Rev Bras Futebol 2022; v. 15, n. 4, 02 - 71

AVALIAÇÃO E MONITORAMENTO DE JOVENS JOGADORES DE FUTEBOL: UMA REVISÃO SISTEMÁTICA

EVALUATION AND MONITORING OF YOUNG SOCCER PLAYERS: A SYSTEMATIC REVIEW

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AVALIAÇÃO E MONITORAMENTO DE JOVENS JOGADORES DE FUTEBOL: UMA REVISÃO SISTEMÁTICA

RESUMO

Introdução: A compreensão do Futebol passa pela necessidade de avaliar e monitorar os jogadores, bem como os métodos e meios empregados no processo de desenvolvimento desses jovens.

Objetivo: O objetivo dessa revisão sistemática é sintetizar os principais resultados encontrados, bem como identificar os principais métodos usados para avaliar e monitorar jovens jogadores de futebol, das categorias Sub-12 à Sub-19, em estudos científicos publicados entre os anos de 2015 a 2018, de acordo com as normas do *Preferred Reporting Items for Systematic Reviews and Meta-analyzes* (PRISMA).

Metodologia: As bases de dados Web of Science, a SportDiscus e a Scopus foram pesquisadas para a obtenção de estudos relevantes, usando as seguintes palavras-chave: "Soccer" AND "Football", associadas aos termos: matur* OR "biological matur*" OR you* OR growth OR "physical fitness" OR "physical performance" OR functional OR "athletic ability testing" OR anthropom* OR "talent selection" OR "talent identification" OR SSG OR "Small and conditioned Games" OR "systematic observation" OR "time-use analysis" OR "skill acquisition" OR "development pathways" OR "training session".

Resultados: Após as buscas, foram encontrados 9070 estudos, dos quais 131 foram selecionados para fazer parte dessa revisão.

Conclusão: Conclui-se que, nos últimos dez anos, é cada vez mais frequente a utilização da tecnologia nas Ciências do Esporte, especificamente no contexto do futebol. Entretanto, a análise das capacidades físicas continuam sendo o foco dos estudos com jovens jogadores de futebol. O método mais utilizado para avaliar os jogos reduzidos e condicionais foi o Sistema de Avaliação Tática no Futebol (FUT-SAT). Por outro lado, as análises de interações e da atividade dos jogadores forma mais exploradas em jogos em formato oficial. Foi possível observar que a maturação biológica foi controlada em vários estudos, entretanto, as sessões de treino ainda são pouco relatadas por estudos com alta qualidade metodológica.

Palavras-chave: Futebol, Categorias de base, Avaliação Multidimensional, Jovens jogadores.

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ABSTRACT

Introduction: Understanding soccer involves the need to evaluate and monitor players, as well as the methods and means used in the development process of these young people.

Objective: The aims of this systematic review were to synthesize the main results find out as well as to identify the most used methods to evaluate and monitoring young soccer players, in the U-12 to U-19 age category, in studies published between 2015 and 2018 according to the Preferred Reporting Items for Systematic Reviews and Meta-analyzes (PRISMA) guidelines.

Methodology: The Web of Science, SportDiscus and Scopus databases were searched for relevant published studies using the following keywords: "Soccer" and "Football", associated to the following terms: matur* OR "biological matur*" OR you* OR growth OR "physical fitness" OR "physical performance" OR functional OR "athletic ability testing" OR anthropom* OR "talent selection" OR "talent identification" OR SSG OR "Small and conditioned Games" OR "systematic observation" OR "time-use analysis" OR "skill acquisition" OR "development pathways" OR "training session".

Results: After the search, 9070 studies were found, of which 131 were selected to be part of the review.

Conclusion: It is concluded that in the last ten years, the technology is being used more frequently in the sports sciences. However, the physical capacities are still the focus of the analysis with young soccer players. Considering the Small-Sided and Conditioned Games, FUT-SAT was the most used method, but it was not used in formal games, in which analyzes of social networks and player activity were performed. The maturation is a controlled variable in many studies. However, there are still few studies dedicated to the analysis of the training sessions.

Keywords: soccer, football, evaluation, multidimensional analysis, youth players.

1. INTRODUCTION

According to the Fédération Internationale de Football Association (FIFA), considering their 207 associated federations, in 2007, soccer had approximately 265 million players all over the world (1). Probably this is the sport modality with more players on the planet and, as well as in all other society fields, and improved over the years using the basic and applied scientific research approaches. This statement is supported by the increase in the number of studies carried out over the years (2).

However, for science to be harnessed, scientists need to recognize which variables influence the game and are therefore of greater interest to managers, coaches, and coach staff (3). During many decades, the study of the morphological and functional capacities of soccer players was the most investigated topic. In this sense, the studies related to the player's growing and developing, trying to understand inter-individual differences were more ordinary (4). For example, Figueiredo et al. (5) did a differentiation between the players who drop out, persist or move up from soccer and used, among other variables, the aerobic performance, anaerobic fitness, agility and the explosive power for this purpose.

In the last 20 years, therefore, tactics and the soccer player's tactical behavior has received more notoriety from researchers (6). Over the years and with the increasingly early player's professionalization, the studies made with adults in the past; nowadays are more frequently made with young players (7).

Moreover, game demands request from the sport sciences a larger link with technological advice to understand in a more accurate way the player's behavior and performance. An example

related to the development of mechanisms of training control is the utilization of the Global Positioning System (GPS) and its capacity to collect external load variables (8). In less than ten years, this kind of device improved its capacity from 1 Hz to 15 Hz, modifying considerable their precision (9-11). Another essential point to highlight it's the use of match analysis softwares. The notational method with paper and a pen gives space in a small period to sophisticated systems, free systems in some cases (e.g., Kinovea), and very expansive in others (e.g., Amisco).

Currently, it is possible to control more variables than in the past, fortunately to the insertion of certain technological devices and systems to control the matches and training sessions. There is a tendency, therefore, that the studies begin to control the greatest number of variables, to increase the generalization capacity of the outcomes found (12, 13).

Based on the above arguments, this systematic literature review aims to synthesize the main results find out as well as to identify the most used methods to evaluate and monitoring young soccer players. For this purpose, will be analyzed studies carried out with young soccer players, among Under-12 and Under-19 age categories, conducted between 2015 and 2018.

2. METHODS

2.1. Search strategy: databases and inclusion criteria

To perform this systematic review, the rules from Preferred Reporting Items for Systematic Reviews and Meta-analyzes (PRISMA) were followed (14, 15). The searches were performed in the following databases: Web of Science™ Core Collection, Scopus, and SportDiscus. Were considered papers published between January 1st, 2015, and March 30th, 2018. The temporal space chosen for

the searches is justified by the substantial increase in the use of technological devices in the monitoring of training sessions and matches.

The searches were done using the keywords “Soccer” and “Football”, each one associated with the terms: matur* OR “biological matur*” OR you* OR growth OR “physical fitness” OR “physical performance” OR functional OR “athletic ability testing” OR anthropom* OR “talent selection” OR “talent identification” OR SSG OR “Small and conditioned Games” OR “systematic observation” OR “time-use analysis” OR “skill acquisition” OR “development pathways” OR “training session”.

In this review, the inclusion criteria for the papers were: 1) including male soccer players (U-12 to U-19); 2) including representative data in match analysis, anthropometrical analysis, maturation analysis, functional capacities, training session, small-sided and conditioned games and multidimensional studies and; 3) articles published in English. On the other hand, were excluded articles that: 1) includes adult players (category higher than U-19); 2) includes other modalities; 3) includes female players and; 4) conference abstracts and reviews.

After this step, two reviewers (EG and HS) independently selected citations and abstracts to identify potential studies, according to the inclusion criteria, to be included in this systematic review. After that, the same reviewers accessed complete articles to certify that studies met the inclusion criteria. Disagreements about whether the inclusion criteria were met were resolved through discussion with another expert (AF).

2.2. Quality of the studies

The methodological quality of the studies was performed according to the recommendation of Sarmento et al. (3) (see the supplementary table S1). In this sense, studies were analyzed to verify

the presence of the 16 followed items: purpose (item 1), the relevance of theoretical background (item 2), adequate experimental design (item 3), the inclusion of sample (items 4 and 5), use of an informed consent procedure (item 6), outcome measures (item 7 and 8), method description (item 9), the significance of results (item 10), analysis (item 11), practical importance (item 12), description of dropouts (item 13), conclusions (item 14), practical implications (item 15), and limitations (item 16). The results, per item, were: 1 (meets the criteria), 0 (doesn't meet the criteria), or NA (not applicable). Critical Review Forms versions used in this review are showed in the supplementary material (S1 and S2).

A final score expressed in percentage was calculated for each one study. This score was obtained through the followed formula: PF% = ∑PA / NTP (items), where ∑PA corresponds to the sum of all the articles scores, and NTP correspond to the total number of items scored. After that, studies were classified in: 1) low methodological quality (score ≤ 50%); 2) good methodological quality (score between 51% and 75%) and; 3) excellent methodological quality (score > 75%). A spread sheet in Excel® was adapted from Cochrane Consumers and Communication Review Group's data extraction template (2016) to be used in the paper inclusion and exclusion procedures. All the studies included in this review were developed respecting quality and clarity criteria. In this sense, the reproducibility assumption was respected.

3. RESULTS

3.1. Search, selection and inclusion of publications

The search criteria, selection, and inclusion of the papers are described in Figure 1. After finding 9070 studies, a selection and inclusion process was carried out. In the end, 131 studies were analyzed.

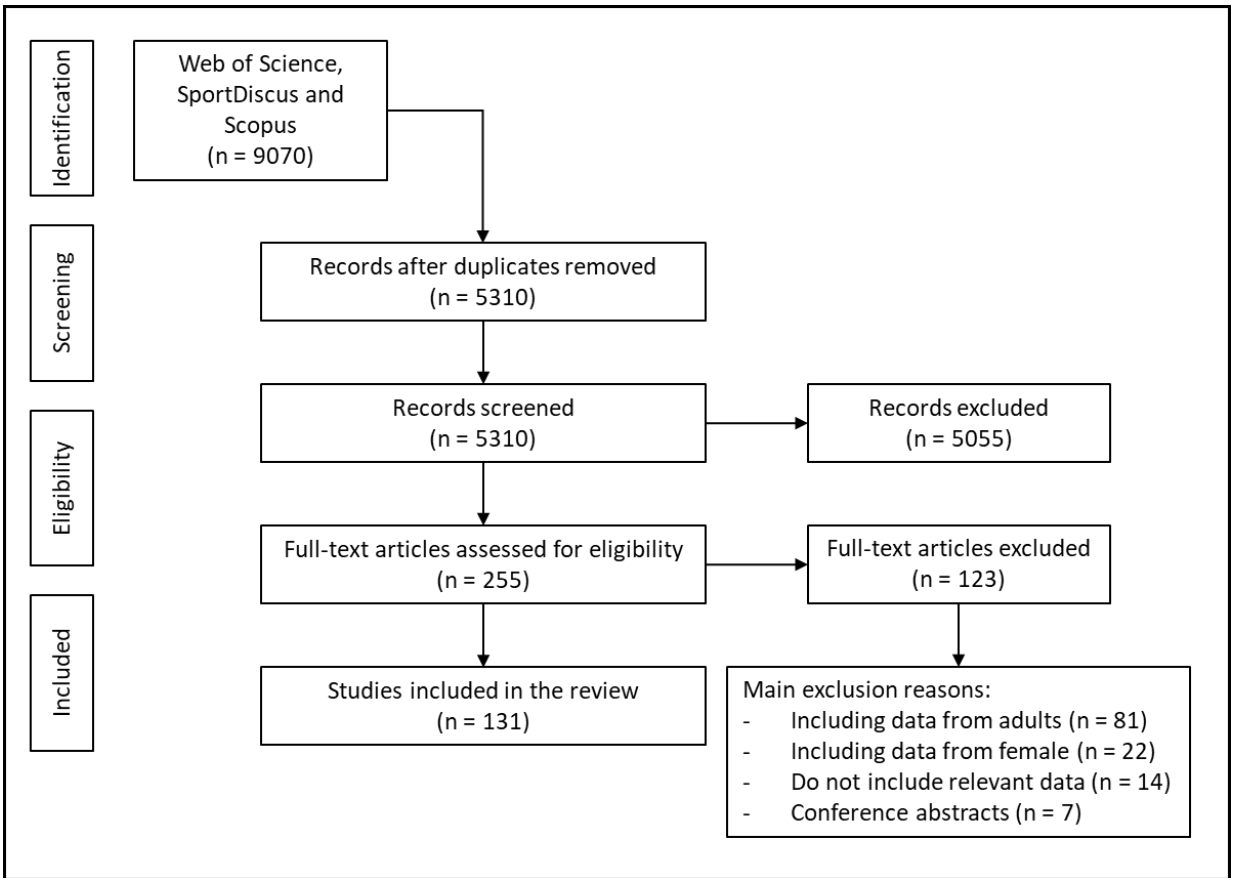

Figure 1: Preferred reporting items for systematic review flow diagram.

3.2. Data organization

The studies were put in different sessions regarding the independent variable and/or the most relevant topic in each one article (Figure 2).

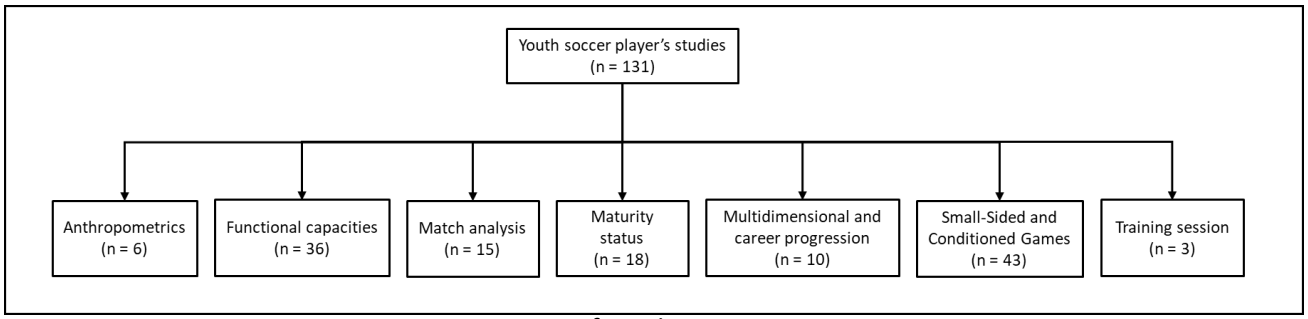

Figure 2: Organization of results session.

The tables presented in the results and discussion sessions will be included a description of the sample, study design, method and procedures, main variables, results, and score of the articles.

Anthropometrics

In 6 studies, the independent variable was the anthropometrical measures (Table 1). Mostly, anthropometrical measures were followed while a period, in a sense to understand how the increase in dimensionality gives players higher functional performances. In these articles, it was possible to verify that players besides presenting an increase in height and body mass, they also improved their aerobic capacity and velocity in sprints.

