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SYSTEMATIC REVIEW ON SPEED IMPROVEMENT IN U19 SOCCER PLAYERS

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Summary. The objective was to compare and analyze the effectiveness of different training methodologies for speed improvement in U-19 soccer players. A systematic review literature study was carried out. Using the PRISMA statement, a literature search was performed using the PubMed database. We included articles that were intervention studies written in Spanish or English, conducted in players aged 10 to 19 years, that had at least one plyometric, strength or sprint training method for speed improvement and that had an evaluation of sprinting. The results of the interventions showed benefits in the improvement of speed through the plyometric method (TE=0.66) in 20 m test, explosive strength (TE=0.64) in 5 m test and sprint (TE=0.33) in 20 m test. It can be concluded that the explosive strength method obtains greater benefits in short distances (5-10 m) when low intensities are used and in 17-year-old players, the ideal training volume is 2 sessions per week. The sprint method over longer distances (20-30 m) at ages 14-15, with a training volume of one or two sessions per week. Plyometrics achieves the same benefits over short and long distances (5-30 m) for ages 15-16 years and without notable differences in training volume.

Key words: Plyometric, explosive strength, sprint, training, method, test.

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Abstract. The objective was to compare and analyze the effectiveness of different training methodologies for speed improvement in U-19 soccer players. A systematic review literature study was carried out. Using the PRISMA statement, a bibliographic search was carried out through the PubMed database. Articles were included that were intervention studies written in Spanish or English, carried out in players aged 10 to 19 years that had at least one plyometric, strength, or sprint training method for speed improvement and that had an evaluation of sprinting. The results of the interventions showed benefits in speed improvement through the plyometric method

(TE=0.66) in 20 m test, explosive strength (TE=0.64) in 5 m test, and sprint (TE=0.33) in 20 m test. It can be concluded that the explosive strength method obtains greater benefits in short distances (5-10 m) when low intensities are used and in 17-year-old players; the ideal training volume is 2 sessions per week. The sprint method at longer distances (20-30 m) in 14-15-year-olds, with a training volume of one or two sessions per week. Plyometrics achieves the same benefits over short and long distances (5-30 m) for ages 15-16 years with no noticeable difference in training volume.

Keywords: Plyometric, explosive strength, sprint, training, method, test.

Introduction

Soccer is a sport that is in continuous expansion and more and more people have a federative license, both in the senior category and in grassroots soccer (Sedano Campo et al., 2007). According to the Royal Spanish Football Federation (RFEF), in the 09/10 season the number of federative licenses was 781,415 while, in the 15/16 season, the federation reached 923,805 federated members (RFEF, 2017). This has led to an increase in the creation of clubs and sports schools, where players start from pre-benjamin (7 years old) to youth (18 years old) (Sedano Campo et al., 2007).

In soccer, performance depends both on individual skills, as well as on the interaction of different players in the same team (Haugen et al., 2014). In addition, it is conditioned by speed, strength and power levels which, in turn, are reflected in sprints, jumps and changes of direction (Jiménez-Reyes et al., 2017). Therefore, in order to become a good soccer player, optimal development in basic skills must be achieved (Haugen et al., 2014).

The continuous evolution of soccer means that more and more schemes, numerous analyses, new ways of playing and new variables are emerging. The pace of the games is progressively higher and so is the intensity (Barraza Gómez et al., 2011). The movements must be performed at a higher speed, and this makes it a very important aspect nowadays, as it can be decisive in the outcome of a match (Beato et al., 2018). One of the main characteristics that soccer has is that its activity profile is intermittent, predominantly changes of direction (COD), accelerations and decelerations, jumps and small recovery periods (Beato et al., 2018). Speed will depend on two variables: i) the internal variable; in which factors such as morphological proportions, number of fast fibers, running technique of each player, speed at which the muscles contract, attention and technical-tactical knowledge are present; and, ii) external factors; such as weather conditions, the state of the terrain or the material used (Barraza Gómez et al., 2011).

