



Assessing physical, technical, and tactical performance of youth football players in small-sided games: a systematic review

Evaluación del rendimiento físico, técnico y táctico de jugadores de fútbol juveniles en partidos reducidos: una revisión sistemática

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Abstract

Introduction: The small-sided games are considered an important way to improve football players performance.

Objective: This systematic review aimed synthesize available information concerning the methodologies, variables, and procedures employed to assess physical, tactical, and technical performance among youth football players through small-sided games.

Methodology: Literature searches were conducted across three databases: EBSCOhost, PubMed and Web of Science. Were employed the following descriptors: (“soccer OR football”) AND (“technical/tactical/physical performance”) AND (“small-sided games”), focused on original articles in English that analysed young male football players. The initial search produced 105 results, and after screening, 45 papers were included in the final sample.

Results: These papers adopted a cross-sectional design, utilizing various procedures aimed at detecting the effect of multiple constraints on players’ physical, tactical, and technical performance.

Discussion: The findings suggested that small-sided games represent an effective methodological tool for improving the performance of youth football players. Researchers commonly investigated variations in the number of players, pitch size and pitch configuration. Technical actions (passes, shoots and ball receptions) offensive and defensive tactical principles, as well as physical variables (total distance covered and distance covered at different velocities) were frequently analysed.

Conclusions: This review presents a comprehensive depiction of the procedures, variables, and constraints commonly employed in the collection and analysis of technical, tactical, and physical data in small-sided games involving youth players.

Keywords

Small-sided games; soccer or football; performance; physical; tactical; technical; young.

Resumen

Introducción: Los juegos reducidos se consideran una forma importante de mejorar el rendimiento de los jugadores de fútbol.

Objetivo: Esta revisión sistemática tuvo como objetivo sintetizar la información disponible sobre las metodologías, variables y procedimientos empleados para evaluar el rendimiento físico, táctico y técnico de jugadores de fútbol juvenil a través de juegos reducidos.

Metodología: Se realizaron búsquedas bibliográficas en tres bases de datos: EBSCOhost, PubMed y Web of Science. Se emplearon los siguientes descriptores: (“soccer OR football”) AND (“technical/tactical/physical performance”) AND (“small-sided games”), centrados en artículos originales en inglés que analizaban a jóvenes jugadores de fútbol. La búsqueda inicial produjo 105 resultados y, tras la selección, se incluyeron 45 artículos en la muestra final.

Resultados: Estos artículos adoptaron un diseño transversal, utilizando varios procedimientos destinados a detectar el efecto de múltiples limitaciones en el desempeño físico, táctico y técnico de los jugadores.

Discusión: Los hallazgos sugirieron que los juegos reducidos representan una herramienta metodológica eficaz para mejorar el rendimiento de los jugadores de fútbol juveniles. Los investigadores comúnmente investigaban las variaciones en el número de jugadores, el tamaño del campo y la configuración del campo. Se analizaron frecuentemente las acciones técnicas (pases, tiros y recepciones de balón), principios tácticos ofensivos y defensivos, así como variables físicas (distancia total recorrida y distancia recorrida a diferentes velocidades).

Conclusiones: Esta revisión presenta una descripción completa de los procedimientos, variables y limitaciones comúnmente empleadas en la recopilación y análisis de datos técnicos, tácticos y físicos en juegos reducidos que involucran a jugadores juveniles.

Palabras clave

Fútbol; juegos reducidos; juveniles; rendimiento; físico; táctico; técnico.

Introduction

Football stands as one of the most widely practised sports worldwide, with a vast number of supporters and registered players. This widespread popularity enables it to mobilize extensive populations and attract significant financial investments. While the senior professional level enjoys the highest prestige and public recognition, the journey to this stage has captured the interest and investment from scientific community, clubs, and football academies (Williams, 2000). This highlights the meaning of talent development and early-age identification (Williams et al., 2020), with the goal of fostering effective practices and instructional environments that facilitate the smooth progression and transition of young players into the senior professional world (Abarghoueinejad et al., 2021).