Table 1. Anthropometrics of young soccer player's studies: authors, sample, study design, main variables, results and quality score.

Study	Sample (number, category, nationality)	Study design	Anthropometric measures	Results	Quality score (%)
Deprez et al. (2015)	42 (11-16 years) from Belgian professional soccer clubs.	Two-year follow-up subsample (n = 21, assessed annually at the end of august). Four-year follow-up subsample (n = 21, assessed every second year, at the end of August.	Height, sitting height and body mass	Two-year follow-up subsample: 1) For stature and body mass at each test moment, high players were significant smaller and leaner compared with low and average players; 2) Similar increases in both stature and body mass in all performance groups. Four-year follow-up subsample: 1) For body mass, low players had a higher body mass compared with average players at the second and third test moment.	81,25
Mathisen and Pettersen (2015)	132 (10-16 years).	Cross-sectional study.	Height, body mass, and body mass index (BMI).	1) Body mass was significantly correlated with 10 m sprint in the 13–14-year-olds, and with 20 m and 10-20 m sprint in the 15–16-yearold group; 2) Height was significantly correlated to 10 m sprint, 20 m sprint, 10-20 m sprint, and agility performance in the 13-14year olds, and with 20 m sprint and 10-20 m sprint in the 15-16 year olds.	75,00
Portes et al. (2015)	296 (10-13 years) from a Brazilian club.	Cross-sectional study.	Height, body mass, body composition and somatotype, skinfolds, girths, thigh and calf, bone breadths, absolute adiposity, body composition, and somatotype.	*Anthropometry*: 1) Goalkeepers and defenders were significantly taller, heavier and exhibited more lean mass than midfielders and forwards, respectively; 2) Forwards exhibited lower values of adiposity (%Fat) than all the other athletes.	87,50
Hirose and Seki (2016)	37 (U-13 to U-17) from a Japanese club.	Two-year follow-up.	Body mass, height and sitting height.	1) All measurements improved significantly from initial values to the 2-year follow-up in both U-13 to U15 and U15 to U17; 2) In both U-13 to U-15 and U-15 to U-17, height and weight exhibited a correlation between initial and 2-year follow-up values.	87,50
Hernández-Camacho et al.	16 (U-19) from an amateur Spanish team.	Cross-sectional study.	Height, body mass, three diameters, six circumferences,	1) Somatotype classifications were goalkeepers (endo-mesomorph), defenders (meso-ectomorph), fullbacks	68,75

(2017)			perimeter, and eight skinfolds.	(meso-ectomorph), midfielders (balance mesomorph), strikers (balance mesomorph) and global player's sample (balance mesomorph).	
Lenjani et al. (2017)	132 (U-15) of the super league (n = 66) and amateur league (n = 66) of the Republic of Kosovo.	Longitudinal and transversal dimensionality of the skeleton, then the volume and mass of the body and subcutaneous fatty tissue.	Height, length of left leg, size of upper leg, body mass, BMI, knee joint diameter, skin fold.	Young soccer players who are competing in higher ranking competitions have lower values on the skinfolds on the back, triceps and belly.	50,00

Note: PHV = Peak of Height Velocity, APHV = Age at the Peak of Height Velocity, YYIR1 = Yo-Yo Intermittent Recovery Test level 1, BMI = Body mass index.

Functional capacities

The player's functional capacities are still of major predominance interest for soccer scientists, probably because of the interest from the soccer clubs (Table 2). In some cases, it was possible to verify the analysis of too many variables, putting together acceleration, velocity, agility, aerobic and anaerobic, and lower limb power analysis. To this end, it was used more frequently the 5, 10, 30 and 40 m sprint test, Zig-Zag test (16), Yo-Yo variations, Krustrup, Mohr (17) and Bangsbo, Iaia (18), Repeated Sprint Ability test (RSA, Rampinini, Bishop (19)), Repeated Shuttle Sprint Ability test (RSSA, Impellizzeri, Rampinini (20)) and Countermovement and Squat jump tests.

Table 2. Functional capacities of young soccer player's studies: authors, sample, procedures, main variables, results and quality score.

Study	Sample (number, category, nationality)	Study design	Functional capacities	Main variables	Results	Quality score (%)
Al Haddad et al. (2015)	180 (U-13: n = 35, U-14: n = 44, U-15: n = 40, U-16: n = 37, and U-17: n = 24) from the ASPIRE academy.	Over a period of three years: match analysis (2 halves of 35 to 45 minutes each. Time motion analysis were recorded using a 1Hz GPS) and maximal sprinting assessment.	Maximal sprinting speed: 40 m.	Peak match speed and Maximal sprinting speed.	Maximal sprinting speed was clearly greater in the older players than the younger players (i.e., U-13 almost certainly < U14 almost certainly < U15 almost certainly < U16 almost certainly < U17).	87,50
Brocherie et al. (2015)	16 (U-18).	A double-blinded, placebo controlled field study.	Lower-limb explosive power (CMJ), linear sprint (10m, 20m, 30m, 40m), Repeated-Sprint Ability (RSA) and repeated-agility (RA), Incremental field running test to estimate maximal aerobic speed (MAS).	Run based in repeated sprints in hypoxia (RSH) vs. repeated sprints normoxia (RSN), soccer specific training, physical fitness parameters.	1) From Pre- to Post- training, the lower-limb explosive power improved to a similar extent in both groups; 2) sprinting performances increased significantly after 5 weeks of training compared with baseline; 3) Repeated-agility performance-related parameters improved.	93,75
Campos-Vazquez et al. (2015)	21 (U-19) from a Spanish club.	Quasi-experimental design in which participants were assigned to 2 experimental groups by balanced randomization according to the average time obtained in the RSA test.	Lower-limb explosive power (CMJ), RSA, YYIRT1, Mean Velocity in Full Squat (FS).	Distance covered in YYIRT1, RSA performance, height achieved in CMJ, average velocity in FS, sum of 6 skinfolds and body mass.	1) In the Squat Group (SG), significant improvements were obtained for the following variables: CMJ, and FS; 2) In the Take-off Group (TG), significant improvements were obtained in the FS.	81,25
Franco-Márquez et al. (2015)	40 (U-15).	Quasi-experimental design (before (Pre) and after (Post) the 6-week experimental period).	20 m all-out running sprints, CMJ and FS exercise.	Anthropometrics: height, body mass and the body mass index (BMI). Maturity status: peak height velocity (PHV, Maturity Offset) and percentage of predicted adult stature (PAS, Khamis-Roche method).	1) Training resulted in a significant improvement in T10-20, T20 and CMJ, and a trend toward a significant improvement in T10 for Strength Training Group.	87,50

Gil-Rey et al. (2015)	28 (U-19: elite (n = 14) and non-elite (n = 14)) from a Spanish club.	Quasi-experimental design (before (Pre) and after (Post) the 9-week experimental period).	Lower-limb explosive power (CMJ), CMJ arm swing, 5 m and 15 m sprints.	Exhaustion time, CMJ, CMJ arm swing, sprint velocity.	In relation to intra-group differences in physical performance, likely substantial changes were found twice: small practical improvement in the Université de Montreal test for the elite team and a moderate practical impairment in the 15 m sprint performance for non-elite team.	87,50
Haugen et al. (2015)	45 (U-18) from four clubs in Norway.	Randomized controlled trial: Control group (CON), weekly repeated-sprint training session (a) 100% intensity without supervision (100UNSUP), b) 90% of maximal sprint speed with supervision (90SUP) or c) 90% of maximal sprint speed without supervision (90UNSUP). Intervention period was 7 weeks.	15 x 20 m repeated-sprint, CMJ, YYIR1, heart rate, blood lactate concentration, step length and step rate.	Group intervention, physical performance, heart rate, blood lactate, step length and step rate.	1) At 90% velocity was accompanied with reduced HR_{peak}, BLA and SR compared to maximal sprinting; 2) It was found a development of repeated-sprint performance (mean sprint time) for 100UNSUP during the intervention period, including pre- and post-training tests.	93,75
Keiner et al. (2015)	40 (U-15, U-17 and U-19) from Germany clubs.	Cross-Sectional study.	Maximal isometric trunk strength lumbar/thoracic extension (EXT) and lumbar/ thoracic flexion (FLEX), SJ, CMJ and the 30 m sprint.	Trunk strength, lower limb strength and Sprint performance.	The data from this study showed small, non-significant correlations between the trunk muscles' strength and their performance in the sprint.	81,25

Köklü et al. (2015)	15 (U-17) from a Turkish club.	Cross-Sectional study.	SJ, CMJ, 10 m and 30 m sprints and Agility test (Zig-Zag test, with and without the ball).	Speed, Agility and Jump performance.	1) Moderate to strong correlations between 10 m sprint times and 30 m sprint times; 2) 30 m sprint times showed moderate to strong correlations with both CMJ performance and with Zig-Zag without the ball; 3) Strong correlation between CMJ and SJ and between CMJ and Zig-Zag without the ball. SJ performance had a strong correlation with Zig-Zag performance without the ball.	68,75
López-Segovia et al. (2015)	21 (U-19) from a Spanish club.	Cross-Sectional study.	30 m linear sprint, 40 m (2 x 20 m) shuttle sprints, CMJ, maximal kicking, 9 repeated-explosive effort sequences (RSA), a progressive isoinertial loading test in full squat and YYIR1.	$RSA_{mean1-9}$, RSA_{best}, $Sdec_{RSA1-9}$, CMJ_{best}, CMJ_{mean}, $Kick_{best}$, $Kick_{mean}$, YYIRT1, V_1load, Lactate9.	1) RSA_{best} showed correlation with jump height and sprint capacity; 2) YYIR1 correlated with $RSA_{mean1-9}$ when the body weight was controlled.	87,50
Malone et al. (2015)	9 (U-18) from an elite academy.	Quasi-experimental design (before (Pre) and after (Post) the 1-week experimental period).	CMJ, Training load was quantified using global positioning systems (GPS), heart rate (HR), and rating of perceived exertion (RPE).	CMJ performance, training load variables (duration, total distance, average speed, high-speed distance, HR_{max} and RPE.	1) There was no significant difference between pre-jump and post-jump height values related to the distance of the match day.	87,50
Malý et al. (2015)	62 (U-16: n = 26, U-17: n = 17, U-19: n = 19) from a Czech Republic club.	Cross-Sectional study.	Performance in sprints for 5 m (S5), 10 m (S10) and a flying sprint for 20 m (F20) after a 30 m run-up, Counter Movement Jump with Free Arms (CMJFA) and CMJ.	Acceleration speed, maximum running speed and lower limb power.	1) The test of between groups effect (regarding the age) revealed significant differences in S5, S10 and F20 running speed test; 2) In F20 test, it was found a significant difference between players of U-16 and U-19.	75,00

Dragijsky et al. (2016)	59 (U-16: n = 26, U-17: n = 14, U-19: n = 19) from the highest Czech leagues.	Cross-Sectional study.	Acceleration speed: 5 m and 10 m.	Running time in 5m and 10 m.	1) The older players (U-19) achieved better performance (5 m and 10 m) in comparison with both U-17 and U-16 category.	68,75
Hammami et al. (2016)	28 (U-16).	Randomized controlled trial with two groups (8 weeks): Experimental (Plyometric training) and Control (Regular soccer activities).	Repeated sprinting 4 x 5m (S 4 x 5m) and sprinting over a 40 m distance with timers set at 5m, 10m, 20m 30 and 40m, sprinting 9-3-6-3-9 m with 180° turns (S 180°), followed by repeated change-of-direction test (RCOD), Sprint 9-3-6-3-9 m with backward and forward running (SBF), RSSA.	Anthropometrical measures, sprint speed, agility, repeated shuttle sprint ability and repeated changes of direction scores.	1) The control group did not show any significant differences in anthropometric measures, sprint, agility, RSSA, RCOD or over the 8-week trial; 2) Plyometric training program induced significant increases in sprint times for the experimental group over distances of 5 m, 10 m and 20 m.	81,25
Makhlouf et al. (2016)	57 (U-15) from a Tunisian soccer club.	Short-term (12 weeks) randomized-parallel fully controlled with pre-to-post measurements: Control group (n=14, only soccer training), strength before (SE, n=15) or after (ES, n=14) endurance training (intra-session), strength and endurance training on alternate days (ASE, n=14).	YYIR1, a progressive maximal field-test, squat and bench-press (1RM), CMJ, SJ and the 5-jump test for distance, medicine-ball throw for distance (3 kg), 10 and 30 m sprints, 15 m run with and with-out the ball.	Endurance performance, Maximal strength, Lower-limbs explosiveness, Upper-limb explosiveness assessment, Sprinting performance, Change of direction abilities.	1) The CG showed significant pre-to-post changes in the YYIR1, 30 m, agility 15 m and squat.	81,25
Marques et al. (2016)	167 (U-14: n = 57, U-16: n = 58, U-18: n = 52) from Portuguese national level.	Quasi-experimental design (before (Pre) and after (Post) the experimental period).	CMJ, overhead medicine ball throw (5kg), 30 m sprint and kicking ball velocity.	Anthropometrical measures, physical performance and tactical position.	1) Significant differences were found among playing positions for CMJ, throwing distance, and 20 m, and 30 m sprint times. 2) U-14 players had lower results in CMJ, kicking velocity, throwing distance, and 20 and 30 m sprint times than the other two age groups.	68,75

Negra et al. (2016)	24 (U-13).	Randomized controlled trial with two groups: Control and Experimental.	1RM of half squat, SJ and CMJ, Multiple 5 bounds test, Standing long jump test, Linear sprint test: 5 m, 10 m, 20 m, and 30 m, Change of direction tests: 1) Illinois change of direction test (ICODT) and 2) T-Test.	Chronological age, height, body mass, stages of puberty development by Tanner, age at PHV, soccer experience and physical performance.	1) A significant main effect of test was found for both, the CMJ and the SJ; 2) Significant main effect of test for all sprint intervals (0-5m, 0-10m, 0-20m and 0-30m sprint); 3) Significant main effects of test were found for the ICODT and the T-test.	93,75
Nikolaidis et al. (2016)	36 (U-14).	Quasi-experimental design (before (Pre) and after (Post) the experimental period).	CMJ and 20 m acceleration.	Anthropometric characteristics, lower limb strength and acceleration.	Compared to the baseline values, an increase of body mass, height, FFM and CMJ and a decrease in BF were observed in the total sample.	75,00
Peñailillo et al. (2016)	63 (U-14) from a professional club of the Chilean First Division.	Cross-Sectional study.	5 m acceleration, 15 and 20 m sprint, agility (Zig-Zag test), leg extension one-repetition maximum (1RM).	Knee extension maximum muscle strength, running speed over 5, 15 and 20 m and agility.	1) Moderate to very high correlations between maximum muscle strength and 5 m, 15 m and 20 m sprint time; 2) Age and time very highly correlated with 15 and 20 m sprint time. Also, moderate correlations between age and 5 m sprint time and agility.	81,25
Selmi et al. (2016)	24 (U-17) from a Tunisian club.	Cross-Sectional study.	3 repeated sprint sets (RSS) protocols consisting of two sets of 5 x 20 m sprints, with 15 s of active recovery between repetitions and with either 1-min (RSS1), 2-min (RSS2), or 4-min (RSS4) recovery periods between sets.	Physiological responses (HR and BL), RPE, performance indices of repeated sprint sets (RSS) and aerobic power.	1) The mean HR increased significantly with the decrease of recovery durations between sets; 2) No significant correlations were found between all RSS performance indices of the three protocols and maximal aerobic power.	75,00

