Uluslararası Bozok Spor Bilimleri Dergisi, 3(3), 1-10
Bozok International Journal of Sport Sciences, 3(3), 1-10

6 Weeks Multi-Directional Training Effect on Explosive Leg Strength, Agility and Speed Performance of Young Football Players

Sezer TAŞTAN[1], Gürhan SUNA[2]

[1]Akdeniz University, Physical Education and Sports Department, Antalya, Turkey
[2]Süleyman Demirel University, Department of Coaching, Isparta, Turkey

To cite this article/ Atıf için:
Taştan, S., ve Suna, G. (2022). 6 weeks multi-directional training effect on explosive leg strength, agility and speed performance of young football players. *Uluslararası Bozok Spor Bilimleri Dergisi, 3*(3), 1-10.

Abstract
Explosive leg strength, agility, and speed training implicate the short and medium-short time abilities of football players in the development of multi-directional performance. The aim of this study is to examine the effects on 10, 20, 30 m sprint, Illinois agility, T-drill agility, and broad jump performance after 6 weeks of versatile explosive power, agility, and speed training in football players. Sixty-four professional football players were divided into two groups in the randomized control. Football players who participated in football training for 6 weeks (age= 16.90±0.39 years, height= 1.74±6.46 m, body mass= 62.56±8.10 kg), football players who did not train (age= 16.90±0.39 years, 1.74±6.87 m, body mass=62.09±8.27 kg) tested for performance. Explosive leg strength, agility, and speed were significantly reduced in duration after training, and there was an increase in distance in the broad jump. There were significant effect sizes between the control and experimental groups at 30 m sprint (d=1.68), agility times in Illinois agility (d=1.00), T-dril agility (d=0.52), and broad jump (d=0.83). Agility times of both experimental and control groups decreased. The performance effect of short-term intense training in professional football players seems great to develop. The data from this study shows that more experienced players perform better because they have been training and playing football for years.

Keywords: Explosive leg strength, Sprint, Agility, Football

INTRODUCTION

Football is popular in almost all countries in our age and it comes out as the game of this period in terms of both watching and playing. Even the lowest level of football competitions between countries is the sports branch that attracts the most attention in terms of the number of spectators. Worldwide amateur and professional football competitions around the world have literally become a sector (Eker et al., 2003; Akıncı and Çakır, 2019). Increasing speed in the game of football has brought to the fore the fast and fast athletes who can decide very quickly in the game, think fast and play the game fluently (Işıldak, 2020). The game of soccer is one of the high-intensity, intermittent, and popular sports that is showcased in both adult and junior soccer players, involving sprinting, jumps, changes of direction, and agility of varying durations (Orendurff et al., 2010). In terms of physiological demands, there are longer periods of short intense exercises, low-level exercises, and moderate-intensity exercise periods (Florin, 2018). Football players work according to their aerobic capacity intensities, but anaerobic power and capacity such as sprinting and agility are more prominent in the literature for high-intensity exercise repetitions (Mann et al., 2021). However, the quality of technical and tactical skills and performance measurement come to the fore in creating an athlete profile in football (Bennett et al., 2021). Athlete profiles focused on rapid change of direction, agility, speed, and explosive leg strength performances in the game process (Young et al., 2015; Lockie et al., 2016).

High-speed agility contributes to 11% of possession and goal scoring in total distances during a game (Amiri-Khorasani et al., 2010). Bangsbo et al. (2006) reported that an athlete ran an average of 30-40 times during the competition, 2-3 meters sprint faster than 15 km and 600 meters faster than 20 km (Bangsbo, Mohr and Krustrup, 2006). Moreover, during a football match, players travel 10 km, speed and agility practices covering a distance of 15 m by sprinting every 90 seconds and sprinting for an average of 2 and 4 seconds are efficiency in improving the game performance of the football player (Florin, 2018). One of the best tests to measure agility in football, Illinois agility and T-dril agility, apart from other performances, are within the short- and long-term preparations (Amiri-Khorasani et al., 2010; Hoffman, 2020). In addition, explosive leg strength, speed and agility are the most important performance components in distance running, acceleration, and deceleration during matches (Hoffman et al., 2011; Ramos et al., 2021). Bennett et al. (2021) obtained significant performance results in a study in which the athletes in the match evaluated sprint, agility, explosive leg strength. In a study, Lockie et al. (2016) reported that 5 and 30 m sprint intervals, standing long jump and agility tests should be analyzed to determine physical capacity in low- and high-level football players. However, there were studies showing that sprint and speed did not change for long-term planning (Hoffman et al., 2011). The planning of speed, explosive leg strength and strength-based exercises and training programs in young football players is not clear (Lockie et al., 2016). Experienced trainers report that ages 15 to 17 are the right developmental age for speed, agility and strength (Bolotin and Bakayev, 2017). For these reasons, speed, agility and explosive leg power should be investigated more in young football players.

