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The Combined Effect of Strength and Speed Training on Change of Direction Performance in Soccer Players

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Abstract

Soccer is an intermittent sport where high-intensity actions such as sprints, jumps, and change of direction (COD) can become determining factors of success. Strength and speed are essential physical qualities related to an athlete's COD ability. The influence of strength and speed training on COD performance has been examined in various sports. The purpose of this study was to determine the effect of a combined strength and speed training program on COD performance in high-performance junior soccer players. The study was a randomized crossover trial designed to determine whether there is a difference in the COD test performance after treatment of strength and speed training. Eighteen soccer players were recruited from the same team and randomly assigned to two experimental groups and a control group. The players were evaluated in four various tests, the Illinois Agility Test, 30 meters speed test, 30 meters speed with a change of direction Test and, the 5RM submaximal strength Test. Four 2(Test) x 3(groups) ANOVAs with Tukey posthoc test were performed to detect any statistically significant differences between and within the training groups. An alpha-level of <0.05 was considered to be statistically significant. This study did not find significant improvements in the performance of the studied qualities speed (linear and COD) and, nor an increase in the strength test's performance linked to the treatment used at the end of the six weeks of combined treatment of strength and speed. Strength plus speed training can be used to improve strength during the competitive season.
Keywords: Change of Direction, Strength, Speed, Soccer, Agility.

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INTRODUCTION

Due to its organized structure and professionalism, soccer has been the focus of much research, which has led to an in-depth understanding of the essential physical qualities such as strength and speed that underpin performance in the sport (Hammami et al., 2018). Strength and speed are important for executing many soccer-specific movements such as sprinting, changing direction, and contesting for the ball's possession.

Team sports have the characteristic of being intermittent, where players frequently require a transition between short periods of high intensity running and long periods of low-intensity activity (Paul et al., 2016). Soccer is an intermittent sport where high-intensity actions such as sprints, jumps, and change of direction (COD) can become determining factors of success (Di Salvo et al., 2007), both in adult and junior soccer players (Castagna et al., 2003; Reilly et al., 2000). Despite this, strength and speed are essential physical characteristics for soccer players. In the case of strength, the soccer players who possess more musculature face a greater task in overcoming the inertia encountered during the deceleration phase of a COD movement (Delaney et al., 2015). High-intensity actions such as sprints, counterattacks, and COD account for the total distance covered in both junior and elite competition (Hammami et al., 2018) that require speed characteristics to perform.

Both strength and speed are important physical qualities related to an athlete's COD ability. The influence of strength and speed training on COD performance has been examined in sports like soccer, rugby, lacrosse and, netball (Hojka et al., 2016; Raya-González et al., 2017). Training programs that have targeted the development of strength have demonstrated positive influences on COD performance. The study of Bourgeois et al., (2017) shows that after six weeks of eccentric strength training, there was an 11.3% better performance change on the 180º COD Test. Among the possible treatments aimed at developing strength and its effect on COD, most of the results are positive about how strength training improves COD performance (Bourgeois et al., 2017; Zghal et al., 2019). Similarly, studies that have targeted the development of speed components such as acceleration have also shown significant COD ability improvements. For example, the study of Born et al., (2016), after six weeks of repeated sprints training and repeated COD sprints training, results in an improvement of 2.8% and 2.4%, respectively, on the Illinois Agility Test.

A meta-analysis Brughelli et al., (2008) on COD training found that both physical qualities (strength and speed) are essential to develop and improve COD performance in collective sports. Interestingly, while multiple studies have examined the effects of strength or speed training in isolation on COD performance, no studies founded to explored the effects of combining both qualities in a training phase in the same intervention time. Combining qualities into a training block is how physical preparation coaches typically design their training programs.

Previous studies have tried to find improvements in COD performance by training one quality in isolation. This study attempts to investigate whether the combined training of two qualities produces a positive effect. No previous studies were found with this intervention protocol or similar; therefore, the authors assume this methodology is the first study. In daily practice, coaches use these methods in combination. Therefore, the purpose of this study was to determine the effect of a combined strength and speed training program on COD performance in high-performance junior soccer players.