Spineti et al. (2016)	22 (U-19) from a Brazilian club of the first division.	Randomized experimental design (8 weeks) with two groups: Traditional Strength Training (TST) and Complex Contrast Training (CCT).	Muscle architecture, one repetition maximum in squat in the Smith machine (1RM), CMJ, and RSSA.	Training types (Traditional Strength Training (TST) and Complex Contrast Training (CCT)), muscle architecture, lower limb strength (squat and CMJ) and RSSA scores.	1) For CCT, the $\%RSSA_{dec}$ was significantly reduced, and there was a trend of reducing the RSSA mean time in the CCT group in comparison between pre and post-training period; 2) Only the CCT group showed a significant increase in the CMJ after the training period.	81,25
Abade et al. (2017)	22 (U-19) from a Portuguese club.	Crossover controlled study.	CMJ and Abalakov jump (AJ) and 10 m and 20 m sprints were tested immediately after warm up and 12 minutes after warm up.	Warm up types, vertical jump performance and sprint performance.	Results showed that repeated changes of direction and plyometrics presented beneficial effects to jump and sprint.	87,50
Alonso et al. (2017)	31 (U-15 and U-17) from a Brazilian club.	Cross-Sectional study.	10 m and 30 m sprints and YYIR2.	Anthropometrical measures, maturational status, distance traveled in the matches (total distances, high and moderate velocity intensities), sprint performance, YYIR2 performance.	1) Moderate correlations (YYIR2 x MI and YYIR2 x AI, VEL30 x AI, VEL 10 x MI and between VEL 10 x AI); 2) Strong correlation (VEL30 x MI, VEL 10 x YYIR2, VEL30 x YYIR2, DIST. Total x MI, DIST. Total x AI, DIST. Total x YYIR2); 3) High correlation (VEL30 x YYIR2).	81,25

Chtara et al. (2017)	42 (U-13) from a Tunisian club.	Randomized controlled trial with four groups (6 weeks): Control group (n = 10), plyometric group (PLYO, n = 10), agility group (AG, n = 10), or repeated sprint (RS, n = 12) training group.	Power lower limbs (bilateral standing horizontal jumps, and unilateral horizontal jumps), 30 m sprint, 20 m zig-zag, and RSA.	Anthropometrics, maturity status, soccer experience, training types, power, and running speed, agility and repeated sprint ability.	1) Post-training the PLYO > AG and RS groups. Both latter groups > CON group; 2) Improvements in overall sprint time and acceleration in the RS group compared to the PLYO, AG and CON groups; 3) Increases in 20 m zig-zag in AG and RS training compared with the PLYO and CON training; 4) The RS group achieved greater improvements in RSA_{best} and $RSA_{meantime}$ than PLYO and AG groups.	81,25
Cunha et al. (2017)	46 (U-13 to U-18) from a Brazilian club.	Cross-Sectional study.	SJ, CMJ, 10 m and 30 m sprint.	Anthropometrics, maturational status, power (SJ and CMJ), sprint performance.	1) The post-pubertal group was older, more experienced in competitive soccer, taller, and heavier when compared with the pre-pubertal and pubertal groups; 2) For all physical performance outputs, the gradient was pre-pubertal < pubertal < post-pubertal.	75,00
Di Giminiani et al. (2017)	19 (U-13) from Italian clubs.	Single-group study over two years.	SJ, CMJ, pre-stretch augmentation (CMJ-SJ), leg stiffness hopping test (HT), short sprint performance 15 m (SSP15) and 30 m (SSP30), aerobic endurance (test of Leger, VO2max), maximal heart rate, and speed-strength endurance (continuous counter-movement-jumps, CCMJ).	Explosive strength, pre-stretch augmentation, leg stiffness, sprint performances (15m and 30m), aerobic endurance, maximal HR and speed-strength endurance.	1) The aerobic performance improved in young elite soccer players from thirteen to fifteen years old determining a significant main effect on the $VO2_{max}$; 2) Increase for both SJ and CMJ; 3) Sprint time decreased on both SSP15 and SSP30.	81,25

Fiorilli et al. (2017)	186 (U-12: n = 39, U-14: n = 42, U-16: n = 70, U-18: n = 35).	Cross-Sectional study.	Change of Direction Speed (CODS) by Illinois Change of Direction Test and Reactive Agility (RA) by Y-Agility Test.	Age category and agility.	Differences among the groups of different-age players were expected: U18 reached a lower time for test execution.	81,25
Hammami et al. (2017)	44 (U-17).	Randomized controlled trial with three groups (8 weeks): Control (standard in-season regimen, n = 12), Strength Training (ST, n = 16), Contrast Strength Training (CST, n = 16).	40 m sprint, 4 x 5 m sprint (S4 x 5), 9-3-6-3-9 m sprint with 180º turns (S180º), 9-3-6-3-9 m sprint with backward and forward running (SBF), RSSA, repeated change of direction (RCOD), SJ and CMJ.	Training type, running velocity, agility, vertical jump performance, lower-limb muscle volume.	1) The strength training group (ST) and the CST group (CSG) increased significantly in S180º, SBF, and S4 x 5 relative to CG, although the S4 x 5 also increased in CSG relative to SG; 2) The RCOD parameters increased in CST relative to both ST and CG.	81,25
Hernández-Camacho et al. (2017)	17 (U-19) from a Spanish amateur club.	Double-blind placebo-controlled randomized experimental.	CMJ (in the beginning and after training session), caffeine ingestion, RPE.	CMJ performance.	Jump height was significantly improved between soccer players that ingested caffeine supplement.	81,25
Iaia et al. (2017)	19 (U-19).	Parallel two-group experimental (5 weeks): Control group (n = 10), short- (5-15; n = 9), long- (5-30; n = 10) rest interval-based (RST) group.	20 m and 200 m sprint, YYIR2, RSA, an aerobic submaximal fitness test.	Training types, physical performance.	5-30 improved the 20 m sprint time. In 5-15, 200 m sprint and YYIR2 test performance improved. Both 5-15 and 5-30 induced improvements in RSA_t and $RSAS_{dec}$ following the intervention.	87,50
Kobal et al. (2017)	23 (U-17).	Parallel two-group, longitudinal: loaded vertical and horizontal jumps (LJ, n = 12) and unloaded vertical and horizontal plyometrics (UJ, n = 11).	5 m, 10 m, and 20 m sprints, mean propulsive power (MPP) relative to the players' BM in the JS exercise, and performance in the SJ and CMJ were assessed pre- and post-training period.	Loaded and unloaded plyometric training strategies, speed and power performance.	1) An increase in the vertical jumps was observed for the LJ group. In the UJ group an increase was observed for both vertical jumps; 2) A decrease in the sprinting velocities along the 20 m course was found in the LJ group.	87,50

Otero-Esquina et al. (2017)	36 (U-17 to U-19) from a professional Spanish club.	Controlled non-randomised study with three groups (EXP1, n = 12; EXP2, n = 12 and Control, n = 12).	CMJ, 10 m and 20 m linear sprint, and a change of direction test (V-cut test).	Training types, lower limb power, sprint time and agility.	Within-group analysis: improvements in CMJ variables and COD in EXP1 and EXP2; 2) Between-group analysis: greater improvements in CMJ variables in experimental groups in comparison to CON; 3) EXP2 achieved a better performance in 20 m than EXP1 and CON.	81,25
Perroni et al. (2017)	112 (U-13 to U-19) from an Italian club.	Cross-Sectional study.	CMJ.	Maturity status, chronological age, anthropometry and countermovement jump performance.	1) U-15: large correlations (chronological age and CMJ, FFM, and PDS; FFM x PDS; %BF x BMI); 2) U-17: moderate correlations (chronological age x FFM and BMI), very large correlations (FFM x BMI); 3) U-19: small correlation (BMI x FFM and %BF).	81,25
Rodríguez-Rosell et al. (2017)	86 (U-13: n = 30, U-15: n = 28 and U17: n = 28).	Randomized controlled trial with two groups (6 weeks): Control group (CG, n = 43), Strength Training group (STG, n = 43).	20 m all-out running sprints, CMJ, and a progressive isoinertial loading test in a FS exercise.	Training type, chronological age, lower limb muscle strength, jumping ability, and sprint performance.	The training period resulted in significant improvements in all measured variables for STG groups.	93,75
Beato et al. (2018)	19 (U-18) from an elite academy at Switzerland.	Randomized pre-post parallel group trial (6 weeks): Change of direction and Jump group (CODJ-G, n = 11) and Change of direction group (COD-G, n = 10 participants).	Long jump test, Triple hop distance test (triple hop test), Sprint 10, 30, and 40 m and 505 Change of Direction (COD).	Explosive strength abilities of the leg muscles, rebounding jump ability, short-sprint ability, change of direction ability.	1) Exercise-induced changes in performance for both COD group and CODJ group after 6 weeks of training; 2) CODJ group reported substantially better results in long jump test than in COD group.	93,75

Dokumaci et al. (2018)	20 (U-17).	Cross-Sectional study.	RAS, 200 m sprint performance test, YYIR2.	Age, anthropometrical measures, oxidative stress indices, aerobic and anaerobic capacity.	1) Total antioxidant status (TAS) level was significantly correlated with the YYIR2 distance and $VO2_{max}$ performance values; 2) Oxidative stress index (OSI) was significantly correlated with the Total oxidant status (TOS) level in U17 soccer players.	75,00
Trecroci et al. (2018)	44 (U15, elite: n = 22, sub-elite: n = 22) from two Italian teams.	Cross-Sectional study.	YYIR1, 10 m sprint, CMJ, modified Illinois agility test (MICODT) and T-drill with a ball.	Group factor (elite and sub-elite), age, anthropometry and fitness status, acceleration, vertical jump and change of direction speed.	1) Both elite and sub-elite groups of players presented non-significant differences in mean age, body height and mass; 2) Elite players were superior in the YYIR1; 3) a significant difference was found between groups for 10 m sprint and CMJ performance.	81,25

Note: AJ = Abalakov jump; CMJ = Counter Movement Jump; SJ = Squat Jump; FS = Full Squat; YYIR1 = Yo-Yo Intermittent Recovery Test level 1; YYIR2 = Yo-Yo Intermittent Recovery level 2; RSA = Repeated-Sprint Ability; GPS = global positioning systems; RPE = rating of perceived exertion; RSSA = Repeated-shuttle-sprint Ability test; COD = Change of Direction.

Match analysis

Fifteen articles related to match analysis were analyzed (Table 3). In all of them, official, friendly or competitive matches, were observed and analyzed — a considerable part of the match analysis studies used social networks as a tactical performance measure. Player's activities during the matches were also analyzed, especially regarding the covered distances in high velocity, the covered distances from players of different positions and functions, and the heart rate from players during sprints.

Table 3. Match analysis of young soccer player's studies: authors, sample, study design, main variables, results and quality score.

Study	Sample (number, category, nationality)	Study design	Instruments / Procedures	Main variables	Results	Quality score (%)
Arruda et al. (2015)	10 (U-15) from a Brazilian academy.	Cross-Sectional.	Five matches were played over 3 successive days. 1th and 2sd matches: 25 x 25 min, 10 min interval, 3rd and 4th: 25 x 25 min, 10 min interval, and 5th: 30 x 30 min, 15 min interval.	Match activities (total distance covered, total distance per minute, total distance in high-intensity running, number of high-intensity runs, high intensity run per minute, frequency of accelerations, accelerations per minute, body-load impacts, body-load impacts per minute).	The only significant differences observed between matches were for the frequency of accelerations per minute, body-load impacts, and body-load impacts per minute.	93,75
Buchheit et al. (2015)	7 (Australian U-17 National team) and 6 (Bolivian U-18 team).	Cross-Sectional.	Both teams played two matches at sea level and then three matches at 3600 m, on Days 1, 6 and 13 at altitude; 10 Hz GPS.	80% of velocity in Yo-YoIR1 and Distance covered at speeds greater than 14.4 $km.h^{-1}$	Bolivians performed moderately better at altitude, and ran largely-to-moderately more than their Australians counterparts; Distance > 80% vYo-YoIR1 was moderately greater in Bolivians at sea-level and during the first altitude game; There was a greater decrement in both vYo-YoIR1 and Distance>14.4 $km{\cdot}h^{-1}$ in Australians compared with Bolivians.	56,25
Atan et al. (2016)	85 (U-13, n = 28; U-14, n = 27; U-15, n = 15) from Auckland Soccer Federation.	Cross-Sectional.	Players were analyzed in two competitive matches; 15Hz GPS.	Match heart rate, match running performances, sprint performance.	*Match HR*: The peak HR U-15 > U-13 and U-14. *Total Distance in Absolute Value (m)*: Absolute total distance U-15 > U-14 and U-13. The U-13 players' HIR distance was higher compared with U-15.	87,50
Clemente et al. (2016)	22 (U-14) from two amateur Portuguese teams.	Cross-Sectional.	Social network analysis in 5 competitive matches.	Degree centralization, Degree prestige or in-degree centrality and betweenness centrality.	*Correlation analysis*: A positive and moderate correlation was found between dribbling test and betweenness centrality, and a negative moderate correlation was found between %fatigue index and betweenness centrality.	75,00

Fernandes-da-Silva et al. (2016)	33 (U-16).	Cross-Sectional.	Time-motion analysis in 2 friendly 11-a-side matches and one 7-a-side match; 10Hz GPS.	Match activities (standing - ST, walking - W, jogging - J, medium-intensity running - MIR, high-intensity running - HIR, sprinting - SPR, high-intensity activity - HIA: HIR + SPR).	*Comparison analysis*: i) Players in the High group had higher mean values for TD covered and HIR compared to players classified in the Low group; ii) Players in the High group covered, on average, 42% and 23–31% more distance at sprinting and HIA, respectively, than those players classified as having Intermediate and Low performance on the T-CAR;	81,25
Mikulic et al. (2016)	24 (U-17) teams competing in group phase of 2015 World Soccer Championship in Chile.	Cross-Sectional.	Data about situational efficacy parameters of teams competing in group phase of 2015 U-17 World soccer championship in Chile were downloaded from FIFA's official website.	Ball possession, goal kicks, kicks inside the frame, kicks outside the frame, corner, free kicks, offside, fouls, yellow cards, red cards, goals scored, goals received.	Difference between teams that passed the group phase and did not passed: i) ball possession, ii) number of goals scored and iii) number of goals received in a match.	46,67
Oliveira et al. (2016)	70 (U-12) from six teams.	Cross-Sectional.	Social network analysis in competitive matches.	Indegree centrality, Outdegree centrality and Betweenness centrality.	i) the two-way MANOVA revealed that players' positions had significant main effects on network centrality measures; ii) With ANOVA, significant differences were found between positions in IDC, ODC, and BC variables.	75,00
Ortega et al. (2016)	22 (U-19) from two Spanish clubs.	Cross-Sectional.	Technical Performance with TSAP and Social Network analysis in one experimental match.	*Technical analysis*: Volume of play, Attacks with Ball and Efficiency index. *Social network analysis*: Indegree centrality, Outdegree centrality and Betweenness centrality.	*Heart rate analysis*: The two-way MANOVA revealed that the tactical position had significant main effects on the technical performance. No statistical differences were found between halves. *Technical performance analysis*: The two-way MANOVA revealed that the tactical position had significant main effects on the technical performance. *Network analysis*: The two-way MANOVA revealed that the tactical position had significant main effects on the tactical prominence.	56,25