Throughout a match, players perform a high number of sprints, however, the duration of these sprints is low (Sedano Campo et al., 2007). Each player executes between 17 and 81 sprints, with a duration of 2 to 4 seconds, over maximum distances of 20 meters (Marzouki et al., 2021). Per match, an average of 9 to 12 km is covered per player, between 8% and 12% of that distance occurs at high intensity (Haugen et al., 2014). Similarly, the maximum sprint speed in a match is around 32 km/h, occurring in most cases without a ball (Marzouki et al., 2021). A study conducted in the English Premier League from 2006 to 2013 determined that, over the 7 seasons, both sprint distance and number of sprints increased by 35% and high intensity actions increased by 50% (Loturco, Jeffreys, et al., 2020). Another study that was carried out in the German premier league analyzed through different videos, 360 goals from which they managed to extract that: in 45% of the goals, the player who scored a goal, previously performed linear sprints mostly without opponent and without ball (Haugen et al., 2014).

In the research literature, straight-line sprinting is classified as acceleration, maximal running speed and deceleration (Haugen et al., 2014). Numerous game analyses have verified that, more than 90% of the total number of sprints performed in a match are in less than 20 meters (Haugen et al., 2014). Fifty percent of sprints performed at maximum speed occur at distances less than 12 m, 20% range from 12 m to 20 m and 15% between 20 and 30 m (Hernandez et al., 2012). This makes the acceleration capacity very important, so it would be convenient to parameterize the speed in ranges of no more than 30 meters.

In soccer, having more speed, power and acceleration over the opponent means having a great advantage, therefore, numerous researches have focused on how sprinting and jumping performance is developed through different training methods such as; sprint training, sprinting against resistances, training through weights, training combining resistance and sprinting or plyometric training (Asadi et al., 2018).

Plyometric training is both popular and effective in producing improvements in sprint power and performance (Beato et al., 2018). Plyometric exercises are based on a specific methodology that enjoys strong support from the scientific literature (Beato et al., 2018). Such methodology focuses on jumping exercises in which the muscle action used is the shortening-stretching cycle (Beato et al., 2018). It is a type of training that is easy to implement as well as effective, therefore, it is attributed as the right approach to achieve performance improvements with respect to soccer, such improvements can be related to neuromuscular adaptations; although these may differ depending on the characteristics of the players and fundamentally maturation (Asadi et al., 2018).

Repeated sprint ability (RSA) is the ability to repeat sprints with short recovery intervals (Haugen et al., 2014). It is a method that, in team sports, has gained great importance in recent years (Haugen et al., 2014). On the other hand, speed is a capacity that depends largely on strength work (Sedano Campo et al., 2007). Usually in research works on strength training in soccer, the most studied aspect is related to the effects on speed (Hernandez et al., 2012).

It can be seen that there are numerous methods for speed improvement. Therefore, the aim of the present study is to compare and analyze the effectiveness of different training methodologies for speed improvement in U-19 soccer players.

Method

For the preparation of this systematic review, a thorough search for articles was carried out using the PubMed database. The keywords used were: "sprint", "soccer", "training" and "young". To make the item search more specific, Boolean operators (AND/AND, OR/OR and NOT/NOT) were used. For the selection of articles, the following inclusion criteria were marked; (1) interventions performed on soccer players aged between 10 and 19 years, (2) that included at least one plyometric, strength or sprint training method for speed improvement and (3) that included an evaluation of sprinting. The exclusion criteria used were; (1) articles written in a language other than Spanish or English, (2) involving women and (3) combined training methods.

Results

Figure 1 shows the flow diagram of the systematic review.

