and Rattray (2017) investigated the effects of agility ladder, speed sprint, and repeated sprint training exercises on agility and speed development (18). Participants were divided into 3 groups: those practicing the ladder exercise, those practicing the repeated sprinting ability exercises, and controls. For speed and agility measurements, the 30 m sprint test and the Illinois sprint test were used, and according to the results, it was observed that ladder and repeated sprinting ability training had a significant effect on agility and speed. However, although both training modes increased agility and speed, the improvement was greater in the repeat sprint ability group compared to the ladder exercise group. Zemkova and Hamar (2010) investigated the effects of a 6-week combined agility-balance exercises on basketball players' neuromuscular performance and found that these exercises improved open and closed dynamic balance, agility performance, contact time, and the ability to differentiate the force of muscle contraction during repeated jumps (19). Chaalali et al. (2016) compared agility training and change of direction drills administered to young elite soccer players and examined the effect of these trainings and drills on straight sprint, change of direction, and agility tests (20). According to the results, the agility group showed more improvement in the reactive agility test (with and without a ball) and the change of direction group showed more improvement in the 505 agility test and the 15m agility test, and the authors emphasized that both training programs improved the straight sprint ability. Asadi (2013) investigated the impact of the plyometric training program on leap and agility in young male basketball players (21). According to the test results, the plyometric training group showed a significant improvement in leap and agility. Rameshkannan et al. (2014) investigated the effect of plyometric training on the agility performance of male handball players and reported that plyometric training is effective and improved agility (22).

In this study, basketball, study, and control groups were composed of 12–13-year-old basketball players and students. In addition to the agility tests administered in the study, the 20 m acceleration test showed improvement in the range of 10–20 m and no significant improvement was observed in 0–10 and 0–20 m ranges. Rumpf et al. (2016) investigated the effects of specific (free sprinting; resisted sprinting by sleds, bands, or incline running; assisted sprinting with a towing device or a downhill slope), nonspecific (resistance and plyometric training), and combined (a combination of specific and nonspecific) training methods on different sprint distances (0–10, 0–20, 0–30, and 31+ m), and reported that the greatest improvement was in 31+ m for specific and nonspecific training methods, and on 0-10 m for the combined training method (23). Lockie et al. (2014) examined the effect of the enforced stopping speed and agility training program (including traditional speed and agility program as well as deceleration) on multidirectional speed and athletic function and found that the traditional training provided improvements in speed, agility, and most of the strength tests and that the deceleration training was effective in all scores other than 0–10 and 0–20m scores (6). Jakovljevic et al. (2012) compared the speed and agility characteristics of 12- and 14-year-old elite male basketball players (24). They also examined the relationship between speed and agility for both age groups. Compared to 12-year-old players, 14-year-old players were better at all of the tests of agility and speed. They observed that 12-year-old players had the same ability in 30m and 50m runs, and different qualities in 20m and 30m runs.

As a result, it is seen that different training programs involving functional speed exercises are effective on agility and speed. It can be concluded that the training program administered in the present study is effective on components such as the agility parameters affecting speed.

Some limitations of the present study should be addressed. First, the findings may be relevant for male in a team of study, which limits the generalizability of the results if considering the study is applied to a specific team. It should also be noted that this study was conducted in Ankara, the capital city of Turkey, which has more sport and technology facilities compared to other Turkish cities. The second limitation of this study is the cross-sectional design. Irrespective of these limitations, the strength of this study is it is one of the first studies on functional speed training.

In this present study, an 8-week functional sprint training program which has affected the development of movement components and aiming at the development of movement has been searched through pre-test and post-tests. The findings showed that RG exhibited the greatest development in Illinois and T-drill agility tests than BG. In addition, for the RG and BG groups, improvement was observed in the 505 agility test and the 10-20 m range of the 20 m acceleration test.

As a result, the 8-week functional sprint training is effective on components such as agility parameters affecting speed. Basketball is one of the sports that accommodate many agility parameters. Along with technical development, the development of speed and agility is crucial for success. The less energy spent on speed and agility movements in the game means more energy is left for technical application. For this reason, it is recommended to include this type of practice in basketball trainings.

Acknowledgement

This study was obtained from Buse Ersoy's master thesis.