Recognized as valuable tools for both sport instruction and training (Abd et al., 2024; Borges et al., 2022; Clemente et al., 2014; Sgrò et al., 2018), small-sided games can play a significant role in this developmental process. Small-sided games enable coaches to design training exercises adapted to specific goals while respecting the essence and principles of the game, providing football players with opportunities to experience game-like situations where crucial skills such as decision-making, spatial awareness, teamwork, and technical proficiency are developed in a realistic setting (Halouani et al., 2014). By participating in small-sided games, young players can refine their talents under pressure, receive immediate feedback, and adapt their strategies accordingly (Clemente et al., 2019). Therefore, integrating small-sided games into talent development programs can serve as a practical and efficient method for fostering growth and progression of aspiring football players. Concurrently, coaches have been progressively integrating this training method into the preparation for competitive events (Aguiar et al., 2012).

The multidisciplinary nature of team sports, coupled with increasing recognition of factors that significantly impact performance, has stimulated the development of comprehensive research designs focused on examining the constraints associated with manipulating small-sided games, covering dimensions such as physical, tactical, and technical performance (Aguiar et al., 2012). Moreover, recent investigation trends have increasingly focused on the age group between 15 and 17 years old (Abrantes et al., 2012; Barnabé et al., 2016; Castillo et al., 2021; Christopher et al., 2016; Pamungkas et al., 2024), possibly due to this chronological period coinciding with the final pubertal phase, thus highlighting its relevance in player development.

Substantial evidence suggesting that small-sided games can be influenced or manipulated by various factors, such as the number of players (Garcia et al., 2020; Sousa et al., 2021), pitch size (Lemes et al., 2020b; Mora et al.; Towlson et al., 2021) and configuration (Canton et al., 2022; Coutinho et al., 2020; Pulling et al., 2016), exercise and rest duration (Christopher et al., 2016; Koklu et al., 2015), or game rules (Machado et al., 2019 e Praxedes et al., 2018), supporting their efficacy in enhancing players' tactical, technical, and physical performance. Despite this, there is a need to better understand the constraints associated with small-sided games handling, as well as their effects across different competitive levels and age groups (Clemente et al., 2019). The research in the constraint's manipulation in small-sided games, can help coaches to understand the impact of their decisions in training conception. Furthermore, the knowledge about its effects in the different development stages of young players, will allow to explore certain performance dimensions and induce specific behaviours according to their needs.

Specifically, there is a lack of systematic reviews concerning performance assessment of young male football players using small-sided games, which makes it difficult to organise and systematise empirical knowledge on this subject. In general, previously conducted systematic reviews in the field of small-sided games have focused on identifying and describing the most common methods and variables for the different performance dimensions, as well as the impact of the different constraints' manipulation in the players responses. However, previous approaches lack scope regarding the performance dimensions and the majority don't distinguish the different age range (i.e. senior or youth players) of the included studies. Therefore, in the current systematic review, we aimed to bridge this gap by presenting a comprehensive overview of the methodologies, variables, and procedures employed in the analysis of performance indicators in small-sided games with young male football players. This approach differs from the previous ones (Clemente et al., 2022; Coito et al., 2020; Halouani et al., 2014; Junior et al., 2023; Sgrò et al., 2018) once it only includes studies carried out with young male football players, belonging

age categories between U11 and U18 and provide knowledge able to support training practices regarding technical, tactical and physical performance in small-sided football games.

This knowledge holds significant implications for future research and practice in youth football development, facilitating a more precise adaptation and effective application of small-sided games to the development stages of young players, reinforcing the support base upon which coaches make decisions and control the training process (Aguiar et al., 2012). This allows for a more accurate replication of several game situations and ultimately, enhances the effectiveness of training sessions. Additionally, disseminating the results of the present systematic review among teachers and coaches can help to define directions for future investigations.

Method

Protocol

This review used the “Preferable Reporting Items for Systematic Reviews and Meta-Analyses Protocols” (PRISMA-P) guidelines. The Cochrane Handbook for Systematic Reviews of Interventions was followed during the review process (Higgins & Green, 2011).

Search Strategy

The search strategy consisted of two phases. In the first phase, electronic databases including EBSCOhost.com, Web of Science™ and, MEDLINE (PubMed/PubMed Central interface) were searched up to July 2023. The online search used the following keywords: (“soccer OR football”) AND (“technical/tactical/physical performance”) AND (“small-sided games”). In the second phase, the selected papers underwent further scrutiny to identify additional articles for inclusion in this review. EndNote Software (version X9.0, X7.0.1, Clarivate Analytics, Philadelphia, PA, USA) was employed to manage the process of searching for studies, eliminating duplicates, and making selections. This software helped in maintaining data integrity and ensuring no studies were overlooked.