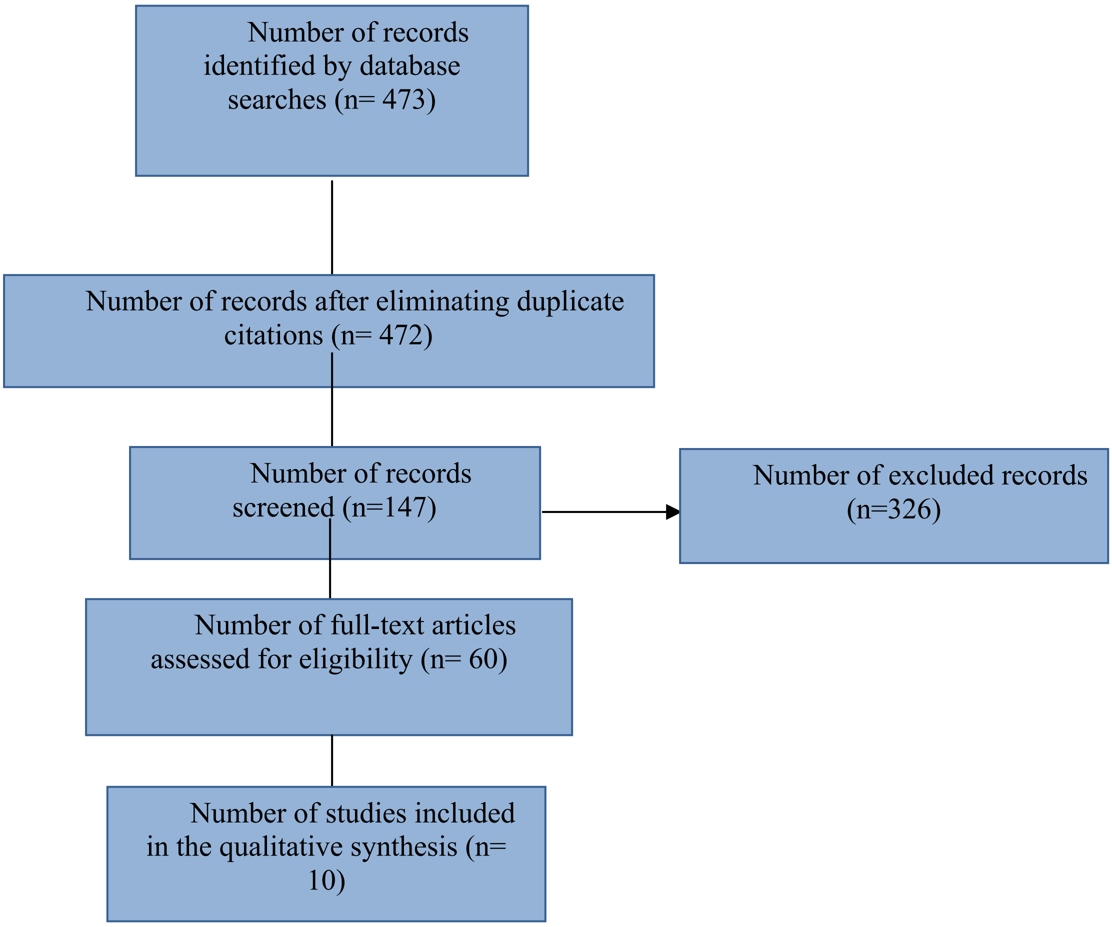

Figure 1. Flow chart.