Bravo-Sanchez et al. (2017)	154 (U-12) from the Royal Spanish Soccer Federation.	Cross-Sectional.	Match running performance; 15Hz GPS.	Match activity and technical analysis.	*Match activity*: 1) High-intensity distance was higher in the 7-a-side than the 8-a-side game modality; 2) The 7-a-side game modality also showed greater very high intensity distance, sprint distance, total distance covered and W/R than the 8-a-side game modality.	75,00
Brito et al. (2017)	66 (U-14) from 3 Portuguese teams.	Cross-Sectional.	9 matches were performed and analyzed (three soccer matches per surface condition at each week); 10Hz GPS.	Match activity and technical analysis.	Match activities: 1) TD covered on artificial turf > natural turf. Also, there was a trend to the players to cover a greater distance in LIR and VHIR categories on the artificial turf compared to natural turf, 2) Central midfielders presented the greatest TD.	68,75
Caballero et al. (2017)	132 (U-18) matches from Spanish regional league.	Cross-Sectional.	Match analysis.	Score difference, Final team standings from 1 to 12, Game location, Scoring first, Cards, Substitutions, Rival team quality and Field surface.	1) The home teams, when they win, score the first goal on the 79.4% of the times, they make more substitutions and receive less cards than the opposite team, 2) If the away teams score the first goal, they win 63.3% of their games, they do more substitutions when they loss or tie, and get less cards, 3) Scoring first, game location and number of substitutions are significant variables with positive values.	60,00

Gonçalves et al. (2017)	44 (U-15, n = 22; U-17, n = 22) from elite Portuguese teams.	Cross-Sectional.	Match analysis: two matches (U-15 and U-17, 50 min with 10 min of recovery); 5Hz GPS.	*Match analysis performance*: Number of successful passes, Number of shots, Teams' efficacy (efficacy = number of goals * 100 / number of shots). *Network analysis*: Closeness centrality, Betweenness centrality, Positioning relations.	*U-15 results*: 1) U15 team with lower performance (team B), the defence central midfielder (DCM) presented higher importance in the network regarding both the closeness and the betweenness measures. *U-17 results*: 1) The lateral central midfielder (LCM) of the lower performance team in U17 presented higher importance in the network regarding both the closeness and the betweenness measures.	75,00
Iacono et al. (2017)	24 (U-19).	Fully controlled observational design with pre-post condition assessments.	Observational design with pre-post condition assessments. During official matches were compared with those induced by the experimental game-profile-based training (GPBT) format in elite soccer players; 15 Hz GPS.	Relative distance covered (RDC), Relative high speed distance (HSD), High intensity efforts (HIE), PowerZ1-5: metabolic power in Zones 1 to 5, HR, BLA, RPE.	1) Between-groups differences were found in all the time-motion variables, 2) Post-GPBT RPE was significantly higher than post-NL and post-UYL matches, 3) Time and group effects were detected in both SJ and CMJ performance values.	81,25
Sevil-Serrano et al. (2017)	186 (U-10, n = 8; U-12, n = 7; U-14, n = 11; U-16, n = 11; and U-19, n = 11) from a Spanish club.	Cross-Sectional.	Analysis of decision making of soccer players by the GPET observation instrument. For this purpose, two matches for each team were recorded.	Total of decisions and the success of decision making.	1) The U-19 group presented the highest values for the pass action, with the U-10 group presenting the lowest percentage, 2) For the dribbling action the U-19 group showed the highest percentage of suitable decisions, 3) For shooting at goal, the U-12 players made the best decisions, and were significantly better than the U-14 and U-16 groups.	81,25

Figueira et al. (2018)	44 (U-15 and U-17) from an elite Portuguese team.	Cross-Sectional.	Three games were performed: 1) U-15 *vs*. U-15, 2) U-17 *vs*. U-17 and 3) U-15 mixed with U-17 *vs*. U-15 mixed with U-17. All games respected the official soccer rules and were played on an official size natural turf pitch (105 x 70 m); 5 Hz GPS.	1) *Match activities*: total distance covered, distance covered at different movement speed categories, distance between players (DBP), 2) *Positional variables*: variability in the distance between players (CV), regularity in the distance between players (ApEn), frequency of near-in-phase synchronization in longitudinal and lateral displacements, spatial exploration index (SEI).	*U15*: 1) An increase in the distance covered while sprinting was also found in games against mixed opposition in the 1st half, 2) ApEn showed a decrease during the 2nd half when compared to the mixed scenario, 3) lateral displacements presented higher values when playing with players of the same age group in both halves; *U17*: 1) ApEn values were likely higher in the mixed condition, in both halves, showing less regularity in the distance between players, 2) In the 1th half, players presented higher values when playing mixed with the different age group, 5) lateral displacements analysis showed higher results when playing mixed with the different age group in both halves.	81,25

Note: HR = Heart rate, DC = Distance covered, TDC = Total distance covered, BLA = Blood lactate, RPE = Rating of perceived exertion.

Maturity status

Among the analyzed studies, 55.5% performed the Maturity Offset protocol (21) to classify the maturity status of the players. The sexual observation method from Tanner (22) and the skeletal age assessment methods (TW2 from Tanner, Whitehouse (23), Fels method from Roche, Chumlea (24), and TW3 from Tanner, Healy (25)) were also used to do the maturational analysis in the articles that were part of this review (Table 4).

Table 4. Maturity of young soccer player's studies: authors, sample, study design, maturity assessment, main variables, results and quality score.

Study	Sample	Study design	Maturity assessment method	Main variables	Results	Quality score (%)
Bidaurrazaga-Letona et al. (2015)	55 (U-14: 12.61 ± 0.6 years) from Athletic Club Bilbao.	Cross-Sectional study.	PHV with Maturity Offset, Mirwald et al. (2002).	Velocity, agility, hand grip, CMJ, and YYIR1 performances, CA, MS, skinfolds and height.	1) CA accounted for 29% of the variance in the velocity test whereas CA and sum of skinfolds explained 33%, 41%, 28% and 58% of the variance in the agility test, the YYIR1, the CMJ and the SCORE, respectively, 2) Height contributed to the 50% of the variance in the handgrip test and three variables contribute to 60% of the variance in the HG: CA, height and sum of skinfolds.	81,25
Teixeira et al. (2015)	92 (U-12, n = 15; U-14, n = 54 and U-16, n = 23) from a Brazilian club.	Cross-Sectional study.	SA with Posterior-anterior X-rays of the left hand-wrist, Fels (1988).	CA, MS or SA, stature, body mass, peak velocity, and fat mass, FFM.	1) For the sample as a whole, 12 players were delayed, 44 players were on time, and 36 players were advanced in SA relative to CA, 2) All variables differed significantly across age groups except estimated FM, 3) Within the U-14 group, players advanced in skeletal maturation were significantly heavier and taller than average (on time) and late maturing players.	87,50
van der Sluis et al. (2015)	26 (U-13) from a Dutch club.	Mixed-Longitudinal study.	PHV with Maturity Offset, Mirwald (2002).	Age, match hours, training hours, PHV, traumatic and overuse injury incidence.	1) The mean age at PHV was 14.04 ± 0.65 years for the whole group, 2) 178 injuries were recorded among the 26 players, 67 in the group of players maturing at a younger age (PHV < 13.92) and 111 in the group of players maturing at an older age (PHV ≥ 13.92).	75,00
Cunha et al. (2016)	79 (U-14, U-17 and U-18) from a Brazilian club.	Cross-Sectional study.	MS with Tanner (1962).	Group (prepubertal, pubertal and postpubertal), aerobic fitness, RCP, VT and body size descriptors.	1) Regarding height and weight: prepubescent < pubescent < postpubescent; 2) The effects of biological maturation on VO2peak, RCP, and VT values after appropriate normalization relative to LLMV: prepubescent < pubescent < postpubescent.	75,00
Cunha et al. (2016b)	201 (11-19 years old) from a Brazilian club.	Cross-Sectional study.	MS with Tanner (1962).	MS, CA, playing position, physical and physiological parameters.	1) Regarding height and weight: prepubescent < pubescent < postpubescent, 2) Chronological age showed medium positive effect relatively to body mass values of VO2peak, VT2 and VT1, 3) large positive effects of biological maturation status and chronological age on MAS and VT2speed were observed.	81,25

Gouvea et al. (2016)	60 (U-14, n = 28; U-17, n = 32) from a Brazilian club.	Cross-Sectional study.	SA with Greulich-Pyle method (1959).	CA, SA, body mass, height, BMI, Fat mass, YYIE1, HG, SJ, CMJ, SR-t, SIT, STS.	1) U-17 category athletes presented superior results in all analyzed tests, except the SR test, 2) In U-14 (YYIE1) the on-time athletes outperforming the early, 3) In the U-17 category, the late maturers presented lower body mass and height values than the other athletes, 4) differences between maturational stages were detected only for flexibility (on-time > late) and hand grip strength (early = on time > late).	81,25
Hammami et al. (2016)	130 (U-11 to U-19) from Tunisia.	Cross-Sectional study.	PHV with Maturity Offset, Mirwald (2002).	Age, MS, balance, muscle strength, and lower limb power (SLJ, CMJ and 3HJ-t).	1) 34 were categorized as pre-PHV, 42 as circa PHV, and 54 as post-PHV, 2) pre-PHV outperformed circa PHV in the Stork test with eyes closed. Post- PHV was better than circa PHV in CMJ, and 3HJ-t. Post-PHV demonstrated better scores than pre-PHV for CMJ, and 3HJ-t.	75,00
Portas et al. (2016)	1163 male English Soccer League soccer players.	Cross-Sectional study.	PHV with Maturity Offset, Mirwald (2002).	MS and FMS scores.	There was a substantial increase in the proportion of players who were able to achieve the FMS_{total} threshold of ≥14 with an increase of 47.5% from the MF_{phase} to the EPD_{phase}. The increase in total score was further explained by substantial increases in the proportion of players who achieved the threshold score in both FMS_{move} and FMS_{stab}.	87,50
Rada et al. (2016)	47 (U-16) from Croatia.	Cross-Sectional study.	PHV with Maturity Offset, Mirwald (2002).	CA, biological and training age (categorical variables). Height, sitting height, body mass, BMI, PHV, YYIR1, Speed (5 m and 20 m), lower limb power (SLJ, VJ), upper limb power (MBST) and agility.	1) All chronologically and biologically more mature soccer players with longer engagement in the training process had greater body and sitting height, they were heavier and had a higher body mass index. They also achieved better results in all the observed motor abilities, as well as the functional test.	68,75

Borges et al. (2017).	37 (U-16) from a Brazilian club.	Cross-Sectional study.	PHV with Maturity Offset, Mirwald (2002).	PHV, practice time, anthropometric variables, body composition, functional capacities, specific motor skills, and declarative tactical knowledge.	1) A significant difference was observed in anthropometric variables, 2) Specific motor skills: significant difference only in handgrip indicators in favor of the post-PHV group, 3) Negative correlation between PHV and DTK.	75,00
McCunn et al. (2017)	306 (U-11 to U-17) from a Scottish Premiership club.	Observational, mixed-longitudinal study.	PHV with Maturity Offset, Mirwald (2002).	RAE, MS, stature, body mass and sprint performance.	1) The magnitude of the relationship between maturity offset and 15 m sprinting speed was trivial for U-11 and U-12, very likely small for U-13, possibly large for U-14, very likely large for U-15, and likely small for U-17.	75,00
Rechenchosky et al. (2017)	68 (U-11, n = 22; U-13, n = 14; U-15, n = 21; U-17, n = 11).	Cross-Sectional study.	PHV with Maturity Offset, Mirwald (2002).	Age, MS, body mass, height, physical performance (YYIR1, CMJ, and 30 m sprint), technical performance (specific motor skills: passing, kicking and dribbling).	1) Body mass and height helped to explain, together, 60% of the variability of speed and 55% of contribution to aerobic power, 2) Dribbling showed to be influenced by body mass and height, 3) performance in the YYIR1, 30 m sprint, and CMJ were influenced by age category.	81,25
Romann et al. (2017)	119 (U-15) from a Swiss club.	Cross-Sectional study.	Skeletal age with TW3, Tanner et al. (2001)) and PHV with Maturity Offset, Mirwald (2002).	Maturity categories by coaches' eye, maturity categories from SA-CA, APHV.	1) Mean APHV was 13.9 ± 0.3 years, 2) The agreement between the SA-CA classifications and the estimations by coaches' eye is 73.9%. Between the SA-CA classifications and APHV is 65.5%.3. Cross-tabulations of the maturity status classifications based on coaches' eye and APHV show an agreement of 78.2%.	87,5

Cumming et al. (2018)	66 (U-12, n = 6; U-13, n = 35; U-14, n = 19; U-15, n = 6), but only 16 were selected to be include in the bio-banded sample.	Cross-Sectional study.	Bio-banded method.	Interview transcriptions after anthropometric assessments, a bio-banded tournament (11-a-side games with 25-min halves).	1) Physical development: early and late maturing players agreed that bio-banding created a physically more equitable playing field, reducing differences in player size and function. The early and late maturing players also reported that the practice of bio-banding encouraged a style of play that was less physical and more technically and tactically oriented, 2) Technical and Tactical development: such competitions afforded more opportunity for coaches to evaluate their potential in a more developmentally appropriate context, 3) Overall impression: participants described the tournament as a positive and welcome addition to their games programme and recommended that the Premier League continue with this initiative.	68,75
Doncaster et al. (2018)	21 (U-14).	Cross-Sectional study.	Self-assessment MS with Tanner (1962) and PHV with Maturity Offset, Mirwald (2002).	Age, stature, body mass, MS (Maturity Offset and Tanner stage), sum of 4 skinfolds, body fat, FFM, training years and training hours.	1) Differences in anthropometric and descriptive measurements revealed significant differences and large effect sizes for stature, BM, FFM, and Maturity Offset, with the mid-PHV group presenting greater values than the pre-PHV group, 2) years spent training also revealed significant and large effect sizes between groups, but with the pre- PHV group demonstrating greater values than the mid- PHV group.	87,50
Malina et al. (2018)	1831 (10.93 to 17.94 years old) from eight countries.	Cross-Sectional study.	SA with TW2, Tanner et al. (1975) and SA with TW3, Tanner et al. (2001).	CA, TW2 SA and TW3 SA scores.	1) The difference between TW3 and TW2 SAs in each CA group is significant, 2) TW3 SAs are, on average, systematically less than TW2 SAs by about 1 year or more.	87,50
Moran et al. (2018)	17 (U-12, n = 25; U-15, n = 17) from three English academies.	Quasi-experimental study (U-12, Training = 12, Control = 13; U-15, Training = 7, Control = 10).	PHV with Maturity Offset, Mirwald (2002).	PHV, 10 m and 20 m sprint performances, 5-10-5 COD.	1) Between-group effect sizes were substantially larger in Pre-PHV (10 m, 20 m, 5-10-5 COD_{test}) than in Mid-PHV (10 m, 20 m, 5-10-5 COD_{test}), 2) Within-group effects demonstrated a similar, though less accentuated, trend which revealed ST to be effective in both Pre-PHV (10 m, 20 m, 5-10-5 COD_{test}) and Mid-PHV (10 m, 20 m, 5-10-5 COD_{test}).	87,50