The aim of the study is to examine the effects on 10, 20, 30 m sprint, Illinois agility, T-agility and standing long jump performance after 6 weeks of versatile explosive power, agility and speed training in young football players.

METHODS

Participants

A randomized controlled experimental design was used in this study. Professional young male football players (n=64) constitute two randomized equal groups. Volunteer athletes participating in the study were divided into experimental group (n=32) and control group (n=32).While the experimental group performed explosive leg strength, agility and speed trainings for 6 weeks during the research process, the control group did not participate in the training. The inclusion criterion of the research is to have participated in training and competitions in the youth football league for at least 2 years. Exclusion criteria of the study were health-related problems, not participating in training and personal testing. The biometric characteristics of the athletes are shown in Table 1.

Table 1. The biometric characteristics of the athletes

Parameters	N	Groups	Min	Max	Mean±Ss
Age (years)	32	Experimental	15	17	16.90±0.39
	32	Control	15	17	16.90±0.39
Length (m/cm)	32	Experimental	160	185	1.74±6.46
	32	Control	163	187	1.74±6.87
Body weight (kg)	32	Experimental	42	78	62.56±8.10
	32	Control	50	76	62.09±8.27
Training Experience (years)	32	Experimental	6	8	6.42±1.03
	32	Control	5	7	5.13±2.02

Measurements

Height and body weight: The height of the football players was determined with a holtainstadiometer. Measurements were made with the accuracy of 1 mm, with the feet of the players bare and flat on the ground, with the heels together and the posture upright. The body mass of the players was measured to an accuracy of 0.01 kilograms (Tanita, 401A, USA).

10, 20, 30 m Sprint Tests

The sprint performance of the players was determined by the 10, 20 and 30 meter sprint test. Football players performed a 10-minute warm-up run before the test. Photocells are placed at the start and end distances of the speed track (Foteselli Chronometer, SE-165, TR). The players performed each sprint test twice. The player's best performance in seconds was recorded (Bennett et al., 2021).

Standing Long Jump Test

The players have reached the starting point we have determined. After a position where the legs are shoulder-width apart and parallel to each other, they were asked to jump to the maximum point they can jump. The distance between the rear heel of the athlete after jumping was measured and recorded. The test was applied to the football players twice and the best grade was evaluated (Mann et al., 2021).

T-Drill Agility Test

For the track, 4 cones are lined up on the track. After the photocell arrangement is completed, the player is given the command to start (Foteselli Stopwatch, SE-165, TR). The t-test was used to determine speed with changes in direction such as forward sprinting, stepping left and right, sprinting, and running backwards. Subjects started with both feet behind the starting line A. Each subject ran towards cone B and touched the base of the cone with their right hand. Facing forward and without crossing their feet, they stepped to the left onto the C-cone, dragging their feet and touching the base with their left hand. Subjects then moved their feet to the right of the D cone and touched its base with their right hand. For cone B, they turned left and touched its base. Finally, subjects ran back as fast as they could and returned to line A. In the T-test, agility was achieved at a distance of 9.14 m from A to B, 4.57 m from B to C, and 4.57 m from B to D. When it came to the A cone, the best grade was recorded with the photocell. The test was applied to the football players twice and the best grade was evaluated (Hoffman, 2020).