Table 1

Description of intervention studies

AUTHORS	PARTICIPANTS	METHOD	INTERVENTION	RESULTS
Asadi et al., 2018	N= 60 -Age: 11-16 -They were divided into 3 groups depending on maturity: -10 players between 11 and 12 years old (GE1), 10 players between 11 and 12 years old (GC1). -10 players between 13 and 14 years old (GE2), 10 players between 13 and 14 years old (GC2). -10 players between 15 and 16 years old (GE3), 10 players between 15 and 16 years old (GC3).	Plyometric	6 weeks -GE: 3 days per week they performed soccer training and 2 days per week plyometric training. The plyometric exercises consisted of 2x10 jumps with drops from 20, 40 and 60 cm Intensity: 100% Rest period between repetitions and sets: 7 and 120 s -GC: 3 days a week they performed soccer training, without plyometric training.	Tests for data collection: -Test: 20 m sprint (pre and post intervention). -GE1: (4.48 ± 0.85 vs 4.3 ± 0.75) TE= -0.12 -GC1: (4.72 ± 0.77 vs. 4.7 ± 0.8) -GE2: (3.82 ± 0.48 vs 3.53 ± 0.45) TE= -0.58 -GC2: (3.76 ± 0.37 vs. 3.71 ± 0.33) -GE3: (3.83 ± 0.52 vs 2.8 ± 0.4) TE= -0.66 -GC3: (3.09 ± 0.68 vs. 3.07 ± 0.59)
Bianchi et al., 2018	N= 21 -Age: 17 ± 0,8 -10 players performed low volume plyometric training (LVP). -11 players performed high volume plyometric training (HVP).	High and low volume plyometric	8 weeks -PBV: Once a week, 4x5 drop jumps from 60cm, jump over two 15cm high hurdles, 4x6 horizontal jumps, 4x6 jumps over 15cm high hurdles. -PAV: Same training, but twice a week.	Tests for data collection: -Test: 10, 30 and 40 m sprint (pre and post intervention). -PBV: 10 m: (1.84 ± 0.08 vs. 1.79 ± 0.08) 30 m: (4.25 ± 0.15 vs. 4.19 ± 0.15) 40 m: (5.48 ± 0.24 vs. 5.27 ± 0.27) -PAV: 10 m: (1.85 ± 0.07 vs. 1.77 ± 0.08) 30 m: (4.36 ± 0.16 vs. 4.26 ± 0.15) 40 m: (5.52 ± 0.18 vs. 5.46 ± 0.17)
	N= 32 -Age: 17-18		8 weeks All players performed 2 sessions per week of their specific method. -F:	Tests for data collection: -Test: 10, 20 and 30 m sprint (pre and post intervention). -F:

De Hoyo et al., 2016	Three training groups were formed, each group performed one method. -11 players were part of the strength group (F). -12 players were part of the resisted sprint group (SRE). -9 players were part of the plyometric group (P).	Strength, resisted sprinting and plyometrics	Full squat: 2-3 sets x 4-8 repetitions. Intensity: 40-60% 1RM. Rest: 3 min between sets. -SRE: Resisted sprint: 6-10 sets of 20 m. It was performed with a sled equivalent to 12.6% of the player's body mass. Rest: 3 min between sets. -P: Plyometric: 1-3 sets x 2-3 repetitions. Intensity: 100%. Rest: 3 min between sets. Exercises: unilateral crosses jumps + 15 m sprint, unilateral alternate jumps + 15 m sprint, unilateral lateral jumps (40 cm).	10 m: (1.67 ± 0.05 vs 1.68 ± 0.08) TE= -0.31 20 m: (2.95 ± 0.09 vs. 2.94 ± 0.10) TE = 0.05 30 m: (4.11 ± 0.12 vs 4.07 ± 0.11) TE= 0.32 -SRE: 10 m: (1.72 ± 0.05 vs 1.71 ± 0.06) TE= 0.11 20 m: (3.00 ± 0.07 vs 2.99 ± 0.08) TE = 0.05 30 m: (4.22 ± 0.12 vs 4.19 ± 0.13) TE= 0.21 -P: 10 m: (1.72 ± 0.07 vs 1.72 ± 0.08) TE= 0.02 20 m: (2.99 ± 0.08 vs 2.98 ± 0.12) TE= 0.12 30 m: (4.17 ± 0.11 vs 4.13 ± 0.17) TE= 0.35
Loturco et al., 2019	N= 23 -Age: 18,3 ± 0,7 Two groups were formed depending on the maximum peak power achieved in the jump squat. -11 players trained with a load above 20% of peak power (GE1) -12 players trained with a load below 20% of peak power (GE2)	Explosive strength	4 weeks All players performed 3 power-oriented training sessions per week. The exercises that were carried out were as follows: -Squat with jump: 6x6 repetitions. The GE1 group with a load 20% higher than the peak power, the GE2 group 20% lower. This loading intensity was chosen because at ± 20% of maximum peak, players produce 90% of their maximum power output in the jump squat.	Tests for data collection: -Test: 5, 10 and 20 m sprint (pre and post intervention). -GE1: (expressed in meters per second) 5 m: (5.03 ± 0.34 vs 5.13 ± 0.22) TE= 0.26 10 m: (5.86 ± 0.27 vs 5.92 ± 0.23) TE= 0.23 20 m: (6.79 ± 0.25 vs. 6.83 ± 0.26) TE= 0.15 -GE2: (expressed in meters per second) 5 m: (5.12 ± 0.17 vs 5.24 ± 0.23) TE= 0.64 10 m: (5.91 ± 0.18 vs 5.98 ± 0.26) TE= 0.41 20 m: (6.84 ± 0.21 vs. 6.84 ± 0.26) TE= 0.03