METHOD

Research Model: This study was designed to investigate if six weeks of strength and speed training could significantly increase a COD test's performance. The participant cohort for this investigation was a group of 18 high-performance youth soccer players who participated in their regular soccer-specific training in addition to the six-week strength-speed development program. All participants were injury-free and informed that participation was voluntary.

The participants were recruited from the same team and randomly assigned to two experimental groups and a control group. Both experimental groups completed the same strength training program with a different speed training program. The Linear Experimental Group (GL) performed linear speed training while the COD Experimental Group (GCOD) performed speed training with COD. The Control Group (GC) participated in their regular soccer training.

The study followed all the guidelines required for the ethical use of people who dictate national and international laws and the Declaration of Helsinki principles.

Research Groups: The description of the participants may be found in Table 1. A total of 18 participants with a minimum of four years of training experience in soccer commenced the study and were randomly divided into three groups. However, only 15 participants completed the study (GL: 5n GCOD: 4n GC: 6n). The three participants who withdrew sustained an injury during a soccer competition. Written informed consent was obtained from all the participants after receiving a verbal and written explanation of the experimental design and the potential risks involved in the study.

Table 1. Characteristics of the subjects

	Mean	SD
Age (year)	18.39	±0.38
Weight (kg)	72.00	± 8.48
Height (cm)	174	± 0.05
Fat (%)	16.84	± 4.94
Body Mass Index	23.87	± 2.29

Training Treatment: The team's regular soccer training consisted of five training sessions per week (120 minutes each session), with a competitive game played each weekend. Physical conditioning was performed two times per week and aimed at developing physical qualities and incorporating high-intensity interval training elements. Anaerobic training consisted of sprint training drills, and aerobic fitness was developed using small-sided games. Soccer-specific training sessions consisted primarily of technical-tactical skill development (80% of session time) and conditioning routines (20% of session time).

The experimental groups' training consisted of the development of the qualities of strength and maximum acceleration. For the development of strength, the half squat exercise using an intensity of 80-95% of the athlete's one-repetition maximum (80%-95%RM) was used. For the half squat exercise, both experimental groups performed them with a progressive overload where the intensity and volume of training increased systematically over the six-weeks. For the development of acceleration, the athletes performed 30-meter sprints at maximal intensity. The difference is the linear sprinting group performed the 30-meter sprint in a straight line while the change of direction group performed a 15-meter sprint, executed a 180-degree COD, and a 15-meter sprint in the opposite direction of the first one. The control group maintained this standard pattern of training throughout the six weeks of the study. The experimental groups replaced a part of their standard regimen (the conditioning routines) with this study's treatment.

The treatment training sessions were held twice a week (Tuesday and Thursday). Considering the necessary recovery after the game and anticipating recovery for the next game, played on Sundays. This recovery allowed fatigue not to influence treatment training or match performance. These sessions were the first activity of formal team training. First, the players started with a general warm-up, a jog for 10 minutes, and then started with the half squat exercise. After performing each squad exercise series, they immediately performed a sprint corresponding to the experimental group in which each subject was. This protocol allowed the session not to be influenced by formal team training in general.

Data Collection Tools*:*

Anthropometry test: The players were evaluated in the Laboratory of Human Movement Sciences of the University of Costa Rica. The instruments used for this purpose were The medical Body Composition Analyzer 514 (mBCA) by SECA (300 kg limit, Hamburg, Germany); six analytical modules processed these measurements. And the height was measured with Digital stationary stadiometer 264 by SECA (Hamburg, Germany) with wireless transmission to mBCA for complete analysis. All players were measured on the same day at the first hours of the morning with the instrument's regulations.