Illinois Agility Test

The agility performance of the football players was determined with the Illinois Test. The track, which is 5 meters wide, 10 meters long, and consists of cones arranged in a straight line with 3.3 m intervals in the middle, was established. The test consists of running 40 meters straight and 20 meters slalom between cones with 180º turns every 10 meters. After the track was ready for use, a photocell capable of measuring with an accuracy of ±0.01 seconds was placed at the start/start and finish/finish points (Foteselli Stopwatch, SE-165, TR). The participant starts the movement with the start/start command and tried to complete the distance between the start and the finish as soon as possible. Before the test, the participants were given the necessary introduction about the use of the parkour, and then they were allowed to make a few attempts at a slow pace. The participants were then given 5 minutes to do stretching and warm-up exercises at a slow pace. Participants exited the starting line of the test track in the prone position with their hands touching the floor at shoulder level. The time to finish the track was recorded in seconds. The test was performed twice and the best value was considered (Amiri-Khorasani et al., 2010).

Training Programme

Explosive strength, agility and speed training were applied to the players for 6 weeks during the season. Standard pre-training warm-up runs were given priority. Afterwards, the training unit was applied in a versatile and combination of various exercises. Training loads were given variable for 6 weeks. The training frequency was 3 times a week and the training duration was 90 minutes. Training load intensities were 60-70% in the 1st week, 70% in the 2nd week, 70-80% in the 3rd week, 80% in the 4th week, 80-90% in the 5th week and 90% in the 6th week.

Statistical Analysis

To detect significant and moderate effects of all measures through an interaction, the sample size estimate in the population is 0.46 moderate effect (n=64), the initial power analysis assumption type I error rate is 0.2, and the type II error rate is 0.5 (95% statistical power) G*

Power software (v3.1.9.7; Heinrich-Heine-Universitat Dusseldorf, Dusseldorf, Germany; http://www.gpower.hhu.de/) was calculated by analysis (Maxwell, 2004). The mean and standard deviation of the study group were determined using the Kolmogorov-Smirnov test for the normality of the data. Results from T-test and Paired-T test analysis were obtained for statistically in-group and intergroup comparisons before and after training ($p<0.05$). In order to determine the level of significance in the data obtained, the effect size was obtained from the mean and standard deviations, and the reference effect size was 0.00 < 0.20 very weak, 0.20 < 0.50 Weak, 0.50 < 0.80 Moderate, 0.80 < 1.20 Strong, 1.20 < 2.00 Very strong 2 or >2 Extremely it was concluded as a strong effect size (Cohen, 1988; Sawilowsky, 2009).

RESULTS

The study examined the performance results of young football players after 6 weeks of explosive power, agility and speed training. The results of sprint, agility and standing long jump in young football players were compared within and between groups.

Table 2. Comparison of pre- and post-test averages within the sprint group

Parameters	Groups	Test sequence	Mean±Ss	t	p	ES
10 m sprint (sec)	Control	Pre	2.26±0.26	5.661	**.000**	0.70
		Post	2.09±0.22			
	Experimental	Pre	2.08±0.20	5.951	**.000**	0.35
		Post	2.01±0.20			
20 m sprint (sec)	Control	Pre	3.36±0.34	4.665	**.000**	0.59
		Post	3.13±0.43			
	Experimental	Pre	3.27±0.44	5.839	**.000**	0.37
		Post	3.11±0.41			
30 m sprint (sec)	Control	Pre	5.36±0.35	4.331	**.000**	0.50
		Post	5.17±0.40			
	Experimental	Pre	4.65±0.54	5.633	**.000**	0.49
		Post	4.39±0.52			

Their pre- and post-sprint performances were compared. The experimental group had weak effect sizes at 10 m, 20 m and 30 m. The control group had medium effect sizes at 10 m, 20 m and 30 m. Although there was a statistically significant difference in the in-group comparison of the experimental group in line with the sprint performance results, it resulted in a weak effect size ($p<0.05$).