Moran et al., 2017	N= 17 -Age: 13.6 ± 0.7 (GE), 14.5 ± 1.0 (GC). - 7 players were part of the experimental group (EG). -10 players were part of the control group (CG).	Sprint	1 weekly session -GE: During the session they performed 16 sprints over a distance of 20m. Rest: 90 s between each sprint -GC: They continued with their usual training program.	Tests for data collection: -Test: 10 and 20 m sprint (pre and post intervention). -GE: 10 m: (1.93 ± 0.10 vs 1.89 ± 0.07) TE= 0.51 20 m: (3,35 ± 0,14 vs 3,30 ± 0,15) TE= 0,33 -GC: 10 m: (1.92 ± 0.11 vs 1.89 ± 0.13) TE= 0.29 20 m: (3.33 ± 0.22 vs 3.28 ± 0.23) TE= 0.24
Black et al., 2018	N= 29 -Age: 13 ± 0,7 -13 players performed plyometric training with load (PCC) -16 players performed plyometric training without load (PSC)	Plyometric with and without load	8 weeks -PCC (all exercises with weighted vest, 8% of body mass) Once a week, bilateral ankle jumps forward (fence height: 20cm), jump against movement. Volume: 4-6 sets, 6-10 repetitions. Ground contacts: 50 the first session, gradually increasing to 120 in the last session. Rest: 90 s between sets. -PSC Same training, but without additional load.	Tests for data collection: -Test: 5, 10 and 20 m sprint (pre and post intervention). -PCC: 5 m: (1.3 ± 0.1 vs 1.2 ± 0.1) TE= 1.00 10 m: (2.2 ± 0.1 vs 2.0 ± 0.1) TE= 2.00 20 m: (3.8 ± 0.2 vs 3.6 ± 0.2) TE= 1.00 -PSC: 5 m: (1.2 ± 0.1 vs 1.1 ± 0.1) TE= 1.00 10 m: (2.1 ± 0.1 vs 2.0 ± 0.2) TE= 0.63 20 m: (3.7 ± 0.3 vs 3.6 ± 0.3) TE= 0.33
Nuñez et al., 2019	N= 20 -Age: 17 ± 1 -10 players performed the strength training and acceleration exercise with conical pulley (GE). -10 players performed only strength training (QA).	Force + conical pulley	9 weeks GE performed all 4 exercises, while GC performed 3 (excluding CP training). The following 4 exercises were performed: -Full squat: 3x4-6 repetitions. Intensity: 30-40% 1RM. -Sled training: 2-3 repetitions of 20 m. Sled weight: 15-20% of body mass. -CP training (conical pulley): 2-3x6 repetitions. Intensity: concentric average power. -Plyometric: 2-3x4 repetitions.	Tests for data collection: -Test: 10 and 20 m sprint (pre and post intervention). -GE: 10 m: (1.69 ± 0.06 vs 1.65 ± 0.04) TE= -0.78 20 m: (2.96 ± 0.08 vs 2.90 ± 0.07) TE= -0.66 -GC: 10 m: (1.64 ± 0.05 vs 1.63 ± 0.05) TE= -0.30 20 m: (2.85 ± 0.09 vs 2.82 ± 0.09) TE= -0.38