Inclusion Criteria

Studies included in the review are required to: (i) have been published after 2010; (ii) have a sample of young male football players, with ages comprised between 10 and 17 years old; (iii) aiming investigate technical, tactical, or/and physical performance through small-sided games; and (iv) be published in English in peer-reviewed journals.

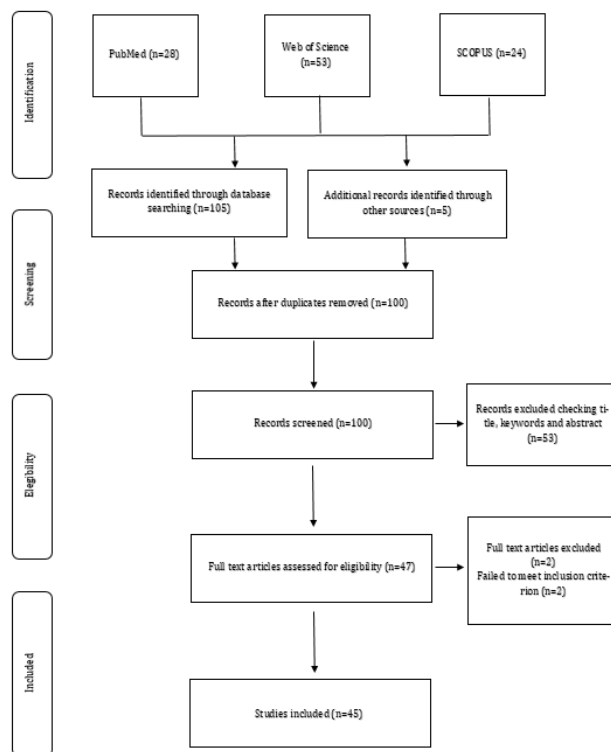
Study Selection

First, the identified articles underwent a selection process based on their title and abstract, which was followed by a detailed examination of those composing the sample. All studies were full screened by two researchers (MF, RB) with special focus on sample characteristics (age and gender), types of performance assessment and applied procedures. Only articles agreed upon both researchers were included. In cases where there was a disagreement, researchers asked for help a postgraduate researcher (DB), provided your opinion for inclusion or exclusion, after the article analysis and justification of decision. This occurred, for instance when articles analysing technical, tactical, or physical performance in small-sided games with female samples were encountered. Since the objective of this systematic review specifically includes male players, these articles were discounted. After the selection of articles, all reference lists were analysed to identify additional papers for inclusion, were founded more five studies. The selected articles then underwent a through reevaluation by both researchers (MF, RB), who jointly decided their inclusion or exclusion from the review. The duplicate articles were identified with the help of

Figure 1 displays the number of studies found in each electronic database, along with a flow chart detailing all the steps performed during the search process. Initially, the search returned 110 results, with 105 papers originating from database searching and five from other sources. After removing duplicates, 100 articles remained, all of which were analysed based on their title and abstracts. Subsequently, 53 papers were excluded, primarily due to failure in analysing young football players. The remaining 47

studies underwent detailed screening, resulting in the exclusion of two investigations due to the assessment of performance indicators in a different context. Following the analysis of the selected studies and their respective reference lists, this systematic review comprised 45 articles.

Figure 1. Flow chart including bibliographic search and steps following the Preferred Reporting Items for Systematic and Meta-analyses (PRISMA) statement (Moher et al., 2015).