Table 3. Comparison of agility and standing long jump in-group pre-test and post-test averages

Parameters	Groups	Test sequence	Mean±Ss	t	p	ES
Illinois agility (sec)	Control	Pre	18.04±0.83	4.892	**.000**	0.44
		Post	17.66±0.88			
	Experimental	Pre	16.55±2.32	5.459	**.000**	0.29
		Post	15.87±2.35			
T- drill agility (sec)	Control	Pre	10.52±0.55	5.689	**.000**	0.29
		Post	10.35±0.59			
	Experimental	Pre	10.13±1.29	3.430	**.002**	0.20
		Post	9.89±1.10			
Standing long jump (cm)	Control	Pre	185.71±28.05	-3.829	**.001**	0.38
		Post	195.06±20.24			
	Experimental	Pre	202.40±22.43	-4.571	**.000**	0.47
		Post	213.12±22.91			

Agility and standing long jump performances were compared before and after, and statistically significant differences were found (p<0.05). Weak effect size was observed in the Illinois agility, T-drill agility and standing long jump results of the control group. Similarly, very weak and weak effect sizes were observed in the Illinois agility, T-drill agility and standing long jump results of the experimental group, respectively.

Table 4. Comparison of pre and post test averages between sprint groups

Parameters	Groups	Test sequence	Mean±Ss	t	p	ES
10 m sprint (sec)	Pre	Control	2.26±0.25	3.099	**.003**	0.79
		Experimental	2.08±0.20			
	Post	Control	2.09±0.22	1.347	.183	no effect
		Experimental	2.01±0.20			
20 m sprint (sec)	Pre	Control	3.36±0.34	0.888	.378	no effect
		Experimental	3.27±0.44			
	Post	Control	3.11±0.41	0.133	.895	no effect
		Experimental	3.13±0.43			
30 m sprint (sec)	Pre	Control	3.11±0.41	6.261	**.000**	3.19
		Experimental	4.64±0.54			
	Post	Control	5.17±0.40	6.657	**.000**	1.68
		Experimental	4.39±0.52			

The performances between the sprint groups were compared and the experimental group achieved a significant difference at 10 m and had a medium effect size. However, no statistically significant difference was found at 20 m (p>0.05). For sprint performance, the control group showed a very strong effect at the pre-test 30 m, while the experimental group showed a very strong effect size at the post-test 30 m.

Table 5. Comparison of pre-test and post-test averages between groups in agility and standing long jump

Parameters	Groups	Test sequence	Mean±Ss	t	p	ES
Illinois agility (sec)	Pre	Control	18.04±0.83	3.429	**.001**	0.86
		Experimental	16.54±2.32			
	Post	Control	17.66±0.88	4.043	**.000**	1.00
		Experimental	15.87±2.35			
T- drill agility (sec)	Pre	Control	10.52±0.54	1.583	.118	no effect
		Experimental	10.13±1.29			
	Post	Control	10.35±0.59	2.069	**.043**	0.52
		Experimental	9.89±1.10			
Standing long jump (cm)	Pre	Control	185.71±28.05	-2.628	**.011**	0.65
		Experimental	202.40±22.43			
	Post	Control	195.06±20.24	-3.341	**.001**	0.83
		Experimental	213.12±22.91			

Agility and standing long jump performances were compared between groups, and Illinois agility showed a statistically significant difference and had a weak effect size (p<0.05). T-drill agility showed statistically significant results only in the post-test, but showed a rather weak effect size (p<0.05). There were statistically significant differences in standing long jump performance (p<0.05). However, while the control group had a medium effect size, the experimental group had a strong effect size.