Thirty-Meter Sprint Performance and Thirty-Meter Sprint Performance with a change of direction: Subjects ran 30 m, with times recorded by timing gates system SMARTSPEED PRO (Fusion Sport, Brisbane, Australia). The sprint commenced from a standing position, with the front foot 0.2 m from the first timing gate. The best of three attempts were taken for the analysis. They performed another speed test after 6 to 8 minutes, the same distance with variation at 15 meters. There was another photocell beam, making a 180-degree turn and returning to the cells they started. The instrument took the times at 15-meters and 30-meters of the speed test with a COD. Each test was carried out three times, and the best of the three attempts was chosen for the analysis.

COD test (Illinois Agility Test): The Illinois Agility test measures COD because it is a preplanned path and does not consider perceptual factors like a stimulus to which the subject has to respond. This test has interrater reliability of 0.96 and validity of 0.75 (Raya et al., 2013). This test is measured by the time it takes to make a planned route with preplanned changes of direction included. The timing gates system (Fusion Sport Sumner Park, Brisbane, QLD, AUS trademark) was used for recording time. The subjects were instructed to any movement between the gate to activate. A line was marked at 45 cm before the gates for the initial position for the subject star the test. All participants were encouraged to make both tests with maximum effort. The participants performed a total of three attempts and choosing the best attempt for the data. The players began the test when they are ready to do it. Times were recorded with timing gates (Fusion Sports, Brisbane, Australia).

Submaximal strength test: The test used to evaluate a maximum repetition (RM) was the five repetitions half-squat test performed in a Smith machine (Cybex, MA, USA). The participants had three attempts to execute five repetitions of the exercise with the greatest weight possible. Following a successful attempt, the participant increased the weight by 5 kg for each attempt. Each subject rested 3-5 minutes between attempts.

Data Collection: The study comprised four sessions in two weeks of familiarization strength training. The familiarization consists of a general preparation exercise in a weight room for all players. After this time, in week 3, the players were tested in all variables and randomly divided into the intervention groups. The start of this study from the first two weeks of familiarization coincided with the second half of the competition phase of the national championship of the national high-performance division. After this time, post-treatment tests were performed at week 10.

Data analysis: All data are presented as mean ± standard deviation (SD). After confirmation of normal distribution, four 2(Test) x 3(groups) ANOVAs with Tukey posthoc test were performed to detect any statistically significant differences between and within the training groups. An alpha-level of <0.05 was considered to be statistically significant. All data were analyzed with the IBM SPSS® v.21.

FINDINGS

Table 2. Summary of performance variables on pretest and post-test (Mean ± SD)

	Pre-test				Post-test			
Group	Agility (s)	30 meters linear (s)	30 meters COD (s)	Strength Test 5rep (Kg)	Agility (s)	30 meters linear (s)	30 meters COD (s)	Strength Test 5rep (Kg)
Group Speed/Linear	16. 165 ± 0.492	4.414 ± 0.119	6.343 ± 0.104	86.363 ± 11.588	15.895 ± 0.482	4.431 ± 0.170	6.231 ± 0.143	126.363 ± 9.854
Group Speed/COD	15.370 ± 0.406	4.239 ± 0.273	6.239 ± 0.171	77.272 ± 3.711	15.613 ± 0.673	4.407 ± 0.214	6.130 ± 0.189	117.045 ± 4.351
Control	15.944± 0.430	4.507 ± 0.110	6.301 ± 0.164	93.939 ± 5.505	15.787 ± 0.457	4.458 ± 0.119	6.299 ± 0.198	115.909 ± 6.265

COD Test analysis (Agility): The agility variable variance yielded an $F_{(1,12)} = 0.297$ sig = 0.596, indicating no significant difference between the pretest and post-test. The treatment factor presents a $F_{(2,12)} = 1.67$ sig = 0.229. While their interaction was not significant either, $F_{(2,12)} = 3.767$ sig = 0.054. This indicates that there is no influence of the treatment on the test results (Table 3).

30 meters speed test: This variance analysis presents the following results: $F_{(1,12)} = 0.807$ sig = 0.387, showing no difference among the pretest and post-test measurements after applying the treatment. The treatment factor presented an $F_{(2,12)}= 1.544$ sig = 0.253; there is no difference between the treatment groups. Likewise, these two factors' interaction shows an $F_{(1,12)}= 1.492$ sig = 0.264, indicating no interaction between the treatment and the measurements (Table 3).