Methodological quality of the studies

The methodological quality of the studies was evaluated considering the scale presented in Table 1, adapted from Abarghoueinejad et al. (2021). This specific methodological quality assessment scale was chosen due to its similarity in purpose to the current investigation, as both aim to analyze and synthesize information about the performance of young players. Each article was assessed considering eight criteria: aim (Q1); sample characteristics (Q2); types of performance assessment (Q3); procedures (Q4); reliability and validity of instruments (Q5); statistical procedures (Q6); results and outcome (Q7); conclusions and practical applications (Q8). All criteria were scored on three levels: 0 (no), 1 (maybe) and 2 (yes), except for Q2 (0 = characteristics of participants and sample calculation not presented; 1 = only one is displayed; 2 = both are displayed) and Q5 (0 = reliability/validity of the instruments is not mentioned; 1 = is mentioned; 2 = is measured). The total scores of each article ranged between 0 and 16. To enable a direct comparison between investigational designs, a percentage score (0-100%) was calculated as measure of the methodological quality of the studies. Studies were classified into three levels of methodological quality scores: low (< 50%), moderate (50-74%) and high ($\geq 75\%$).²⁵ Two researchers (MF, RB) analysed the articles, and in case of disagreement, a third researcher (DB) was consulted to make the final decision.

The resulting quality scores are presented on Table 2. Overall, the mean \pm standard deviation score of the 45 articles was 91.3 ± 9.9 per cent. Additionally: (a) one study achieves score of 100% and no study scored below 50% (indicating low quality); (b) all articles were classified as high quality (with scores ranging between 75% and 100%); (c) lower values were primarily related to question 2 (sample calculation) and question 5 (validity of instruments).

Table 1. Methodological Quality Scoring System (adapted from (Abarghoueinejad et al., 2021).

Question	Answer	Score
Q1 Was the aim of the study clearly set out?	Yes= 2 Maybe= 1 No= 0	0-2
Q2 Were the characteristics of participants (number, age) and sample calculation presented in detail?	All= 2 Only one= 1 None= 0	0-2
Q3 Are the types of performance assessment and variables described? Are the measures of analysis specified?	Yes= 2 Maybe= 1 No= 0	0-2
Q4 Are the procedures clearly described? (players a-side, pitch size, match duration, match type, constraints)	Yes= 2 Maybe= 1 No= 0	0-2
Q5 Was the reliability/validity of the instruments mentioned or measured?	Measured= 2 Mentioned= 1 Not mentioned=0	0-2
Q6 Were statistics clearly presented?	Yes= 2 Maybe= 1 No= 0	0-2
Q7 Where the main results described in detail? (Mean, standard deviation/error deviation)	Yes= 2 Maybe= 1 No= 0	0-2
Q8 Were the conclusions clairvoyants (with clear practical implications and suggestions for future research)	Yes= 2 Maybe= 1 No= 0	0-2

Special rules applied to Q2 (no reference = 0; only number/age = 1; number/age and sample calculation = 2) and Q5 (not mentioned = 0; mentioned = 1; measured = 2).

Results

The studies included in the current review are presented in Table 2, which includes details about the authors and year of publication, participants (including the number and age group), study dimensions and performance assessment variables; procedures/constraints (including number of players involved, game structures, constraints, and game spaces), and quality score of each article.

Table 2. Properties and variables of the included studies.