DISCUSSION

This study aimed to examine the effects of six weeks of versatile speed, agility and explosive leg strength training. The physical performances of U15-U17 football players were examined. The results showed that versatile speed, agility and explosive training adaptations can generate the capacities of young football players. However, the study results did not achieve speed performance over long distances. The development of sprint, agility and explosive leg strength of young football players is an important problem. Players must show maximum speed and agility at short-term maximal and near-maximal sprints and at high speed. In the results of this study, explosive power, sprint and agility performances had reliable effect sizes, and most of them had strong and extremely strong effect sizes. In agility performances, Illinois agility had a higher effect size compared to the more traditional T-drill agility. The fact that Illinois agility has similar relationships with traditional T-drill agility may be the similarity of the reactive speeds of the athletes (Hoffman, 2020). However, the longer distance of Illinois agility may have created different cognitive load for the subject and increased complexity (Amiri-Khorasani et al., 2010). At the same time, high differences could occur in T-dril agility measurements in the evaluation of long-term agility performance, since returns in a parallel position and sufficient time to prepare for subsequent responses were provided (Hoffman et al., 2011). In our study, low seconds were obtained in T-dril agility compared to other studies (11.59 s) (Baydemiret al., 2017). However, when compared with long-term five-year studies (8.90 h vs 8.71 h), we have conflicting results (Hoffman et al., 2011). Considering Illinois agility performance, significant improvements in young soccer players (16.54 vs. 15.87 s; $p<0.05$) after training are consistent with a similar study (Gonzalez-Fernandez et al., 2021). In fact, the authors of similar studies also conducted a randomized controlled trial (Gonzalez-Fernandez et al., 2021). In addition, another study found similar improvements in agility components in Illinois agility (Baydemir and Yurdakul, 2020). However, the Gonzalez-Fernandez et al. (2021) study used training interventions in a long-term approach and with different task constraints. The present study also used explosive leg strength complex exercises, and the reported differences in strength may be due to this. Regarding Illinois agility test performance, this study revealed significant reductions in completion time in control and experimental junior soccer players. Similar to these findings, it was revealed that there was no significant difference between U15 (15.82 h) and U17 (15.24 h) in age-related agility performance (Andrasic et al., 2021). Regarding the 30 m sprint test, the control group and experimental group showed significant differences from the pre-assessment to the post-assessment. This finding contradicts a study conducted on 40 young football players that showed significant improvements in the 30 m sprint test (4.62 vs 4.70 s; $p<0.05$) after 6 weeks of multi-directional speed training (Gonzalez-Fernandez et al., 2021). However, in our study, an extremely strong effect size was obtained for the 30 m sprint performance. The fact that the current studies only consider the 30 m sprint and our sample consists of elite athletes may explain the lack of differences found. The reason for this can be considered that efficient results based on speed occur in medium-short distance runs. In a study conducted for physical performance measurements in football players, the weak effect size for the 20 m sprint is similar to our study (Bennett et al., 2021). However, in another study, U15 (1.93 s) and U17 (1.85 s) players improved more in the 10 m, but similar improvements were seen in speed and acceleration performance in the 20 m U15 (3.38 s) and U17 (3.18 s) (Andrasic et al., 2021). Also, since soccer players typically run shorter sprint distances, it is possible that applied agility, speed, and explosive strength training interventions will produce improvements in acceleration-related distances. In the study, the standing long jump, which is a versatile performance parameter, was used in explosive leg strength. In other studies, explosive leg power performance seemed similar in young football players (min 2.50 m and max 2.87 m) to create an athlete profile (Lockie et al., 2016). For these reasons and considering the characteristics of football, the implementation of initial leg strength, agility and speed training for U15-17 players is of great importance to train more durable athletes (Lockie et al., 2016).

CONCLUSION

The results of this study showed that all-round training produced adaptations in strength and agility capacities of young football players, but not in acceleration rate performance. While coaches can use all-round training to improve the physical fitness of their players, combining this training with other training methods such as strength and plyometrics will potentially increase chronic adaptations in agility, power, speed and strength.

REFERENCES

Akıncı, A.Y. & Çakır, F. (2019). Examination of the expectations of athletes who play football in high schools 14-17 age group against sports and the levels of environmental factors affecting athletes according to some variables. *International Social Sciences Studies Journal, 5*(50), 6486-6491.

Amiri-Khorasani, M., Sahebozamani, M., Tabrizi, K. G., & Yusof, A. B. (2010). Acute effect of different stretching methods on Illinois agility test in soccer players. *Journal of Strength and Conditioning Research*, *24*(10), 2698–2704. https://doi.org/10.1519/JSC.0b013e3181bf049c.

Andrašić, S., Gušić, M., Stanković, M., Mačak, D., Bradić, A., Sporiš, G., & Trajković, N. (2021). Speed, change of direction speed and reactive agility in adolescent soccer players: age related differences. *International Journal of Environmental Research and Public Health*, *18*(11), 5883. https://doi.org/10.3390/ijerph18115883.

Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences, 24*(07), 665-674.

Baydemir, B., Yurdakul, H. Ö. (2020). Amatör futbolcularda hız, çabukluk ve çeviklik performanslarının bileşenleri. *Akdeniz Spor Bilimleri Dergisi, 3*(1), 64-71. https://doi.org/10.38021asbid.733904.