30 meters speed with a change of direction: According to the analysis, the results for each factor were as follows. For the measurement factor $F_{(1,12)}$ = 1,873 sig = 0.196, there is no difference between the pre-test and post-test measurements. For the treatment factor $F_{(2,12)} = 0.985$ sig = 0.402, in the same way, it does not present a statistically significant difference. The interaction of these factors presented an $F_{(2,12)} = 0.498$ sig = 0.620, which allows us to infer that there is no interaction between the factors on performance (Table 3).

Strength analysis: This analysis of variance presented in its measurement factor $F_{(1,12)}$ = 530,342 sig = 0.001, presenting a significant difference between the pre-test values and the post-test values. In turn, the interaction of the factors presents a $F_{(2,12)}$ = 18,283 sig = 0.001; which shows a significant interaction between the factors, treatment x measurements. The post hoc of simple effects with the correction of LSD shows significant differences between the Pre-test and Post-test individually in each group, being greater the Post-test (GL: $F_{(1,12)}= 252.751$ sig: 0.001; GCOD: $F_{(1,12)} = 199.909$ sig: 0.001; CG: $F_{(1,12)} = 535.751$ sig: 0.001), this indicates that there was an improvement between both measurements. The other comparison level is a difference in the post-test between the GL and the GCOD and CG, being higher GL (F = 12.9 sig: 0.001, F= 18.83 sig: 0.001 respectively) (Table 3).

Table 3. ANOVAs resume chart of variables (Fs and significance *p<0.05)

ANOVA Fs	Agility			30 meters linear			30 meters COD			Strength		
	F	p	w^2	F	p	w^2	F	p	w^2	F	p	w^2
Measurements	0.297	0.596		0.807	0.387		1.873	0.196	1.4%	530.342*	0.001	77.6%
Treatment	1.670	0.229	7.2%	1.544	0.253	2.9%	0.985	0.402		2.169	0.157	2.1%
Measurements*Treatment	3.767	0.54	3.6%	1.492	0.264	1.13%	0.498	0.620		18.283*	0.001	5%