Author	Participants Age/Number	Performance Assessment/Study Dimension	Procedures/Constraints	Quality Score
Abrantes et al. (2012)	16 players (U16)	Technical: pass, reception, dribble, shot, tackle, and interception. Physical: heart rate (HR) zone 1 (< 75% HRmax); zone 2 (75–84.9% HRmax); zone 3 (85–89.9% HRmax), and zone 4 (\geq 90% HRmax) and rate of perceived exertion (RPE) (Borg Scale).	GK+3 vs 3+GK 20x30 m GK+4 vs 4+GK 20x40 m Only offensive [OFF]; only defensive [DEF]; and both defensive and offensive [GAME]	94%
Alcântara et al. (2021)	11 players (U14)	Technical: total number of successful passes, unsuccessful passes, contacts with the ball, ball involvement, goals scored, shots on target and unsuccessful shots performed per player. Physical: total distance covered (m), distance covered at different speed (high intensity running 13-18 km.h ⁻¹ , sprinting \geq 18km.h ⁻¹ ; individual speed threshold > 80% of peak speed reached) and RPE (CR-10 Scale).	GK+3 vs 3+GK 37x24 m 4x5 min/2x10 min/1x20 min GK+5 vs 5+GK 48x31 m 4x5 min/2x10 min/1x20 min	88%
Angulo et al. (2020)	40 players (U12)	Tactical-technical: technical action by the player who gained possession the ball; actions performed when a team has ball possession and actions that result in the team losing possession; the height of the ball when possession starts and ends; the body surface used to initiate and terminate possession; distance from the nearest opponent; support from teammates; pressure lines breached with the ball; and field area.	GK+7 vs 7+GK 58x38 m Goal Size (6x2 m) GK+4 vs 4+GK 38x20 m Goal Size (3x2 m)	94%
Aquino et al. (2019)	51 players (U11/U13/U15/U17/U20)	Physical: total distance covered (m), high-intensity running (U11 mean \geq 14km.h ⁻¹ ; U13 mean \geq 15 km.h ⁻¹ ; U15 mean \geq 16 km.h ⁻¹ ; U17 mean \geq 17 km.h ⁻¹ ; U20 mean \geq 18 km.h ⁻¹) acceleration (\geq 2m.s ⁻²), deceleration (\leq 2 m.s ⁻²) and mean heart rate (HR).	GK+5 vs 5+GK 49x25 m	94%
Barnabé et al. (2016)	36 players (U16/U17/U19)	Tactical: surface area, stretch index, team's length, and width.	GK+5 vs 5+GK 33x60 m	94%
Bravo-Sanchez et al. (2017)	154 players (U12)	Physical: zone 1 - 0–3.5 km·h ⁻¹ ; walking/jogging or 2: 3.6–7.9 km·h ⁻¹ ; jogging or 3: 8–12.9 km·h ⁻¹ ; running or 4: 13–15.6; high-speed running or 5: 15.7–19.9 km·h ⁻¹ ; sprinting or 6: \geq 20 km·h ⁻¹ . Total distance covered during the match (sum of zones 1–6), and distance covered at high-intensity (zones 4, 5 and 6), very high-intensity (zones 5 and 6), and	GK+7 vs 7+GK 40x60 m GK+8 vs 8+GK 40x60 m	94%