Read et al. (2018)	347 (10 to 18 years old) from the academies of 6 English professional soccer clubs.	Cross-Sectional study.	PHV with Maturity Offset, Mirwald (2002).	Single-leg 75% horizontal hop and stick, single-leg CMJ (SLCMJ), single-leg hop for distance (SLHD), Y-balance anterior reach (Y-Bal).	1) SLCMJ asymmetry increased in the later stages of maturation, with significantly higher scores in both the circa- and post-PHV players, 2) the magnitude of asymmetries was significantly greater for landing force variables during the 75%Hop and SLCMJ than both the SLHD and Y-Bal anterior reach distance, 3) With all the players combined, asymmetry was greatest during SLCMJ (85%), followed by the 75%Hop (86%).	81,25

Note: CA = Chronological age, SA = Skeletal age, MS = maturational status, PHV = Peak Height Velocity, APHV = age at Peak Height Velocity, FFM = fat-free mass, RAE = Relative Age Effect, RCP = respiratory compensation point, VT = ventilatory thresholdand, STS = Specific technical skills, SR-t = sit-and-reach test, SIT = modified sit-up test, HG = hand grip, 3HJ-t = 3-hop jump test, VJ = Vertical jump, CMJ = Countermovement jump, SLJ = standing long jump, MBST = medicine ball squat throw, ST = Sprint training.

Multidimensional and career progression

As mentioned in the introduction, it is becoming more common to find studies with more than one variable analyzed to answer the research question (Table 5). Moreover, it was also included studies about the youth soccer player's career progression in an attempt to show which variables predict the success in soccer.

Table 5. Multidimensional and career progression of young soccer player's studies: authors, sample, study design, procedures, main variables, results and quality score.

Study	Sample	Study design	Procedure	Main variables	Results	Quality score (%)
Deprez et al. (2015)	356 (U-12 to U-15) Flemish.	Longitudinal study.	Height, weight, sitting height, CA, PHV, hamstring flexibility (sit-and-reach test), Motor coordination (Körperkoordinations Test für Kinder (KTK): moving sideways (MS), backward balancing (BB), and jumping sideways (JS), jumping performance (SBJ and CMJ).	Age, APHV, anthropometrical characteristics, flexibility, motor coordination, and jumping performance.	1) Players improved with age on all parameters, 2) significant differences between latest, average, and earliest maturing players at baseline were found for anthropometrical characteristics, SAR and SBJ.	81,25
Fragoso et al. (2015)	133 (U-15) from a Portuguese top elite soccer academy.	Longitudinal study.	Birth dates by birth quarters (Q1, first; Q2, second; Q3, third; Q4, fourth) and by semesters (S1, first; S2, second), SA, stature, body mass, thigh, calf and upper arm girths, and fitness profile (10 m and 30 m sprint times, SJ, CMJ, and YYIR).	Birth dates, biological maturity, anthropometric profile, fitness profile.	1) Significant differences were found for decimal age and SA by quarters (Q4-Q1, Q2) and semesters, and stature (Q3-Q1, Q2, Q4; S1-S2), body mass (Q1-Q3; S1-S2), thigh girth (S1-S2), SJ (Q1-Q2) and sprint time (Q4-Q1, Q2; S1-S2), 2) When maturity was considered as covariate all PF variables, with exception of SJ (Q1-Q2) and 10 m sprint time (S1-S2), were very similar among the studied groups.	81,25
Lloyd et al. (2015)	30 (U-11 to U-16) from a club from the United Kingdom.	Cross-Sectional study.	PHV, FMS, SJ, reactive strength index protocol and reactive agility cut.	Maturity status, movement performance and physical performance.	1) Older players significantly outperformed younger participants in all tests, 2) Deep overhead squat, in-line lunge, active straight leg raise and rotary stability test were significantly correlated to all performance tests, 3) The greatest variance in reactive strength index and reactive agility cut performance, whilst maturation was the strongest predictor of SJ performance.	81,25

Forsman et al. (2016)	288 from 16 Finnish clubs.	Retrospective cohort study.	A Perceived Game-Specific Soccer Competence Scale, Tactical Skills Inventory for Sports, subscale Motivation from The Psychological Skills Inventory for Sports, Dribbling and passing skills were measured to examine technical skills of the players, 30 m sprint and 8 figure for agility.	Perceived competence, tactical skills, motivation, technical skills, and speed and agility characteristics.	Positive relationships were found between these levels and changes in perceived competence and motivation, and levels of perceived competence and speed and agility characteristics.	87,50
Aquino et al. (2017)	66 (U-17) from a Brazilian club.	Retrospective cohort study.	Height, sitting height, weight, skinfolds: triceps, subscapular, chest, midaxillary, suprailiac, abdominal and mid-thigh, PHV, DTK, soccer-specific technical skills, and 30 m sprint, CMJ, RAST and YYIR1 performances.	Anthropometrical characteristics, PHV, tactical skills, technical skills and physical performances.	In general, selected players were taller, had more lean body mass, and performed better in technical, tactical, and motor tests than non-selected players.	87,50
Borges et al. (2017)	48 (U-16) from a Brazilian club.	Cross-Sectional study.	Weight, height, and sitting height, PHV, physical performances: sit-and-reach test, YYIR1, HG, modified abdominal test, and vertical jumps: CMJ and SJ and tactical performance (FUT-SAT).	Anthropometrical characteristics, PHV, physical performances and IPT.	1) Early maturational players presented higher values in the performance of physical performances such as aerobic endurance and lower limb muscle strength, 2) Tactical principles offensive coverage, offensive unity, and concentration were executed more frequently by the Post-PHV group than the Pre-PHV. Significant correlations were observed between PHV and the principles offensive coverage, offensive unity, and concentration.	87,50
Gouvea et al. (2017)	62 (U-12 to U-17) from two Brazilian clubs.	Cross-Sectional study.	CA, SA (Greulich-Pyle method), height, weight, BMI, Body fat percentage, sit-and-reach test, sit-ups, SJ and CMJ, YYIE1, Soccer-specific skills: dribbling speed test, shuttle dribble test, slalom dribble test and practice time.	CA, SA, anthropometrical characteristics, physical performances, technical performances and practice time.	1) The 3 technical tests were correlated. More skilled subjects in DST and SDT showed (respectively) higher time of practice, and greater performance sit-ups, squat jump, countermovement jump, and YYIE1 compared to the less skilled subjects; 2) More skilled subjects in SLDT showed greater performance only in the squat jump and YYIE1.	81,25

James et al. (2017)	60 (U-12 to U17) from United Kingdom.	Cross-Sectional study.	Height, weight, maximum forearm girth, skinfolds: triceps and calf, CMJ, hand-grip strength, 30 m sprint running, and an agility T-test.	CA, anthropometrical measures, physical fitness.	1) Players with fast sprint performance for their age were taller and had high performance in jump power output and grip strength for their age, 2) Absolute sprint performance was significantly correlated with absolute agility performance.	87,50
Sporis et al. (2017)	37 (U-19) from six Croatian clubs.	Cross-Sectional study.	Height, weight, skinfolds (triceps, subscapular, thigh, calf, supraspinal and abdominal) and match activities.	Anthropometrical measures and match activities.	1) The total distance covered was associated with subscapular and abdominal skinfolds. In addition, the subscapular skinfolds were significantly related to high intensity running and sprinting.	68,75
Aquino et al. (2018)	25 (U-15, n = 13, U-17, n = 12) from a Brazilian club.	Cross-Sectional study.	10 and 30 m maximum Speed, Agility (Zig-Zag test), RAST, YYIR1, and match performance (total distance covered (TD), maximal velocity (Vmax), the percentage of distances covered at eight velocity bands.	Functional capacities performances and match running performance.	The Zig-Zag test was negatively correlated with V_{max}. The minimum power (MP), average power (AP), and total distance covered in the YYIR1 were positively correlated with speed range V4 (medium intensity running).	75,00

Note: APHV = Age at Peak Height Velocity with Maturity Offset (Mirwald et al., 2002), PHV = Peak Height Velocity, CMJ = Countermovement Jump, SJ = Squat Jump, SBJ = standing broad jump, SA = skeletal age, CA = Chronological age, FMS = Functional Movement Screen, DTK = declarative tactical knowledge, RAST = Running-based anaerobic sprint test, YYIR1 = Yo-Yo Intermittent Recovery level 1, YYIE1 = Yo-Yo Intermittent Endurance level 1, HG = handgrip test, FUT-SAT = System of Tactical Assessment in Soccer (Teoldo et al., 2011), IPT = tactical performance indexes.

Small-sided and conditioned games

More than 30% of the studies that were part of this systematic review used the Small-Sided and Conditioned Games (SSCG) in their approach, with different purposes, but especially to analyze the tactical behavior from the youth soccer players (Table 6). Modify pitch size, the number of players, rules, time, or the purpose of the SSCG are examples of tasks applied to verify the tactical behavior adaptation, the player's activities, and the variation of the internal variables of the players. The System of Tactical Assessment in Soccer (FUT-SAT, Teoldo, Garganta (26)) was one of the most used methods to analyze the SSCG.

Table 6. Small Sided and Conditioned Games in studies with young soccer players: authors, sample, study design, task conditions, procedures, main variables, results and quality score.

Study	Sample	Study design	Task conditions	Procedure	Main variables	Results	Quality score (%)
Clemente et al. (2015)	10 (U-14) from Portuguese regional league.	Cross-Sectional study.	Task 1: maximize the ball possession time and there was no goal, Task 2: players was asked to cross the end line of opponents with the possession of the ball and there was no goal, and Task 3: a small goal (2m of width and 1m of height) was placed on the team's end line and the aim was to score.	All SSCG had the same duration (and same number of players and different task conditions), which was lasted for 3 minutes and 3 minutes of recovery. The SSCG with 1v1+1 were played with field dimensions of 20x15m, whereas the 2v2+1 SSCG were played on 28x18m field. In all SSCG the neutral player (+1) only provided coverage to the team with ball possession.	Task conditions, Heart rate, distances covered, speed and acceleration.	1) Format had significant main effects and moderate effect size on heart rate responses and time-motion profiles; 2) The task conditions had a significant main effects and a small effect size on heart rate responses and time-motion profiles; 3) Significant differences were found in between the three task conditions for $\%HR_{res}$, distance coverage, speed, and acceleration.	81,25
Falces-Prieto et al. (2015)	27 (U-18).	Cross-Sectional study.	Players played with the presence (PHC) or absence (AHC) of the head coach	Pitch size: 40 x 30 m with 2 official portable goals, 6 min of duration, Internal load: values of HR and RPE with the CR-10 modified, Two teams (5 vs 5 + GK), and the matches were recorded and technical actions were analyzed.	Presence of the Head Coach (PHC), Absence of the Head Coach (AHC), Heart rate (HR), Rate of Perceived Effort (RPE) and Technical actions.	1) HR_{max}, HR_{mean} and RPE were substantially greater during the SSCG-PHC (presence of the head coach). During the SSCG-PHC there was a substantial increase in the percentage of time spent by players at very high-intensity of exercise > 90% HR_{max}.	87,50
González-Rodenas et al. (2015)	20 (U-14) from an academy team from a first division professional club in Spain.	Cross-Sectional study.	3 SSCGs: 1) possession play (PP) (maintain ball possession), 2) small goals (SG) (score a goal, and try not to concede one, using small goals) and 3) regular goals (RG) (score a goal, and try not to concede one, using regular goals and goalkeepers).	Each SSCG with 4 min duration with 2 min of passive recovery. The three SSCG formats were performed by both 4-a-side and 6-a-side teams.	SSCG format, type of the SSCG goal, number of players, heart rate.	1) PP in 4-a-side format registered higher intensity of play than PP in 6-a-side format, 2) SG higher intensity of play than RG for 4-a-side, 3) PP in 4-a-side format obtained higher intensity of play than RG for 4-a-side, 4) RG in 4-a-side games registered the highest SD compared with the same format in 6-a-side games.	87,50

Koklu et al. (2015)	12 (U-16).	Cross-Sectional study.	3-a-side SSCGs consisting of 4 bouts (18 x 30 m pitch), each bout last for 4 minutes with different time to recover between the bouts (1 min, 2 min, 3 min and 4 min), were performed (the main goal was to maintain the possession of the ball).	Height and body mass, YYIR, Time motion analysis® monitored with GPSports®, SPI ProX, Technical actions.	Recovery period, SSCG format, heart rate, RPE, blood lactate concentration, number of technical actions and the various time-motion characteristics.	1) SSCGs under R1 conditions induced higher %HR_{max} and %$HR_{reserve}$ than both R3 and R4 conditions, 2) players covered greater distances by WLK in the R1 than those in R2, R3 and R4, 3) in R3 condition players covered greater distances by HIR than in R1.	75,00
Koklu et al. (2015b)	16 (U-18).	Cross-Sectional study.	2-a-side (4 bouts of 2 min separated by 2 min of passive recovery, pitch: 15 x 27 m), 3-a-side (4 bouts of 3 min separated by 2 min of passive recovery, pitch: 20 x 30 m), and 4-a-side (4 bouts of 4 min separated by 2 min of passive recovery, pitch: 25 x 32 m). SSCG with (2 goals and 2 GK) and SSCG without games consisting of 4 bouts.	Height, body mass, YYIR, SSCGs, Time motion analysis (15Hz GPS).	SSCG format, %HRmax, RPE, La-, and distances covered at different speeds.	1) Significant differences between $SSCG_{with}$ and $SSCG_{without}$ in terms of %HR_{max}, 2) 2-, 3-, and 4-a-side $SSCG_{without}$ showed significantly higher %HR_{max} responses than 2-, 3-, and 4-a-side $SSCG_{with}$, 3) In 2-, 3-, and 4-a-side $SSCG_{without}$, the players covered significantly greater distances in LIR than in 2-a-side, 4) in 2-, 3-, and 4-a-side $SSCG_{without}$, the players covered greater distances in total distance than in 2-, 3-, and 4-a-side.	87,50
Los Arcos et al. (2015)	15 (U-16) from a Spanish First division club.	Parallel two-group experimental (5 weeks): IT and SSCG.	SSCG: 3 x 4 min by 3 min of rest. Scores were considered valid only if made with the first touch, and in all SSCGs the relative pitch size was 85 m2, coach encouragement, without the offside rule.	Players were randomly assigned to the SSCG or the Interval Training groups. SSCG and IT sessions were done twice a week over 6 weeks. Tests: Université de Montréal Tract Test (UM-TT; VO2máx), CMJ, Training load quantification: HR and RPE, Physical Activity Enjoyment Scale (PACES),	Training type, aerobic fitness and physical enjoyment.	Players in the SSCG group accumulated a likely greater training time at high intensity (> 90% of HR_{max}) than in the IT group, but likely moderate lower training time at medium intensity (80-90% of HR_{max}), and small lower practice time at low intensity (< 80% of HR_{max}).	93,75