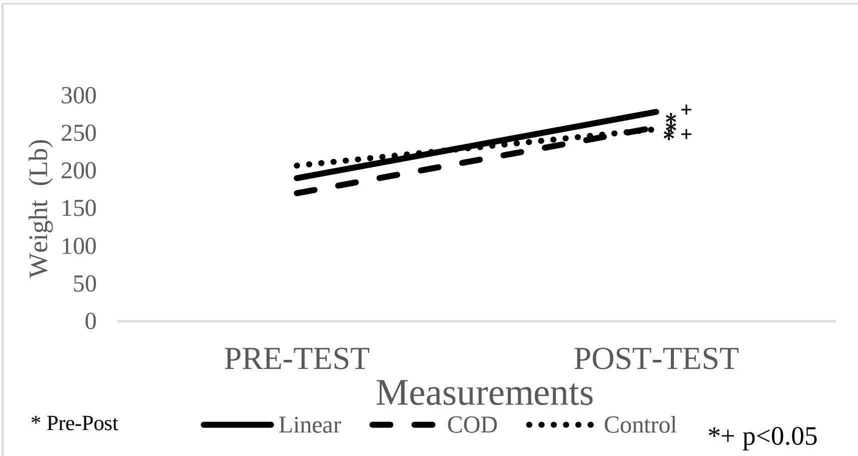

Figure 1. Interaction between Treatments*Measurements

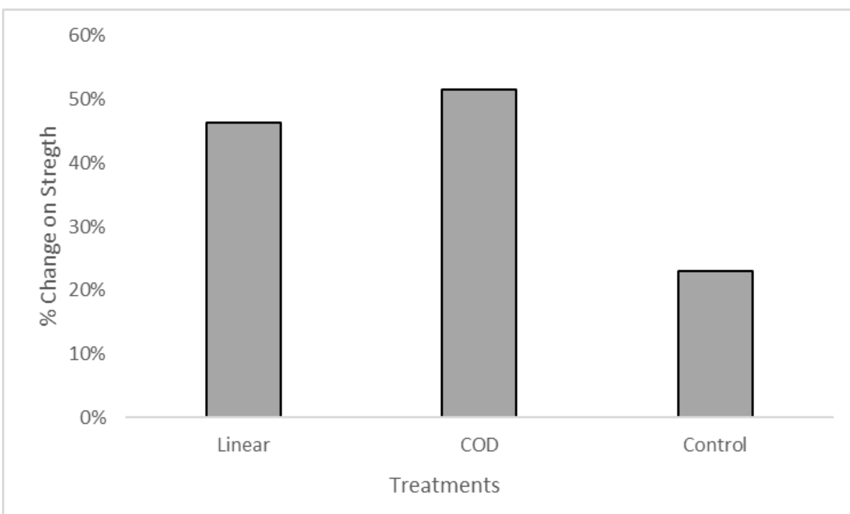

Figure 2. Differences in the change of strength between treatments.

DISCUSSION AND CONCLUSION

This study was proposed to examine the effect of strength training combined with two types of sprints, one linear and one with a change of direction, on an agility test's performance. Our hypothesis indicated that the experimental group with COD would improve in the specific speed test and that the linear group would improve in the same way in its particular test. Regarding agility, it was going to be improved in both experimental groups.

Regarding this type of study, when two types of physical qualities are combined to improve agility, no similar studies were found to contrast these results; we assume that they have not been carried out before. Studies, where treatments have been applied to improve qualities such as agility and COD confirm that the use of training with various combined qualities improves performance in this type of test (Brito et al., 2014; Sharma & Kailashiya, 2018; Tricoli et al., 2005; Young et al., 2001; Zghal et al., 2019).

The results obtained after six weeks of training these qualities in the experimental groups show no improvement between an agility test or the speed tests. The strength test (RM) was found to increase all groups' performance between pretest and post-test and a difference in the post-test between GL and CG, being the GL better.

Previous research by Keiner et al., (2014) showed that six weeks of strength training with sport-specific training added significantly increased COD performance. This study had a protocol of training blocks of strength training by free squatting in three blocks of 5x10 (75% RM), 5x6 (85% RM), and 5x4 (90% RM) in addition to regular soccer training. When comparing the results with our study, a lower training load is shown since only 3x8 (85% RM), 4x6 (90% RM), and 5 x 4 (95% RM) were performed. Additionally, players from the experimental groups exchange part of their regular training for this training protocol. Our treatment may not have provided enough stimulus in volume and cause improvement. The improvement in CG may be due to neuromuscular coordination, but the experimental groups had a greater gain above this gain.

Performance on the speed test did not improve significantly in either group. However, there appears to be a trend towards improvement. Previous research only focused its treatment on exclusive speed activities without any other physical quality training that influences the test's result to be carried out, such as strength training in this case. Likewise, some research supports the use of speed training to improve COD capacity, including agility training activities, which could enhance the performance of the same agility tests and not just speed training alone (Little Thomas & Williams Alun, 2007; Lockie et al., 2014; Mathisen & Pettersen, 2015).

The increase in performance from the strength tests performed can be speculated because 8-12-week soccer training programs have led to improvements. In this sense, it has been mentioned that it has been suggested that soccer training alone could contribute to the development of strength parameters in endurance, strength, jumping ability, flexibility, and agility (Chamari, 2005; McMillan, 2005).

Another finding analyzed in this study is the specificity of training in improving qualities. Strength training affected the experimental groups to increase strength, but soccer training improved the participants' strength. Similarly, the trend of improvement in speed with a change of direction is equally present in both experimental and CG groups. This result may mean that the principle of specificity of training is not met. Similar studies were found in the meta-analysis by Behm et al., (2017) on strength training versus plyometric training in speed performance and indicate that the magnitudes of change from strength training exceed those from power training for the speed test results. The slower movements of strength training would not be expected to have better adaptations for speed test performance. These meta-analysis findings contradict, like this study, the specificity of training for performance enhancement in the case of strength itself.