Otero-Esquina et al., 2017	N= 36 -Age: 17,0 ± 1,0 -12 players performed 1 session per week (GE1). -12 players performed 2 sessions per week (GE2) -12 players did not perform the strength training (GC)	Force	7 weeks 4 exercises carried out in the following order: -Full back squat: 3x4-6 repetitions. Intensity: 40-55% 1RM. Rest: 3 min between sets. -Yo Yo leg curl: 2x4, 3x4, 3x5 and 3x6 repetitions, every two weeks increase. Rest: 2 min between sets. -Plyometric: (box jumps, drop jumps feet together, hurdle jumps) 1x3-6 repetitions per session. Rest: 1 min between repetitions. -Resisted sprint: 3-5 repetitions of sprint 20 m.	Tests for data collection: -Test: 10 and 20 m sprint (pre and post intervention). -GE1: 10 m: (1.70 ± 0.06 vs 1.70 ± 0.05) TE= -0.3 20 m: (2.99 ± 0.07 vs. 2.98 ± 0.08) TE= 0.3 -GE2: 10 m: (1,71 ± 0,05 vs 1,69 ± 0,05) TE= 1,4 20 m: (2.98 ± 0.09 vs 2.93 ± 0.11) TE= 1.5 -GC: 10 m: (1.74 ± 0.04 vs 1.74 ± 0.05) TE= 0.5 20 m: (3.04 ± 0.05 vs 3.04 ± 0.06) TE= 0.1
Pavillon et al., 2020	N= 55 -Age: 14-18 -27 players were part of the sprint change of direction (SCD) group. -28 players were part of the linear sprint (SL) group.	Linear and change of direction sprint	30 weeks They carried out 2 sessions of specific training per week. The exercises performed were as follows: -SCD: 3 short and intense exercises, 4 sets x 10 repetitions. 20 m distance in 5 s intervals. Rest: 25 s between repetitions. Sprint totals: 1200 -SL: Back and forth sprints of 20 m (10 out and 10 back), 2 sets x 10 repetitions. Rest: 25 s between repetitions. Sprint totals: 1200	Tests for data collection: -Test: 5 and 10 m sprint (pre and post intervention). -SCD: U-15, 17 and 19 5 m: (1.19 ± 0.07 vs. 1.14 ± 0.02) sub-15 10 m: (2.03 ± 0.10 vs. 2.14 ± 0.06) sub-15 5 m: (1.17 ± 0.08 vs. 1.05 ± 0.03) U-17 10 m: (1.93 ± 0.10 vs. 1.79 ± 0.12) U-17 5 m: (1.20 ± 0.08 vs 1.08 ± 0.2) u-19 10 m: (1.94 ± 0.11 vs. 1.84 ± 0.03) U-19 -SL: U-15, 17 and 19 5 m: (1.21 ± 0.07 vs. 1.15 ± 0.02) sub-15 10 m: (2.06 ± 0.09 vs. 2.25 ± 0.23) sub-15 5 m: (1.14 ± 0.06 vs. 1.31 ± 0.03) U-17 10 m: (1.95 ± 0.09 vs 2.07 ± 0.13) U-17 5 m: (1.20 ± 0.09 vs 1.11 ± 0.21) U-19 10 m: (1.94 ± 0.09 vs 1.85 ± 0.03) u-19

Rey et al., 2019	N= 27 -Age: 14,5 ± 0,5 -14 players performed one session per week of repeated sprinting (SR1). -13 players performed two sessions per week of repeated sprinting (SR2).	Repeated sprint	6 weeks -SR Training: 2-6 sets of 4-6 x 15 to 30 m of maximal straight line sprints. Intensity: 100% Rest: 20 s of passive recovery between repetitions. 240 s between sets.	Tests for data collection: -Test: 5, 10 and 20 m sprint. Repeated sprint skill test (6 maximum sprints of 25 m). -SR1: 5 m: (1.05 ± 0.53 vs. 1.05 ± 0.91) 10 m: (1.87 ± 0.99 vs. 1.85 ± 0.11) 20 m: (3.31 ± 0.15 vs. 3.23 ± 0.21) TM: (4.20 ± 0.17 vs. 4.12 ± 0.20) TMR: (4.08 ± 0.16 vs. 4.02 ± 0.21) TT: (25.17 ± 1.03 vs. 24.71 ± 1.21) -SR2: 5 m: (1.04 ± 0.52 vs. 1.04 ± 0.54) 10 m: (1.84 ± 0.09 vs. 1.81 ± 0.11) 20 m: (3.28 ± 0.15 vs. 3.23 ± 0.22) TM: (4.20 ± 0.20 vs. 4.08 ± 0.19) TMR: (4.06 ± 0.19 vs. 3.97 ± 0.16) TT: (25.18 ± 1.23 vs. 24.46 ± 1.13)