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

References

1. Brown LE, Ferrigno VA. Training for speed-agility and quickness. 2nd ed, Human Kinetics, Library of Congress Cataloging in Publication Data, United States of America, 2005; 12–22.
2. Foran B. High-performance sports conditioning. Ed. B. FORAN, Human Kinetics, United States of America, 2001; Chapter 9,1678–192.
3. Gambetta V. Athletic development. Human Kinetics, USA, 2007; Chapter 12, 229–252.
4. Verstegen M, Marcello B. Agility and coordination. High performance sports conditioning. Champaign, IL: Human Kinetics, 2001; 139–165.
5. Bilge M, Caglar E. The roles of various agility performance parameters on the linear single sprint performance among young male basketball and handball players. 14th International Sport Sciences Congress, Antalya, 1-4 November, 2016; 169–170.
6. Lockie RG, Schultz AB, Callaghan SJ et al. The effects of traditional and enforced stopping speed and agility training on multidirectional speed and athletic function. The Journal of Strength and Conditioning Research, 2014; 28(6): 1538–1551.
7. Born D. The speedcourt: Performance analysis and training for team sport-specific speed and agility. 6th International TGFU Conference, Germany, 25-27 July, 2016; 86.
8. Paul DJ, Gabbet TJ, Nassis GP. Agility in team sports: Testing, training and factors affecting performance. Sports Medicine, 2016; 46(3): 421–442.
9. Haugen TA, Tonnessen E, Hisdal J. et al. The role and development of sprinting speed in soccer. Human Kinetics Journals, 2014; 9 (3): 432–441.
10. Hoffman J. Norms for fitness, performance and health. Human Kinetics, United States of America, 2006; 107–112.
11. Jeffreys I. Developing speed. NSCA (National Strength and Conditioning Association), Ed. I Jeffreys, Human Kinetics, United States of America, 2013; 100–102.
12. Yuksel S, Guler M, Karakoc E et al. The effect of basic basketball training on basic motor skills of 8-12 aged boys. The International Balkan Conference in Sport Sciences, Bursa, 21-23 May, 2017; 39.
13. Dintiman G, Ward B. Sports speed. 3rd ed., Human Kinetics, United States of America, 2003; 4–5.
14. Mackenzie B. The nine key elements of fitness. Baskerville Press Ltd, British Library, 2005; 26–30.
15. Mackenzie B.101 performance evaluation tests. Jonathan Pye Publisher, 2005; 57–172.
16. Asadi A. Relationship between jumping ability, agility and sprint performance of elite young basketball players; A field-test approach. Revista Brasileira de Cineantropometria and Desempenho Humano, 2016; 18(2): 177–186.
17. Suna G, Beyleroglu M, Alp M et al. Investigating the effects of coordination trainings on velocity balance and agility features of tennis kids. International Refereed Academic Journal of Sports, Health and Medical Sciences, 2016; 20: 13–21.
18. Kusnanik NW, Rattray B. Effect of ladder speed run and repeated sprint ability in improving agility and speed of junior soccer players. Acta Kinesiologica, 2017; 11(1): 19–22.
19. Zemkova E, Hamar D. The effect of 6-week combined agility-balance training on neuromuscular performance in basketball players. The Journal of Sports Medicine and Physical Fitness, 2010; 50(3): 262–267.
20. Chaalali A, Rouissi M, Chtara M et al. Agility training in young elite soccer players: promising results compared to change of direction drills. Biology of Sport, 2016; 33(4): 345.

21. Asadi A. Effects of in-season short-term plyometric training on jumping and agility performance of basketball players. Sport Sciences for Health, 2013; 9(3): 133–137.
22. Rameshkannan S, Chittibabu B. Effect of plyometric training on agility performance of male handball players. International Journal of Physical Education, Fitness and Sports, 2014; 3(4): 72–76.
23. Rumpf MC, Lockie R., Cronin JB et al. Effect of different sprint training methods on sprint performance over various distances: A brief review. Journal of Strength and Conditioning Research, 2016; 30(6): 1767–1785.
24. Jakovljevic ST, Karalejic MS, Pajic ZB et al. Speed and agility of 12-and 14-year-old elite male basketball players. The Journal of Strength and Conditioning Research, 2012; 26(9): 2453–2459.

Correspondence:
Murat Bilge
Faculty of Sports Sciences, Kırıkkale University,
Kırıkkale, Turkey
E-mail: muratbilge@gmail.com