Previous studies show that strength and speed qualities are necessary to improve the ability to change direction. However, this study did not find significant improvements in the performance of the studied qualities speed (linear and COD) and, nor an increase in the strength test's performance linked to the treatment used at the end of the six weeks of combined treatment of strength and speed. Strength plus speed training can be used to improve strength during the competitive season, opting to improve the player's strength component. Likewise, soccer training alone can produce improvements in strength.

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Conflicts of Interest: The authors declare no conflict of interest.

Ethical clearance*:* National and international laws and the Declaration of Helsinki principles were fulfilled.

REFERENCES

Behm, D. G., Young, J. D., Whitten, J. H. D., Reid, J. C., Quigley, P. J., Low, J., Li, Y., Lima, C. D., Hodgson, D. D., Chaouachi, A., Prieske, O. & Granacher, U. (2017). Effectiveness of traditional strength vs. power training on muscle strength, power and speed with youth: A systematic review and meta-analysis. *Frontiers in Physiology*, *8*. 1-37. https://doi.org/10.3389/fphys.2017.00423.

Born, D.-P., Zinner, C., Düking, P. & Sperlich, B. (2016). Multi-directional sprint training improves change-of-direction speed and reactive agility in young highly trained soccer players. *Journal of Sports Science & Medicine*, *15*(2), 314-319.

Bourgeois, F., Gamble, P., Gill, N. & McGuigan, M. (2017). Effects of a six-week strength training programme on change of direction performance in youth team sport athletes. *Sports*, *5*(4), 83. https://doi.org/10.3390/sports5040083.

Brito, J., Vasconcellos, F., Oliveira, J., Krustrup, P. & Rebelo, A. (2014). Short-term performance effects of three different low-volume strength-training programmes in college male soccer players. *Journal of Human Kinetics*, *40*(1), 121-128. https://doi.org/10.2478/hukin-2014-0014.

Brughelli, M., Cronin, J., Levin, G., & Chaouachi, A. (2008). Understanding change of direction ability in sport. *Sports medicine*, *38*(12), 1045-1063.

Castagna, C., D'Ottavio, S. & Abt, G. (2003). Activity profile of young soccer players during actual match play. *Journal of Strength and Conditioning Research*, *17(4)*, 775-780.

Chamari, K. (2005). Endurance training and testing with the ball in young elite soccer players. *British Journal of Sports Medicine*, *39*(1), 24-28. https://doi.org/10.1136/bjsm.2003.009985.

Delaney, J. A., Scott, T. J., Ballard, D. A., Duthie, G. M., Hickmans, J. A., Lockie, R. G. & Dascombe, B. J. (2015). Contributing factors to change-of-direction ability in professional rugby league players. *Journal of Strength and Conditioning Research*, *29*(10), 2688-2696. https://doi.org/10.1519/JSC.0000000000000960.

Di Salvo, V., Baron, R., Tschan, H., Calderon Montero, F., Bachl, N. & Pigozzi, F. (2007). Performance characteristics according to playing position in elite soccer. *International Journal of Sports Medicine*, *28*(3), 222-227. https://doi.org/10.1055/s-2006-924294.

Hammami, M., Negra, Y., Billaut, F., Hermassi, S., Shephard, R. J. & Chelly, M. S. (2018). Effects of lower-limb strength training on agility, repeated sprinting with changes of direction, leg peak power, and neuromuscular adaptations of soccer players. *Journal of Strength and Conditioning Research*, *32*(1), 37-47. https://doi.org/10.1519/JSC.0000000000001813.

Hojka, V., Stastny, P., Rehak, T., Gołas, A., Mostowik, A., Zawart, M. & Musálek, M. (2016). A systematic review of the main factors that determine agility in sport using structural equation modeling. *Journal of Human Kinetics*, *52*(1). https://doi.org/10.1515/hukin-2015-0199.