Olthof et al. (2015)	39 (U-17, n = 23; U-19, n = 16) from the highest level in the Netherlands.	Cross-Sectional study.	6 SSCG (In total, twenty-four SSCG), 4-a-side, pitch: 40 x 30 m, during 6min, without offside rule.	Positional data of each player were collected using the local position measurement (LPM) system.	Age category and tactical behavior.	Centroid positions of the opposing teams in both age categories showed high correlations in longitudinal direction. Team centroids were moving simultaneously in the same direction for more than 70% of the time during the SSCGs.	75,00
Praça et al. (2015)	18 (U-18) from a Brazilian club.	Cross-Sectional study.	36 SSCGs: 12 in numerical equality (3vs.3), 12 with supporting players around the field (3vs.3+2), and 12 with an additional player inside the field (4vs.3), 4 min and 4 min interval between bouts, pitch: 36 x 27 m.	Familiarization with equipaments and rules in the week 1, in weeks 2 to 4, the players participated in SSCGs. Time motion analysis was recorded with GPS, 15Hz.	SSCG format, distances covered, acceleration.	1) Significant differences for total distance between the three configurations, 2) the 3vs.3+2 game exhibited a smaller number of acceleration actions and a lower percentage of distance covered than the 3vs.3 configuration.	68,75
Praça et al. (2015b)	24 (U-15 to U-16) from a Brazilian club.	Cross-Sectional study.	6 SSCGs, 4 min each, with a configuration of "GK+3 vs 3+GK", pitch: 36 x 27 m.	Tactical behavior (FUT-SAT, Teoldo et al. 2011), Technical skills: General Soccer Ability Skill Test Battery proposed by Mor and Christian (1979) (dribbling, shooting on goal and passing, in this order).	Tactical Performance Index (offensive and defensive) and technical performances.	1) The dribble variable was positively correlated with shot on goal and TPI-O, 2) A significant and positive correlation was observed between dribbling performance and the incidence of tactical actions of width/length with a ball with negative characteristics.	68,75
Silva et al. (2015)	24 (U-15) from Portugal.	Cross-Sectional study.	In each treatment (7-, 8- and 9-a-side) there were 3 SSCGs, 6 min duration, for two weeks, constant area of 57.3 x 37.1 m yielded	Time motion analysis recorded with GPS, 15Hz.	Player numbers, field dimensions and inter-individual coordination.	1) Differences can be observed for all variables and relative spaces per player treatments.	87,50

Almeida et al. (2016)	16 (U-13, n = 8; U-15, n = 8) from Portugal.	Cross-Sectional study.	SSCG: 4-a-side without GK was the basis of the experimental task: Control condition: The central goal scoring mode, Experimental condition 1: line goal, scoring by dribbling past an extended line, Experimental condition 2: double goal, scoring in either of two lateral goals. Pitch: 30 x 20 m.	Protocol consisted of six independent sessions for 2 weeks. In each session, participants performed the three SSCGs during 10 min periods interspersed with 5 min of passive recovery.	Ball-recovery type, ball-recovery sector, configuration of play and defence state.	1) Irrespective of scoring mode and age group, the set play was the most frequent type of ball recovery (47.4%), predominantly regained in the defensive sector (45.5%), 2) The variables scoring mode and age group significantly predicted whether youth teams regained possession through interception or set play.	75,00
Américo et al. (2016)	400 (U-11: n = 100; U-13: n = 100; U-15: n = 100; U-17: n = 100) from Brazil.	Cross-Sectional study.	SSCGs, 4 min each, with a configuration of "GK+3 vs 3+GK", pitch: 36 x 27 m.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	Tactical behavior efficiency.	1) players from the U-17 and U-13 age levels were more efficient when performing offensive and defensive tactical principles, 2) Offensive principles performed more efficiently were *Offensive Coverage* and *Width* and *Length*, 3) defensive principle more efficiently performed was the *Concentration* and the principles of *Defensive Coverage* and *Delay* displayed the lowest values of performance efficiency.	68,75
Andrade et al. (2016)	100 (U-15) from Brazil.	Cross-Sectional study.	SSCGs, 4 min each, with a configuration of "GK+3 vs 3+GK", pitch: 36 x 27 m.	Continuous Performance Test-II (CPT-II by Conners et al. (2003)) and System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	CPT measures (Omission Errors and Commission Errors) and the Tactical Performance Indexes (Offensive, Defensive, and Game).	Positive correlation was observed between CPT Commission and GTPI (rho = 0.226; p = 0.018).	68,75
Asci et al. (2016)	22 (U-18 and U-16) from Turkey.	Cross-Sectional study.	SSCGs: 3-, 4-, 5-, 7- and 9-a-side, all including the GK in different dimensions of pitch and, one official match per week.	Height, weight, 7 skinfolds, running test, physiological parameters: heart rate, blood lactate.	Game format, HR, time spent in HR zones.	1) Lowest HR and $\%HR_{máx}$ responses were found in 9-a-side game, while the 3-a-side game resulted in the highest HR and $\%HR_{máx}$ responses.	75,00

Badin et al. (2016)	20 (U-19) from an Australian National Premier League club.	Counterbalanced crossover design (mental fatigue and control condition).	SSCG: 5-a-side without GK, during 15 min, on 2 occasions separated by 1 week.	Borg's CR10 RPE scales, YYIR1, Visual Analog Scales (VASs): mental fatigue, mental effort, physical fatigue, and motivation, and performed 10 minutes of the Stroop task and Technical tests. Time motion analysis using a 15Hz GPS.	Mental fatigue, technical performance and physical performance.	1) HR was possibly higher in the control treatment than the fatigue condition, 2) Trivial differences existed for accelerations, whereas repeated sprints showed a likely positive effect. In contrast, mental fatigue impaired performance in most offensive and defensive technical variables.	81,25
Barnabé et al. (2016)	36 (U-16, n = 12; U-17, n = 12; U-19, n = 12).	Cross-Sectional study.	6-a-side games, eight minutes on a 33 m x 60 m, official rules except offside.	Height, body mass, SSCG, Time motion analysis using a 15Hz GPS.	Surface area, Stretch index, Team's length and width, and Age-related effects in attacking phases.	1) Differences in team width were observed between the U-16 and U-17, and in surface area (U-16 and U-17, and U-16 and U-19), 2) Differences in the stretch index values were registered (U-16 and U19), in defensive phases (U-17 and U-19) for team length, (U-17 and U-19) for stretch index.	68,75
Christopher et al. (2016)	12 (U-16) from Chelsea FC.	Cross-Sectional study.	2 tasks in 6-a-side SSCGs (8 min each): 1) 8 min continuous, 2 blocks of 4 min by 1 min rest, 2) four blocks of 2 min by 45-60 s rest. Pitch: 50 x 32 m, without offside rule.	CR10 RPE, YYIR2 (HR), Technical analysis, Time motion analysis using a 15Hz GPS.	Game format, physical and technical performances.	1) More goals were scored in both the 4 x 2 min game, and the 2 x 4 minute game, as opposed to the 8 min continuous game, seemingly due to the greater number of shots taken.	75,00
Koklu et al. (2016)	14 (U-18).	Cross-Sectional study.	2-a-side (2 min, 12 x 24m), 3-a-side (3 min, 18 x 30 m) and 4-a-side (4 min, 24 x 36 m).	Height, body mass, skinfold thickness, circumference measurements, YYIR1, SSCGs, CR10 RPE and HR monitored during the SSCGs and blood sampling 3 min after each SSCG.	SSCG format, %HRmáx, BLA and RPE scores.	The lowest $\%HR_{máx}$ responses (2-a-side), the highest (3-a-side).	81,25

Moreira et al. (2016)	60 (U-14 to U-15) from a Brazilian club.	Cross-Sectional study.	5-a-side + GK using 2 repetitions of 8 min by 3 min of passive recovery, in a 45 x 60 pitch size.	Technical performance, Physical performance, Time motion analysis using a 15Hz GPS.	Time of game, physical performance and technical performance.	1) Significant changes in TDC, accelerations, decelerations, number of sprints, and MP, body load, impacts, 2) TDC was found to decrease from the 1st quarter to all subsequent quarters of the SSCG.	87,50
Praça et al. (2016)	18 (U-18) from a brazilian club.	Cross-Sectional study.	FUT-SAT applied in two different configurations: "GK+3vs.3+GK" and "GK+3vs.3+GK plus offensive joker".	Teams formed according their PTK (G1 = high score in PTKT and G2 = low score in PTKT). Teams from G1 and G2 did not played against each other, SSCGs.	Group (High and low level in PTKT), Game format, Tactical behavior.	1) the group with greater tactical knowledge (G1) showed higher incidence of width and length (without the ball) actions in the 4 x 3 SSCG than in the 3 x 3 SSCG, 2) the 4 x 3 setting allowed for higher frequency of offensive unity tactical actions than the 3 x 3 SSCG, 3) significant differences as to defensive coverage tactical principles, recovery balance and defensive unity.	75,00
Sannicandro et al. (2016)	12 (U-13).	Cross-Sectional study.	2 tasks: 1) 8-a-side (62 x 44 m) 25 min by 5 min of passive recovery, 2) 3-a-side (16 x 8 m) with (4 bouts, 3 min, 2 min passive recovery).	Anthropometrics, Maximal incremental aerobic test (Leger test), SSCGs. In both SSCGs format HR was monitored.	SSCGs format, HRmean, HRmáx and VO2máx.	HR_{mean}, $HR_{máx}$ were lower in 8-a-side than in 3-a-side format.	87,50
Arslan et al. (2017)	16 (U-17).	Cross-Sectional study.	3 tasks: 2-, 3-, and 4-a-side (4 bouts without GK, purpose to maintain the possession of the ball. Encouragement was provide for the coaches.	Height and weight, YYIR1, SSCGs HR was recorded using a 15Hz GPS; 4) RPE and lactate responses in the SSCGs.	SSCGs format (2-, 3-, and 4-a-side), SSCGs active and passive rest, HR, %HRmax, level of BLA, RPE and time-motion characteristics.	There were significant differences between SSCGar and SSCGpr in terms of BLA and RPE responses in all SSCG formats.	75,00

Barbero-Alvarez et al. (2017)	22 (U-12: n = 11; U-14: n = 11) from a national Spanish academy.	Cross-Sectional study.	2 training matches (7-a-side) per age groups, a regular pitch size, artificial-grass, 2 x 25 minutes by 10 min of passive rest.	Time motion analysis using a 1Hz GPS.	Total distance covered, peak speed, HR, and individual efficiency index (Effindex).	1) TDC at SPR and HIA, also the number of HIR (U-14 > U-12), 2) The players covered more distance during the first half compared with the second. The distance at HIA decreased significantly during the second half.	75,00
Beenham et al. (2017)	40 (U-18).	Cross-Sectional study.	2-a-side (4 x 2min, 3 min of rest, 20 x 15m), n = 10, 3-a-side (4 x 3 min, 3 min of rest, 25 x 18m), n = 7, 4-a-side (4 x 4 min, 3 min of rest, 30 x 20m), n = 5, SSCGs rules: possesion of the ball, limited to 2 touches per player.	Players were also analyzed during six home English College friendly fixtures, Time motion analysis using a 5 Hz GPS (Catapult).	Tri-axial activity, SSCG format, match play workload.	$PL_{acc \cdot min\text{-}1}$ was significantly higher in each SSCG format compared to MP (SSCG2: 15.00 ± 3.53; SSCG3: 14.68 ± 3.27; SSCG4: 13.47 ± 3.35 vs MP: 10.18 ± 2.12 AU).	75,00
Borges et al. (2017)	48 (U-13, n = 12; U-15, n = 15; U-17, n = 21) from a Brazilian club.	Cross-Sectional study.	SSCGs, 4 min each, with a configuration of "GK+3 vs 3+GK", pitch: 36 x 27 m.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	Performance of offensive and defensive core tactical principles.	Most offensive and defensive tactical principle, respectively performed: width and length and the defensive unit.	87,50
Brandes et al. (2017)	14 (U-19) from a Germany club.	Cross-Sectional study.	2 tasks: 1) strongly pushed coach encouragement (SSCG-P) and 2) only mild, unobtrusive feedback (SSCG-M). Both SSCG: unlimited touches of the ball, regular goals (7.32 x 2.44 m), without offside, artificial grass, pitch 40 x 40 m. 3 x 4 min by 2 min of passive rest.	Blood sample during SSCG, HR, Time motion analysis using a 5Hz GPS, Game performance: Team Sports Assessment Procedure described in detail by Gréhaigne et al. (2005).	SSCGs format, Game performance measures, time motion analysis variables, Physiological parameters.	1) The mean HR did not change significantly between SSCG-M and SSCG-P, the overall distance traveled was possibly shorter in SSCG-M than in SSCG-P, 2) Players were likely to perform more sprints during SSCG-P than during SSCG-M.	93,75