Note: TE: Size effect, GE: Experimental group, GC: Control group, SR: Repeated sprint, TM: Average time, TMR: Faster time, TT: Total time, RM: Maximum repetition, CP: conical pulley, PBV: Plyometric low volume, PAV: Plyometric high volume, F: Strength, P: Plyometric, SRE: Resisted sprint, PCC: Plyometric with load, PSC: Plyometric without load, SCD: Sprint with change of direction, SL: Linear sprint.

Discussion and conclusions

The objective of this study is to compare and analyze the effectiveness of different training methodologies for the improvement of speed in U-19 soccer players. With a plyometric exercise program have been widely implemented as a training method for sports performance improvement (Bianchi et al., 2019). This training method is mainly performed with jumps, in which the aim is to generate maximum power levels (Sáez-Sáez et al., 2009) .In the review, 3 articles that implemented such method in their soccer players were included (Asadi et al., 2018; Bianchi et al., 2019; Negra et al., 2020). In all the articles, improvements were observed in the 10, 20, and 30 m sprint performance. The improvement obtained in the 20 m sprint may be due to the maturity effect, as there were greater changes in the GE3 group (15-16 years) than in the GE1 (11-12) and GE2 (13-14) groups, all 3 groups performed two plyometric trainings per week with the same exercises and intensity (Asadi et al., 2018). Stride speed and stride length condition running performance, both elements are influenced by anthropometric characteristics so, the results obtained in the more mature group are due to the anthropometric change between groups (Asadi et al., 2018). Higher training volume could not be shown to produce changes in sprint performance (Bianchi et al., 2019). The low and high volume groups showed improvements after applying the method, but showed no differences between them. This may be because two sessions instead of one session per week is not enough to obtain significant differences in young elite players, who are used to 4 sessions per week (Bianchi et al., 2019). Therefore, it is advisable to employ low-volume plyometric training that is equivalent to 80-100 jumps per week (Bianchi et al., 2019). In plyometric training with and without load, improvements were obtained in both groups, but greater in the group with load (PCC) (Negra et al., 2020). This may be due to the higher eccentric load attributed to the loaded group (Coratella et al., 2018). Increased eccentric overload during loaded training may have produced improvements in central nervous system efficiency, tendon muscle tissue stiffness and muscle activation (Negra et al., 2020).

Sprint acceleration is a fundamental aspect of physical performance in team sports (Morin et al., 2017). What will determine the sprint acceleration profile is the ability the player has to produce high levels of mechanical power (Morin & Samozino, 2016). Power production basically depends on ground reaction forces going in the postero anterior direction only if the movement is performed at high contraction velocities (Morin et al., 2017). Because of this, plyometric training can be an effective way to train power as it involves jumping exercises in which the stretch-shortening cycle is used, which can elicit improvements in the neural and muscle-tendon systems to produce the greatest possible force in the shortest amount of time (Beato et al., 2018).

A further 3 strength articles were added and included in the review (Loturco et al., 2020; Nuñez et al., 2019; Otero-Esquina et al., 2017). In explosive strength training with heavy and light load (± 20% maximum peak power), the light-loaded group obtained better scores than the heavy-loaded group in the 5 and 10 m tests (Loturco et al., 2020). Although the reason for this is unclear, it can be speculated to be related to the lower fatigue levels produced by light loads compared to heavy loads (Loturco et al., 2020). Strength training using conical pulley proved to be more beneficial at distances of 10 meters than at distances of 20 meters, even so, the expected benefits were not obtained (Nuñez et al., 2019). The improvements in the 10 meters may be due to the fact that the training routine was based on squat, sled and plyometric exercises, which makes it have an additional effect to improve the ability to accelerate in the first meters (Nuñez et al., 2019). Delivering this method once a week for 9 weeks does not seem to be sufficient to get the maximum benefit from the device (Nuñez et al., 2019). On the other hand, in terms of volume, the execution of two explosive strength training sessions per week elicited greater benefits than one session per week in linear sprint performance (Otero-Esquina et al., 2017). By applying two sessions per week increase lower body strength levels, players produced higher levels of reaction strength, greater momentum and higher rate of strength development after workouts, conducive to higher training performance and improvements in linear sprinting ability (Otero-Esquina et al., 2017).