Keiner, M., Sander, A., Wirth, K. & Schmidtbleicher, D. (2014). Long-term strength training effects on change-of-direction sprint performance. *Journal of Strength and Conditioning Research*, *28*(1), 223-231. https://doi.org/10.1519/JSC.0b013e318295644b.

Little, T. & Williams, A. (2007). Effects of spritn duration an exercise: rest ratio or repeated sprint perfomance ans physiologicl responses in profesional soccer players. *Journal of Strength and Conditioning Research*, *21, 2*, 646-648.

Lockie, R. G., Schultz, A. B., Callaghan, S. J. & Jeffriess, M. D. (2014). The effects of traditional and enforced stopping speed and agility training on multidirectional speed and athletic function. *Journal of Strength and Conditioning Research*, *28*(6), 1538-1551. https://doi.org/10.1519/JSC.0000000000000309.

Mathisen, G. E. & Pettersen, S. A. (2015). The effect of speed training on sprint and agility performance in 15-year-old female soccer players. *LASE Journal of Sport Science*, *6*(1), 61-70. https://doi.org/10.1515/ljss-2016-0006.

McMillan, K. (2005). Physiological adaptations to soccer specific endurance training in professional youth soccer players. *British Journal of Sports Medicine*, *39*(5), 273-277. https://doi.org/10.1136/bjsm.2004.012526.

Paul, D. J., Gabbett, T. J. & Nassis, G. P. (2016). Agility in team sports: Testing, training and factors affecting performance. *Sports Medicine*, *46*(3), 421-442. https://doi.org/10.1007/s40279-015-0428-2.

Raya, M. A., Gailey, R. S., Gaunaurd, I. A., Jayne, D. M., Campbell, S. M., Gagne, E., Manrique, P. G., Muller, D. G. & Tucker, C. (2013). Comparison of three agility tests with male service members: Edgren side step test, t-test, and illinois agility test. *Journal of Rehabilitation Research and Development*, *50*(7), 951-960. https://doi.org/10.1682/JRRD.2012.05.0096.

Raya-González, J., Suárez-Arrones, L., Moreno-Puentedura, M., Ruiz-Márquez, J. & Sáez de Villarreal, E. (2017). Efectos en el rendimiento físico a corto plazo de dos programas de entrenamiento neuromuscular con diferente orientación aplicados en jugadores de fútbol de élite U-17. [Short-term physical performance effects of two different neuromuscular oriented training programs on u-17 elite soccer players]. *RICYDE. Revista internacional de ciencias del deporte*, *13*(48), 88-103. https://doi.org/10.5232/ricyde2017.04801.

Reilly, T., Bangsbo, J. & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences*, *18*(9), 669-683. https://doi.org/10.1080/02640410050120050.

Sharma, H. B. & Kailashiya, J. (2018). Effects of 6-week sprint-strength and agility training on body composition, cardiovascular, and physiological parameters of male field hockey players. *Journal of Strength and Conditioning Research*, *32*(4), 894-901. https://doi.org/10.1519/JSC.0000000000002212.

Tricoli, V., Lamas, L., Carnevale, R. & Ugrinowitsch, C. (2005). Short-term effects on lower-body functional power development: weightlifting vs.vertical jump training programs. *Journal of Strength and Conditioning Research*, *19*(2), 433-437. https://doi.org/10.1519/00124278-200505000-00032.

Young, W. B., Mcdowell, M. H. & Scarlett, B. J. (2001). Specificity of sprint and agility training methods. *National Strength and Conditioning Association*, *15*(3), 315–319.

Zghal, F., Colson, S. S., Blain, G., Behm, D. G., Granacher, U. & Chaouachi, A. (2019). Combined resistance and plyometric training is more effective than plyometric training alone for improving physical fitness of pubertal soccer players. *Frontiers in Physiology*, *10*, 1020, 1-11. https://doi.org/10.3389/fphys.2019.01026.