		sprinting pace (zone 6). Technical: number of passes, dribbles, attacking movements, ball recoveries, clearances, shots, and ball contacts.		
Canton et al. (2019)	30 players (U15/U23)	Tactical: sector (from back - 1 to front - 6), corridor (from right - 1 to left - 6) (m), centroid speed (m.s), team length (m), team width (m), speed of spread rate (m.s).	GK+4 vs 4+GK GK+5 vs 4+GK GK+6 vs 4+GK 40x45 m	94%
Canton et al. (2021)	24 players (U12)	Tactical: sector (from back - 1 to front - 6), corridor (from right - 1 to left - 6) (m), team length (m), team width (m), centroid angle (degrees), speed of spread rate (m.s), centroid speed (m/s), distance from centroid to own goal (m).	GK+5 vs 5+GK 31x37 m (frontal goal; diagonal right goal; and diagonal left goal)	94%
Canton et al. (2021)	24 players (U12)	Physical: total distance covered in offensive and defensive phases (m), distance covered in different speed zones, mean speed, speed coefficient of variation, spatial exploration index (SEI) and the complexity index from the multiscale entropy (MSE) of width and length displacements. Tactical: duration of ball possession, team width, team length and their ratio in both offensive and defensive phases.	GK+5 vs 5+GK 31X37 m 3X5 min (control; left diagonal and right diagonal)	88%
Castillo et al. (2021)	10 players (U16)	Physical: total distance covered (m), distance covered at different speeds (walking < 7 km.h ⁻¹ ; jogging 7-14 km.h ⁻¹ ; cruising <14-21 km.h ⁻¹ ; sprinting > 21km.h ⁻¹), maximal speed achieved, mean and peak heart rate.	GK+5 vs 5+GK 38x26 m 4x6 min; 6x4 min GK+5 vs 5+GK 53x37 m 4x6 min; 6x4 min	94%
Christopher et al. (2016)	12 players (U16)	Physical: total distance covered (m), distance covered at different speeds (low speed running 0-6 km.h ⁻¹ ; moderate speed running 6-17 km.h ⁻¹ ; high-speed running > 17 km.h ⁻¹), number (No) high speed runs, No accelerations (> 2m.s ²), No decelerations (< 2m.s ²). HR and RPE (CR-10 Scale) Technical: passes, successful passes, individual possessions (time), regains, shoots and shoots on target.	GK+5 vs 5+GK 50x32 m 8 min continuous; 2x4 min (1 min rest); 4x2 min (45-60 s rest)	88%
Clemente et al. (2019)	16 players (U11)	Technical: conquered balls, received balls, lost balls, attacking balls/passes and shots.	3 vs 3 (small goal 2x1 m) 15x20 m 3x3 min 6 vs 6 (small goal 2x1 m) 30x22 m 3x6 min	94%
Clemente et al. (2020)	48 players (U13/U15/U18)	Tactical: the area occupied by the players of each team, the distance between both teams' centroids, the players distances to their own teams, the stretch index.	GK+4 vs 4+GK 30x20 m	94%
Coutinho et al. (2017)	12 players (U16)	Physical: distance covered (m.min), high acceleration (> 3 m.s), moderate acceleration (2-3 m.s), low acceleration (1-2 m.s), high deceleration (> 3 m.s), moderate deceleration (2-3 m.s), low deceleration (1-2 m.s). Tactical: space exploration index (m), longitudinal synchronization (%), lateral synchronization (%), length (m), width (m), dispersion speed (m/s) and contraction speed (m/s).	GK+6 vs 6+GK 62x43 m	88%
Coutinho et al. (2019)	12 players (U15)	Tactical: stretch index (approximate entropy), distance between dyads (coefficient of variation and approximate entropy), regularity zones occupied (approximate entropy), lateral and longitudinal synchronization (%) Physical: total distance covered at very low intensity (0-6.9 km.h), low intensity (7-9.9 km.h), moderate intensity (10-15.9 km.h), very high intensity (≥ 16 km.h).	GK+6 vs 6+GK 62x43 m (with no spatial references; with spatial references)	88%
Coutinho et al. (2020)	10 players (U14)	Tactical: distance between dyads (m, coefficient of variation and approximate entropy), effective playing space (m ²), lateral and longitudinal synchronization (%). Technical: successful passes (%), successful dribbles (%), shots on target (%) and goals (%). Physical: total distance covered (m), game pace (km.h), walking (0-3.5 km.h ⁻¹), jogging (3.6-14.3 km.h ⁻¹), running (> 14.4 km.h ⁻¹).	GK+5 vs 5+GK 30x25 m (lines condition; dashed condition; corner condition)	94%
Coutinho et al. (2022)	12 players (U17)	Technical: number of touches per possession, successful passes and unsuccessful passes, shots on target and shots out of the target. Physical: total distance covered (m), and the distance covered at different speed levels: walking (0.0-3.5 km.h); jogging (3.6-14.3 km.h), running (14.4- 19.8 km.h) and sprinting (≥ 19.9 km.h). Tactical: distance from each player to the nearest opponent, variability in the distance from each player to the nearest opponent, regularity in the distance from each player to the nearest opponent.	GK+6 vs 6+GK 62x43 m (control condition; modified individual behaviour; modified collective behaviour; modified individual and collective behaviour)	88%
Folgado et al. (2019)	20 players (U15)	Physical: total distance (m) covered with and without the ball, distance covered at different velocities (walking 0-7.1	GK+4 vs 4+GK 40x30 m/30x40 m	88%