Baydemir, B., Suna, G., Alp, M. (2017). Effects of prepatory period trainings on some physiological and motoric features of U19 soccer players. *International Refereed Academic Journal of Sports Health and Medical Science*, 23, 27-36.

Bennett, H., Fuller, J., Milanese, S., Jones, S., Moore, E., & Chalmers, S. (2021). Relationship between movement quality and physical performance in elite adolescent australian football players. *Journal of Strength and Conditioning Research*. https://doi.org/10.1519/JSC.0000000000003903.

Bolotin, A., & Bakayev, V. (2017). Pedagogical conditions necessary for effective speed-strength training of young football players (15-17 years old). *Journal of Human Sport and Exercise*, *12*(2), 405-413. https://doi.org/10.14198/jhse.2017.122.17.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Eker, H., Ağaoğlu, Y. S., Albay, F., (2003). Analysis of respiratory and anthropometric parameters of the students who played football, who left football and did not do sports regularly, between 20-25 in Niğde University. *Journal of Physical Education and Sports Sciences*, 2, 89-97.

Florin, T. D. (2018). Physical conditioning-speed and agility in youth football. *Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health*, *18*(1), 80-85.

González-Fernández, F. T., Sarmento, H., Castillo-Rodríguez, A., Silva, R., & Clemente, F. M. (2021). Effects of a 10-week combined coordination and agility training program on young male soccer players. *International Journal of Environmental Research and Public Health*, *18*(19), 10125. https://doi.org/10.3390/ijerph181910125.

Hoffman J. R. (2020). Evaluation of a reactive agility assessment device in youth football players. *Journal of Strength and Conditioning Research*, *34*(12), 3311–3315. https://doi.org/10.1519/JSC.0000000000003867.

Hoffman, J. R., Ratamess, N. A., Kang, J., Faigenbaum, A. D (2011). Anthropometric and performance changes in NCAA Division III college football athletes. *Journal of Strength and Conditioning Research*, 25(S10). https://doi.org/10.1097/01.JSC.0000395594.94616.95.

Işıldak, K. (2020). Plyometrik antrenmanların çabukluk, dikey sıçrama ve durarak uzun atlama performansı üzerine etkisi. *Akdeniz Spor Bilimleri Dergisi*, *3*(1), 36-44. https://doi.org/10.38021/asbid.727497

Lockie, R. G., Lazar, A., Orjalo, A. J., Davis, D. L., Moreno, M. R., Risso, F. G., Hank, M. E., Stone, R. C., & Mosich, N. W. (2016). Profiling of junior college football players and differences between position groups. *Sports*, *4*(3), 41. https://doi.org/10.3390/sports4030041.

Mann, J. B., Bird, M., Signorile, J. F., Brechue, W. F., & Mayhew, J. L. (2021). Prediction of anaerobic power from standing long jump in NCAA Division IA football players. *Journal of Strength and Conditioning Research*, *35*(6), 1542–1546.

Maxwell, J. A. (2004). Causal explanation, qualitative research, and scientific inquiry in education. *Educational Researcher*, *33*(2), 3-11. https://doi.org/10.3102/0013189X033002003.

Orendurff, M. S., Walker, J. D., Jovanovic, M., Tulchin, K. L., Levy, M., & Hoffmann, D. K. (2010). Intensity and duration of intermittent exercise and recovery during a soccer match. *Journal of Strength and Conditioning Research*, *24*(10), 2683–2692. https://doi.org/10.1519/JSC.0b013e3181bac463.

Ramos, G. P., Nakamura, F. Y., Penna, E. M., Mendes, T. T., Mahseredjian, F., Lima, A. M., Garcia, E. S., Prado, L. S., & Coimbra, C. C. (2021). Comparison of physical fitness and anthropometrical profiles among brazilian female soccer national teams from u15 to senior categories. *Journal of Strength and Conditioning Research*, *35*(8), 2302–2308. https://doi.org/10.1519/JSC.0000000000003140.

Sawilowsky, S. S. (2009). New effect size rules of thumb. *Journal of Modern Applied Statistical Methods*, *8*(2), 597 – 599.

Young, W. B., Miller, I. R., & Talpey, S. W. (2015). Physical qualities predict change-of-direction speed but not defensive agility in Australian rules football. *Journal of strength and conditioning research*, *29*(1), 206–212.