An article analyzing the strength (full barbell squat), plyometric and resisted sprint method across different groups was included in the review (de Hoyo et al., 2016). In all 3 groups, substantial improvements were only found in the 30 m sprint (de Hoyo et al., 2016). This may be because the loads implemented have been low (40-60% 1RM in barbell squat and 12.6% body mass in repeated sprint), as numerous studies that have employed higher loads in strength training (80% 1RM) or repeated sprint (20% body mass) have provided improvements in the early phases of sprinting (de Hoyo et al., 2016).

Sprinting is an action that occurs continuously in soccer, so the inclusion of sprinting in a speed training program is a fundamental factor (Rumpf et al., 2011). We added 3 articles related to sprint training (Moran et al., 2018; Pavillon et al., 2021; Rey et al., 2019).

In the linear sprint, no differences were noted between the experimental and control groups (Moran et al., 2018). This is due to the phenomenon of adolescent clumsiness, whereby the motor coordination of young people is temporarily disrupted because of rapid growth of the limbs and trunk at 13-14 years of age (Moran et al., 2018). At these ages the body is in continuous change, it is recommended to decrease the volume of sprint training and increase the volume of endurance training to optimize a correct development, since biological maturation can derive in increases in sprint speed regardless of the training method employed (Moran et al., 2018). Linear and change of direction sprint training produced significant changes in sprinting in U-15, U-17 and U-19 soccer players, although the results were very similar in all age groups (Pavillon et al., 2021). These changes can be related to improvements in technique, greater stride, greater strength in the lower extremities, even improved body coordination (Pavillon et al., 2021). Improvements in change-of-direction sprinting are associated with an improvement in lower extremity strength produced by the large number of turns performed, high braking forces in deceleration and propulsive forces in acceleration make increased strength demands on the lower extremities (Pavillon et al., 2021). One or two sessions per week of repeated sprinting are equally effective in the development of the 20-m sprint, but are not effective in the development of the 5- and 10-m sprint (Rey et al., 2019). Improved 20 m performance is closely related to different metabolic adaptations, such as increases in muscle metabolites (phosphocreatine and glycogen) in addition to neuromuscular changes, changes in contractile properties, and increases in muscle fiber recruitment, activation frequency, and motor unit synchronization (Rey et al., 2019). More specific training strategies (plyometric, sprint with resistance) are necessary to obtain improvements in 5 and 10 m (Rey et al., 2019).

To conclude, this review aimed to compare and analyze the effectiveness of different training methodologies for speed improvement in U-19 soccer players. Each method produces more or less improvement in sprint performance depending on variables such as volume, age of maturation or the exercises that have been implemented in each method. It can be concluded that the explosive strength method obtains greater benefits in short distances (5-10 m), at low intensities and in 17-year-old players, the ideal training volume seems to be 2 sessions per week. On the other hand, the sprint method obtains better results at longer distances (20-30 m), at ages 14-15 and with a volume of one or two sessions per week. It seems that at 14-15 years of age repeated sprinting is more indicated while at 17-18 years of age it is linear sprinting. Likewise, the plyometric method achieves the same benefits over short and long distances, and is most effective in players aged 15-19 years. In volume there seems to be no noticeable difference, the most advisable is a low volume training equivalent to 80-100 jumps per week. From all this, it can be concluded that there is no perfect method that improves speed in all areas, i.e., each method must be applied according to the characteristics and needs of the players.

This review has some limitations that are explained below: the great variability in the ages of the players analyzed in the articles makes it difficult to establish an optimal age range on which to focus the review. In this line, the period of time in which the interventions are applied is short and different in most of the articles (6-9 weeks), which means that the results do not reflect the expected adaptations.

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