Coutinho et al. (2017)	12 (U-17).	Cross-Sectional study.	Prior to the SSCG, one team: motor coordination task to induce mental fatigue, other team: control task. 4 tasks: (a) with MF against opponents without MF in a normal pitch, (b) with MF on a pitch with additional reference lines, (c) without MF against MF opponents on a normal pitch, (d) without MF on a pitch with reference lines. SSCGs: 4 x 6-a-side plus GK (62 x 43 m pitch, 24 min: 3 x 6 min bouts by 3 min passive recovery).	CMJ, Mental fatigue: Visual Analog Scale (VAS) immediately prior to, and following each treatment condition, and again in the end of the SSCG, Time motion analysis using 15Hz GPS.	SSCG format, mental fatigue, positional variables, physical performances, tactical performances and RPE responses.	1) Overall, higher values were found in the perception of mental fatigue following the mental task as compared with the control task.	81,25
Halouani et al. (2017)	18 (U-15) from an amateur club.	Cross-Sectional study.	2 tasks: Stop-Ball SSCG (SB-SSCG) and Small-goal SSCG (SG-SSCG), 3 conditions: 2-, 3- and 4-a-side, pitch 20 x 25 m, 4 x 4 min by 2 min of passive recovery, 6 training sessions: SB-SSCG and SG-SSCG for 3 forms of players' number.	CR10 RPE, HR and BLA.	Game rules, players' number, RPE, HR and blood lactate.	1) HR values: SB-SSCG > SG-SSCG in all conditions, 2) %Hrmax: SB-SSCG > SG-SSCG in the 3-a-side as compared to 2-a-side and 4-a-side.	75,00
Halouani et al. (2017a)	16 (U-14).	Cross-Sectional study.	2 tasks: Stop-Ball SSCG (SB-SSCG) and Small-goal SSCG (SG-SSCG), 4-a-side, 3 conditions: small pitch sizes: 10 x 15 m, medium: 15 x 20 m, and large: 20 x 25 m, 4 x 4 min by 2 min of passive recovery.	SSCGs, Self-administered MS with Tanner (1962), HR, CR10 RPE and BLA.	Game rules, maturity status, pitch dimensions, HR, RPE and blood lactate.	HR: SB-SSCG > SG-SSCG, with higher inter-subject coefficients of variation (CV) during SG-SSCG in the small and the medium size compared to the large pitch.	81,25

Köklü et al. (2017)	15 (U-18) from a Turkey team.	Cross-Sectional study.	12 SSCG training sessions (2-a-side, 3-a-side, and 4-a-side), continuous (1 x 12 min) or interval (6 x 2 min, 3 x 4 min, and 2 x 6 min).	SSCGs, Height, body mass, YYIR1, Time motion analysis using a 15Hz GPS.	Bout duration, HR, blood lactate, RPE and time motion characteristics.	Differences were found between bout durations in terms of distance covered in the walking speed zone, low-intensity running speed zone, moderate-intensity running speed zone, total distances covered, maximum speed reached and HR.	87,50
Martone et al. (2017)	33 (U-12: n = 17; U-14: n = 16) from the Società Sportiva Dilettantistica Europa (Naples).	Cross-Sectional study.	SSCGs: 18min (Interval Training = 3 x 4 min by 3 min of active recovery). 2 pitch sizes (20 x 20 m and 30 x 30 m), 3 conditions: 3-, 4- and 5-a-side were played by U-12 and U-14 group was established randomly.	Physiological measures (HR and $\%HR_{max}$), Technical evaluation.	$\%HR_{max}$, Technical measures, pitch dimension, game format.	1) For 112.5 and 150m^2 (EI): U-12 > U-14 group. Also U-12 group's EI for $A_P150 > A_P40 > A_P50 > A_P90$.	87,50
Moreira et al. (2017)	40 (U-15) from a Brazilian club.	Cross-Sectional study.	SSCGs: 5-a-side plus GK, 2 x 8 min by 3 min of passive rest, pitch 46 x 60 m, were filmed and individual technical performance annotated for further analysis.	Saliva samples (testosterone assessments), height and weight, MS with Tanner (1962), SJ, CMJ, YYIR1 and Technical performance.	Hormonal status, sexual maturity level, anthropometric profile, and physical performance and SSCG technical performance.	1) Principal component analyzes identified four technical actions of importance: total number of passes, effectiveness, goal attempts, and total tackles.	81,25
Padilha et al. (2017)	168 (U-17) from Brazilian clubs.	Cross-Sectional study.	2 tasks: 1) Gk+3 vs. 3+Gk and 2) Gk+3 vs. 3+Gk+2 floaters side lines, 4 min, pitch 36 x 27 m.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	Game format, core tactical principles of soccer.	1) 3-a-side plus GK: higher frequency of concentration and penetration, 2) 3-a-side plus GK +2 FL: higher effective of space (width and length) in the opponent's half and defensive unity.	81,25
Praça et al. (2017)	18 (U-17) from a Brazilian club.	Cross-Sectional study.	SSCGs: 1) 3-a-side, 2) 3-a-side + 2 FL side lines, 3) 4 vs 3, the purpose was to score as many goals as possible in a small goal (5 m x 2 m), 4 min.	Procedural Tactical Knowledge Test (PTKT, Greco et al. 2014) and Network analysis was carried out.	SSCG, network variables, playing position.	1) Density and total links: 4 vs. 3 > 3 vs. 3 and 3 vs. 3 + 2 task conditions, 2) the network properties in the analysis with and without the additional floater player revealed higher values of total links in the condition with the floater.	81,25

Praça et al. (2017a)	30 (U-14, n = 14; U-15, n = 16) from a Brazilian club.	Mixed-Longitudinal study.	Monthly, over 10 months: 4 min, "GK3 vs. 3GK", 36 x 27 m, 6 x 2 goalpost, with all the rules of formal games.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	Category, month and core tactical principles of soccer.	Incidence of offensive coverage actions (U-15 > U-14 players), 2) U-14 players performed more defensive coverage actions at the beginning of the year, 3) U-15 players performed more defensive coverage actions in the last two months.	87,50
Praça et al. (2017b)	18 (U-17) from a Brazilian club.	Cross-Sectional study.	36 SSCGs: Gk+3 vs. 3+Gk, each one: 4 min, pitch 36 x 27 m with all the rules of formal games.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011), YYIR2 and 20 m sprint.	Tactical behavior, aerobic power and speed performance.	SSCG played by teams balanced for the tactical knowledge criterion it was observed a higher defensive tactical performance compared to the other two criteria.	68,75
Rechencho sky et al. (2017)	54 (U-17) from anuniversity social project in Brazil (regional competitive level).	Cross-Sectional study.	SSCGs: Gk+3 vs. 3+Gk, each one: 4 min, pitch 36 x 27 m with all the rules of formal games, except offside rule.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	Core tactical principles of soccer (Offensive and Defensive).	Concentration was performed more efficiently than other principles. Midfielders and forwards executed offensive unity more efficiently than defenders. Defenders present high defensive coverage efficiency than midfielders.	81,25
Reis et al. (2017)	152 (U-13, n = 50; U-15, n = 62; U-17, n = 40) from a Brazilian club.	Cross-Sectional study.	SSCGs: Gk+3 vs. 3+Gk, each one: 4 min, pitch 36 x 27 m with all the rules of formal games, except offside rule.	System of Tactical Assessment in Soccer (FUT-SAT, Teoldo et al. 2011).	Offensive tactical performance index (OTPI), defensive tactical performance index (DTPI) and Efficiency of Core Tactical Principles of soccer.	1) Highest performance index in offensive phase = Depth Mobility, 2) highest frequency in the defensive phase = Defensive coverage.	68,75

Rowat et al. (2017)	25 (U-19) from an academy in Singapore.	Cross-Sectional study.	SSCGs: 5-a-side, 4 x 5 min by 3 min of passive recovery.	CA, MS with Pubertal Development Scale (PDS) by Petersen et al. (1998), height, weight, and BMI, YYIR1, RSA, 15 m sprint, four specific skill tests, the technical evaluation of players in SSCG's.	Technical skills performance, Physical performance, Maturation status.	When the technical evaluation of players in a match situation were correlated with maturity status there was a moderate relationship observed that approached significance.	87,50
Sanchez-Sanchez et al. (2017)	22 (U-19).	Cross-Sectional study.	6 conditions: 1) 4vs4-NO, 2) 4vs4+2IW-NO, 3) 4vs4+2IW+2IEW-NO, 4) 4vs4-GK, 5) 4vs4+2IW-GK and 6) 4vs4+2IW+2IEWGK, 4 bouts x 4 min by 2 min of passive recovery, 30 x 40 m pitch; NO = without GK, IW and IEW = internal and external wildcard players, respectively.	YYIR1, CR10 RPE, HR monitors, and SSCGs. and technical-tactical actions (pass, dribbling, collective success, and game pause).	SSCG format, SSCG purpose, HR, Perceived Exertion, Technical-Tactical Actions.	No differences were observed in %HRmax between 4 vs 4-NO, 4 vs 4 + 2IW-NO, 4 vs 4 + 2IW + 2IEW-NO, 4 vs 4-GK, 4 vs 4 + 2IW-GK, and 4 vs 4+2IW+2- IEW-GK. During 4 vs 4 + 2IW + 2IEW-NO, time spent in Z1 was greater compared with 4 vs 4-NO and 4 vs 4 + 2IW-NO.	81,25
Coutinho et al. (2018)	10 (U-15) from Portugal.	Quasi-experimental study (EXP Condition: both teams induced MMF and MF at the same time, CONtrol conditions: players were not under the effect of any of the other	SSCGs: 3 x 5-a-side plus GK, pitch: 30 x 25 m, formal 7-a-side goals, 24 min (3 bouts x 6 min by 3 min rest).	Time motion analysis using a 5 Hz GPS.	Mental and muscular fatigue on physical activity and tactical performance.	1) Decrease in the distance between dyads and an increase on the ApEn distance dyads with MMF compared to the CON condition, 2) Decrease in the team's stretch index with MMF compared to the CON condition, 2) MMF condition decreased the time spent synchronized in longitudinal displacements compared to the CON condition.	87,50

		initial conditions (declared their RPE), MMF condition: was induced with the RCOD task, MF condition: 30 min Stroop color-word task.					
Olthof et al. (2018)	148 (U-13, n = 36, U-15, n = 43, U-17, n = 28 and U-19, n = 43) from three Dutch professional academies.	Cross-Sectional study.	SSCG: 4-a-side plus GK, Pitches: small (40 x 30 m) and large (68 x 47 m), 4 min by 4 min of rest.	SSCGs, Time motion analysis were recorded using a Local Position Measurement (LPM) system.	Game characteristics, physical performance, team tactical performance, type of SSCG and age group.	1) A significant main effect of pitch size was observed for all game characteristics, physical performance and team tactical performance, 2) Significant interaction effects (pitch size*age category) were found for physical and team tactical performance.	81,25
Santos et al. (2018)	40 (U-13, n = 20, U-15, n = 20) from Portugal.	Randomized Controlled Trial (Control group and Experimental group (Differencial-Learning SSCG)).	SSCGs: 5-a-side plus Gk, 2 x 6 min by 3 min of passive recovery, on an artificial-turf pitch (36 m x 25 m), 7-a-side goals.	The experimental groups participated in a differential learning training program for 5 months (40 sessions) with a volume of approximately 90 min per week; Test sessions were performed before and after.	Creative components, passes, dribbles, shots, positional data.	Differential learning facilitated the development of creative components, mainly concerning attempts, versatility, and originality of players' actions, 2) Differential-learning approach provided a decrease in fails during the game in both experimental groups.	81,25

Note: BLA = Blood Lactate, GK = goalkeeper, TDC = Total distance covered, MF = mental fatigue, MMF = Muscular fatigue, SJ = Squat Jump, CMJ = Countermovement Jump, RSA = Repeated sprint ability test, CA = Chronological age, SA = Skeletal age, MS = Maturity status, CR10 RPE = Borg's CR 10 scale for Rate Perception Exertion, RCOD = repeated change of direction.

Training session

Despite the importance of the training' control, this is the topic less researched in youth soccer players studies, regarding the analyzed period (Table 7). Probably, this is a problem of the restriction imposed by the soccer clubs considering the training session analysis, or the less interest of the researchers to understand the training process.

Table 7. Training session analysis of young soccer player's studies: authors, sample, study design, training session analysis, procedures, main variables, results and quality score.

Study	Sample	Study design	Training session analysis	Procedure	Main variables	Results	Quality score (%)
Coutinho et al. (2015)	141 (U-15, n = 56; U-17, n = 66; U-19, n = 19) from an elite Portuguese team.	Cross-sectional study.	During 33 TS (U15: n = 12; U17: n = 11; and U19: n = 10). All TS started with a standard warm up, with a preliminary articular and muscular mobilisation consisting of low-intensity running, followed by ball possession and stretching exercises; 15 Hz GPS.	All U-15 (four TS per week), U-17 (four TS per week with the exception of one team that performed three times per week) and U19 (five TS per week). Weekly microcycle: post-match (first TS in the microcycle), the middle week (mean values of the TSs between the first and the last TS of the week) and the pre-match (last TS of the week). Number of players per training unit was 23 ± 4.	Distance covered, heart rate and body impact.	*U-15*: Middle-week TS presented lower values in both average DC and time intervals per sprint than the Post-match and Pre-match; *U-17*: 1) Pre-match showed higher values in both TI and average DC, 2) Pre-match showed lower values in the number of sprints compared to the Middle week; *U-19*: 1) Post-match presented higher values in all sprint variables compared to Pre-match and Middle week, 2) Significant effects were found between Pre-match and Middle week, 3) Pre-match presented lower values in relative DC and body impacts; *General*: 1) Relative DC and BI showed significant differences across all TSs, 2) Strong differences were found in BI between both Post-match and Pre-match and Middle week and Pre-match, 3) There was an interaction between HR zones and moments. The results showed that the Post-match spent approximately 191% more time in ≥ 90% HR_{max} than the Middle week.	87,50
Brito et al. (2016)	13 (U-19) from a first league club in France.	Mixed-Longitudinal study.	2,591 TS from 36 microcycles. Instruments: RPE using CR-10, Category ratio scale (CR-10) for each TS or match, Duration of TS and Perceived fatigue.	*Season parts*: 4 different phases: preparation I (July-August), competition I (August-December), preparation II (January-February), and competition II (January-April); Number of microcycles (MC) comprised 5-11 training sessions (TS).	Rating of perceived exertion, internal training load, perceived fatigue, match-related contextual variables (result, location, and opponent's level).	1) Weekly training load: after losing or drawing > after winning a match. When preparing for a home match: weekly training load > an away match, 2) After playing against a top team, the average sRPE in 3 days after the match was lower than that after playing a medium level team, 3) Weekly training load scores decreased as the season progressed, 4) During preparation I, weekly training volume, average sRPE, and weekly training load were higher than during the other phases of the season. Additionally, during competition I, average sRPE was higher than during preparation II, and weekly training volume was higher than during competition II, 5) during the competition periods, higher sRPE scores were reported in the first 3 days of the microcycle compared with the last 2 training sessions of the microcycle.	93,75

Gjaka et al. (2016)	22 (U-15) from a Kosovan team.	Prospective cohort experimental study.	12 TS from 4 microcycles. Instruments: RPE, CR-10 Borg scale, Recovery questionnaire.	1) Players' RPE and recovery, during and after (30 minutes) trainings and matches (CR-10 scale) during four-weeks, three training units per week; 2) ITL: training duration (minutes) multiplied by training intensity (RPE value); 3) recovery questionnaire was submitted to the players before every TS and match.	RPE, recovery and ITL.	1) Significant session-RPE differences between training units. Additionally, significant differences were found in recovery score between training units; 2) significant differences in weekly session-RPE between weeks with a different competition schedule.	75,00

Note: RPE = Rating of perceived exertion, TS = Training session, IL = Internal training load, CR-10 = CR-10 Borg's scale.

4. DISCUSSION

This systematic review purposed to synthesize the main results find out as well as to identify the most used methods to evaluate and monitoring young soccer players. For this purpose, were analyzed studies carried out with young soccer players, among Under-12 and Under-19 age categories, conducted between 2015 and 2018. Preferred Reporting Items for Systematic Reviews and Meta-analyzes (PRISMA) guidelines were followed.

Anthropometrics

In all reviewed studies, the height, weight, and some of the skinfolds were evaluated. It was interesting the diet/nutritional approach used in one of the studies, bringing evidence that this variable is determining the performance and, therefore, should be controlled by the club managers (27). One of the most valuable variables used in the identification, selection, and development process of soccer players is the height. Despite being genotypic, it is linked with phenotypic factors like nutrition, so it is a surprise that only one study controlled the diet.

In terms of body mass in young soccer players, this variable is linked to the aerobic capacity, is essential to the performance in the training and matches (28). It was found in a sample followed for four years, in which players with low-performance level also presented a higher level of body mass compared with players with a high level of performance (29).

A limitation in the analyzed studies is the non-control of biological maturation (27, 30, 31). Biological maturation is a variable, in terms of young soccer players, that should always be controlled because it directly affects individual capacity. On the other hand, among the studies that controlled maturation, the method proposed by Mirwald et al. (21) was the most used (29, 32, 33).

In this systematic review, it was found that the age at the peak of height velocity (APHV) in young soccer players keep following the tendency of past studies, happening around 13 to 14 years old (32,

33). Furthermore, results from the analysis between maturation and anthropometrical measures also followed the past studies' tendency. In this sense, players after PHV are taller and heavier than players before or during this somatic period (32).

Functional capacities

Lower limb strength was the focus of the studies dedicated to analyze the functional capacities (34, 35). Almost unanimous was the use of Countermovement Jump (CMJ), Squat Jump (SJ), LongJump (LJ) or even a combination between two types of a jump (e.g., Abade et al. (35); Malone et al. (36); Cunha et al. (37)).

Some studies made training protocols to analyze the effects on functional capacities. After six weeks, with resistance exercises combined with plyometric exercises and regular soccer training, the lower limb strength was improved. This study was found a significant difference between the group that participated in the training protocol and the group that only practiced soccer (38).

Regarding the acceleration and velocity, in a general way, it was possible to observe these improvements as the player's progress about their chronological age (11), when they take part in a training period (34, 38), or when there is an increase of trunk stability (39).Brocherie et al. (34) submitted players to 5 weeks of training based in sprints of high intensity (RSA, Rampinini, Bishop (19)) and another based in power, agility, and sprints exercises. In another study, Franco-Márquez et al. (38) followed players for six weeks, applying power combined with muscular resistance training. In both studies, in the final of the training period, players were compared with players that only did regular soccer training.

It was found, analyzing the articles focused agility' soccer players, that it is related with velocity, even if it is assessed in a protocol that maximal velocity is not reached (40). Moreover, it was found that the soccer training (41) and the age (42) are related with a significant improvement in agility tests.

The Yo-Yo variations (17, 18) were the most used tests to analyze aerobic capacity, as well as to determine the maximal heart rate (43, 44). To study the anaerobic capacity and the repeated sprint ability, the most used test was the Repeated Shuttle Sprint Ability test (RSSA test, Impellizzeri, Rampinini (20)). To the same purpose, some researchers (45, 46) chosen the Repeated-Sprint Ability test (RAS, Rampinini, Bishop (19)). Referred tests are similar to considering the material and human resources to apply the tests.

Functional capacities assessments with the purpose of following the sport-related performances have been giving rise to more robust experiments. It was possible to verify that, about 40% of the studies analyzed performed experimental design with intervention periods, with different types of training, purposing to identify the most effective method to improve the sport performance over time.

Besides that, only about 30% of the studies do not use a control group in the analysis during the intervention period. In a soccer context, where the result stills the most important for a considerable number of coaches, it is admirable that this kind of research is made. Finally, it supposed to stop the extra activities in the control group, in a sense to compare the other treatments with regular and specific soccer activities.

Match analysis

Match analysis has been studied with different purposes, with simple a method, and with technological support. Global Positioning System (GPS) are more accurate and comfortable and are more and more incorporated in the day-by-day of the soccer clubs in the professional category but also the young categories. One of the analyzed studies in this systematic review was comparing the soccer players' performance in the sea level and under 3600 m of altitude influence (47). In all the cases, the GPS systems that were used had a capacity between 5 Hz and 15 Hz, increasing the

reliability of the obtained data. Technical analysis was performed by some scientists using the social network analysis and match activities for this purpose (10, 12, 48).

In one of the studies related to social networks, analyzing players from the U-14 age category, Clemente et al. (49) found a positive and moderate correlation between performance in the *Dribbling test* and the variable *Betweenness centrality*. To the authors, this correlation means that the players could improve the cooperation between teammates if their technical ability is good enough. These players could be essentials to maintain ball possession. In another study with players from the U-12 age category, Oliveira et al. (50) found that midfielder player is the offensive sequence builder, being a link between the defense and attack players. This is the expected function of a midfielder but finding this kind of behavior in the U-12 category is essential to realize how the game has developed during the years.

It was possible to verify in the studies that analyzed player's activities, that U-15 players covered longer distances than U-13 and U-14 players. Besides that, it was possible to identify a difference in the heart rate peak (PHR) between categories (PHR U-15 > PHR U-14 > PHR U-13) (51). Comparing players of high and low level, from the same club and age group (U-16), it was found that high-level players covered higher distances at high speed running (52).

Related with the player's activities, play in a natural or in artificial turf could make the difference. In a study performed by Brito et al. (48), it was found that players covered higher distances in an artificial turf than in a natural turf. Moreover, in artificial grass, players can perform more high-intensity actions. Once again, midfield players covered more distances than the other position players.

Only one analyzed article assessed player's decision making (53). It was a surprise considering the importance of this variable to the player's performance during a soccer match (54-56). Considering the age range in which these studies are performed, the analysis of tactical behavior should also be

carried out, since, during the development process, learning and acquisition of this component is essential for soccer practitioners (57).

Maturity status

Maturation is an essential variable for youth sports in general and youth soccer in particular. There are different methods to access maturation, and, in this systematic review, it was found that some methods are more usual than others and probably the preference for an applied-friendly method is overcoming the internal reliability of the instruments.

With the Maturity Offset method (21), it is possible to identify the age at the peak height velocity (PHV) and, as well, the years apart from the PHV. In most of the studies analyzed, PHV was used to sort split players into groups so that they could be compared, for example, in the functional performance variables such as speed, agility, and lower and upper limb strength.

Romann, Javet (58), in an innovative approach, analyzed the coaches' opinion about the maturational status of the players and performed two other methods, Maturity Offset by Mirwald et al. (21) and the TW3 method by Tanner et al. (25). In this study, the results showed that coaches can determine the maturational status of young soccer players without resorting to specific methods for this purpose. In another interesting and innovative study, Cumming et al. (59) divided the players by the Bio-Banding approach to be included in a competition. The players reported feeling better in this type of competition format, alleging to be less demanded on functional capacities, being this type of competition more appropriate for the development of tactical and technical aspects.

It is important to note that more than half of the studies (61.10% (n = 11)) in this session are aimed to analyze the maturation and functional abilities of the players (e.g., McCunn, Weston (60) and, Bidaurrazaga-Letona, Lekue (61)). Among these, some studies consider functional capacities and technical capacities as variables of interest (62, 63), functional capacities and tactical declarative knowledge (64) and, finally, functional capacities and the Relative Age Effect (60).

One of the studies calls attention to analyze the quality of joint movement in the different maturational status of the players (65). The method developed by Cook (66) is useful for the parsimonious analysis of movement and lack of movements in the different joints. During a competitive season, players with more opportunities to participate in training sessions and matches will benefit from injury prevention (67).

As in other sessions of this systematic review, it was possible to note that authors didn't analyzed the procedural, tactical knowledge, leaving an important gap for future studies. After all, science has already demonstrated that an individual with high declarative knowledge doesn't necessarily hold a high tactical procedural knowledge (68). In a sport-related context, although players have a high declarative knowledge level since it is the know-how that can decide on the success or unsuccess of players and teams (69).

Multidimensional and career progression

Multidimensional studies were grouped in this section, as well as the studies that analyzed relevant aspects for the career progression of a soccer player. In this sense, it was found studies that differentiate players that were selected to progress in the youth soccer departments and the excluded ones (70). The present review also found studies that observed differences between skillful players and their peers less skillful, regarding anthropometrical aspects, maturational status, functional capacities and the practice time (71-73).

Once again, it is possible to note that most of the articles analyzed functional capacities as well as the maturational status. However, it is possible to observe that technical and tactical capacities are approached in the studies included in this section. Besides that, joint movement quality was also an analyzed variable (74). There are still few studies that carried out this analysis, probably due a lack of knowledge of the method proposed by Cook (66). It would be advantageous for all individuals involved in the process of identification, selection, and development of young soccer players, that

the joint health assessment could be performed and monitored. After all, there are evident benefits in preserve the articular joint healthy, acting in the sense of injury prevention, locomotor improvement, and, consequently, the development of functional capacities as jumps, changes of direction, and speed.

Analyzing U-16 players, Forsman, Blomqvist, Davids, Liukkonen, & Konttinen (2016) concluded that the most necessary aspects related to the career progression to the professional category are the psychological and physiological aspects. In another analysis with U-17 soccer players, the practitioners that were kept in the soccer career presented higher values of height, body mass, tactical declarative knowledge, shooting accuracy, ball control, speed (30 meters), and Countermovement Jump (70).

In the study performed by Sporis et al. (72), the authors found that anthropometrical measures have an inverse relationship with the performance of functional capacities, in general. However, as in other studies, researchers highlighted the necessity to analyze different variables as technical, psychological, and decision-making related variables. Besides that, the authors consider that the practice time also should be included in the spectrum of variables analyzed in the identification, selection, and development of young soccer players.

Small-Sided and Conditioned Games

The Small-Sided and Conditioned Games (SSCG) has been used as part of the training sessions in soccer clubs, as well as to perform scientific studies. It is a useful instrument for these purposes because of the similarity with an official match demand, and in an SSCG, there are a lot of variables that could be controlled (e.g., number of players, field size, time of the game, etc.). Among the studies analyzed in this systematic review, the method most used to analyze the SSCG was the System of Tactical Assessment in Soccer (FUT-SAT, Teoldo, Garganta (26)). This system uses a

configuration of GK+3 vs. 3+GK, in a 36 x 27 m field, during 4 minutes, being observed the core principles of soccer (75).

One of the studies that performed this evaluating system analyzed the relationship between the technical and tactical performance of players (76), and they found a positive and significant relationship between the variables. Specifically, they detected that tactical principles *Penetration*/*Width* and *Lengthwith ball* performances are related to the dribbling skill.

In other studies, tactical behavior was analyzed in different age categories (77-79). In all of the studies mentioned above was possible to identify a higher efficiency in the offensive phase principles than in defensive ones. Young players without the ball possession (in the defensive process) probably have more difficulties in understanding and performing the core principles of soccer.

Tactical behavior outcomes were related to the impulsivity of young Brazilian soccer players (80). Other analyses was performed to check the influence of tactical procedural knowledge and numerical advantage on the tactical behavior (81, 82). When players are in a numerical advantage situation, they perform, offensively and defensively, tactical principles with higher accuracy probably because they have more time to analyze the environment and decide and chose the best actions to do. It was also assayed the development of tactical behavior during a competitive season (83).

Other analyzed dimensions were the tactical behavior of soccer players, compared by different performance indicators (84) and the tactical behavior compared from players with different tactical functions (85). Midfielders presented a higher frequency of successful movement in the *Offensive Unity* compared to the defenders. On the other hand, defenders registered better results regarding the *Defensive Coverture*, given support to the player that is performing the *Delay*.

Without identifying a specific analysis method of the SSCG, pointed out research questions that were related with the impact of different tactical tasks (variation in the number of players, field size,

and recovering time) on the player's activities and the heart rate (HR) and mental fatigue associated to these activities (86-88).

Moreover, the difference in the HR and rating of perceived exertion (RPE) in the presence and the absence of head coaches were also analyzed. Players performed a higher number of high-intensity actions under the encouragement of head coaches (89). Los Arcos et al. (90) used the SSCGs as a training method comparing it with the effects of Interval Training on the player's aerobic capacity.

It is essential to highlight the use of the technology of Global Positioning System (GPS), between 5 Hz and 15 Hz, to monitoring the SSCGs in 16 articles in this section. It is not happening in the regular and official matches of youth soccer, and probably this is a problem of regulation from the federations. Finally, both at the level of professional soccer and youth soccer, the SSCGs are a serviceable resource, driving the evaluations and the training sessions.

Training session

It was possible to find out that rating of perceived exertion (RPE) (91, 92), as well as activity levels of players, were analyzed recurrently (93). Training session and their content are essential to an accurate understanding of the obtained outcomes. Thus, besides to analyze the individual and collective capacity, coaches and their staff, as well as researchers, should focus higher efforts to assay the training sessions in soccer clubs.

5. LIMITATIONS

The main limitation of this study was the fact that decision making was not included as a study variable, considering the link between decision making and the development of soccer player's process. Also, the short temporal period analyzed in this review is treated a limitation. Finally, analyzing only manuscripts written in English is another limitation, even if the majority of scientific literature is produced in this language.

6. CONCLUSION

After analyzing the results and further discussion, it is possible to conclude that the young soccer players have been evaluated by different perspectives, but that the functional capacities are still a priority on the part of the researchers. It was also possible to verify that the sports sciences are using on a larger scale the technological instruments to increase the precision with which the players are evaluated.

Technological advice (e.g., GPS advice) are widely used with different purposes in all age categories. On the other hand, it was possible to verify that player's analysis is still made by notational technics. Statistical knowledge applied to the sport sciences is also a meaningful instrument to identify the most representative variables to the player's performance. Besides that, statistical support is essential to perform more sophisticated analysis like sequential analysis, social network analysis, multinomial regression, and multivariate modeling.

Among the SSCGs, it was possible to verify that the FUT-SAT has been used in scientific research, although the same is not repeated in official games. Analyzes of the tactical principles were not carried out in official games, in which the evaluations regarding the activity of the players and social network analysis prevailed during them.

Maturity is a recurring variable, and this is a positive point among the results found given the importance of this variable in the analysis of young soccer players. However, the analysis of the training sessions still needs to be explored more frequently and in a more detailed way to understand what has been done with the young. In this way, reflecting on more precise answers regarding the analysis of the performance in physical tests, in SSCG, or even in official matches. Finally, note that analysis isn't yet done to look for the outliers; on the contrary, they compare groups by some behaviors or activity level using average measures.

7. DISCLOSURE STATEMENT

No relevant conflict of interest was reported by the authors.

8. FUNDING

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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