		km.h ⁻¹ ; jogging 7.2-14.3 km.h ⁻¹ ; running 14.4-19.7 km.h ⁻¹ ; high speed running >19.8 km.h ⁻¹ . Tactical: positional data (team centroid distance, length and width while attacking and defending). Technical: No and distance of forward, lateral, and backward passes, lost balls, dribbles shoots and goals.		
Gonzaga et al. (2014)	153 players (U15)	Tactical: offensive tactical behaviour (penetration, offensive coverage, depth mobility, width and length and offensive unity); defensive tactical behaviour (delay, defensive coverage, balance, concentration, and defensive unity) and game tactical performance.	GK+3 vs 3+GK 36x27 m	94%
Hill-Haas et al. (2010)	16 players (U16)	Physical: total distance covered (m), mean speed (m.min ⁻¹), distance covered in different speed zones 1 (0-6.9 km.h ⁻¹), 2 (7-13 km.h ⁻¹), 3 (> 13 km.h ⁻¹), percent HR max (4 intensity zones: zone 1, < 75%; zone 2, 75-84%; zone 3, 85-89%; and zone 4, < 90%); percentage time in each zone and actual HR.	3 vs 4/3 vs 3 (+1 floater) (small goals 1.2x1.8 m) 37x28 m GK+5vs5+GK (+1 floater) 47x35 m Condition A: with offside rule Condition B: ball cannot be thrown in if it leaves the grid Condition C: all attacking team in offensive zone for a goal to count. Condition D: with 2 neutral players out the pitch Condition E: 1 player from each team leave the pitch during interval time	94%
Joo et al. (2016)	32 players (U13)	Physical: total distance covered (m) covered inplay (during actual ball playing period) and outplay (during moving or positioning for free-kick, corner kick and ball outs); distance covered at different speeds (zone 1 - 0-6.9 km.h ⁻¹ ; zone 2 - 7-9.9 km.h ⁻¹ ; zone 3 - 10-12.9 km.h ⁻¹ ; zone 4 - 13-15.9 km.h ⁻¹ ; zone 5 - 16-17.9 km.h ⁻¹ ; zone 6 - ≥ 18 km.h ⁻¹). Technical: ball touches, pass variables (according to distance (m), range (°), area and success rate) and shoot variables (all goal shoots and valid goal shoots).	GK+7 vs 7+GK 68x47 m/75x47 m GK+10 vs 10+GK 75x47 m	88%
Koklu et al. (2015)	12 players (U16)	Physical: walking (0-6.9 km.h ⁻¹), low intensity running (7.0-12.9 km.h ⁻¹), moderate intensity running (13.0-17.9 km.h ⁻¹), high intensity running (> 18 km.h ⁻¹). RPE and HR (% of HR MAX) Technical: No of touches of the ball, No of total passes, No of successful passes, No of tackles and No of passes received.	3 vs 3 (maintaining ball possession) 18x30 m (recovery time - 1,2,3 and 4 min)	94%
Lemes et al. (2020)	18 players (U17)	Physical: average speed (km.h ⁻¹), distance covered at different speeds (0-7.2 km.h ⁻¹ ; 7.3-14.3 km.h ⁻¹ ; 14.4-21.5 km.h ⁻¹ ; 21.6-25.5 km.h ⁻¹), distance covered by accelerations higher than 1 m.s ⁻² , distance covered in different acceleration zones (1-2 m.s ⁻² ; > 2-3 m.s ⁻² ; > 3m.s ⁻²).	GK+3 vs 3+GK 36x27 m (athletes with different levels of endurance)	94%
Lemes et al. (2020)	48 players (U13/U14)	Physical: total distance covered (m), percentage of total distance covered at different speeds (0-6.9 km.h; 6.9 - 14.3 km.h; 14.3-21.4 km.h), peak HR and mean HR.	GK+3 vs 3+GK (+1 floater) 36x27 m/40x29 m	88%
Lopes et al. (2020)	35 players (U15)	Technical: involvements with the ball, goal attempts, total passes, tackles and interceptions and total involvements.	GK+5 vs 5+GK 46x60 m	94%
Lozano et al. (2020)	26 players (U16)	Physical: total distance covered per minute (TD.min), distance covered at low-intensity (< 14.4 km.h ⁻¹), distance covered at high-intensity per minute (> 14.4 km.h ⁻¹), distance covered at high-speed running per minute (> 21.0 km.h ⁻¹), number of accelerations (> 2 m.s ⁻²), number of decelerations (> 2 m.s ⁻²), and peak velocity (Vpeak)	LSG 8vs8 + 1 30x25m SSG 4vs4 + 2 30x25m Match-play 11vs11 100x60 m	94%
Machado et al. (2019)	268 players (U17)	Tactical: offensive tactical behaviour (penetration, offensive coverage, depth mobility, width and length and offensive unity); defensive tactical behaviour (delay, defensive coverage, balance, concentration, and defensive unity) and game tactical performance.	GK+3 vs 3+GK 36x27 m	94%
Machado et al. (2019)	20 players (U15/U17)	Tactical-technical: duration of ball possession, number of players involved, number of ball touches, number of passes, number of shots, players involved/duration of ball possession, ball touches/duration of ball possession, passes/duration of ball possession, ball touches/players involved, passes/players involved, passes/ball touches and goals/shots, start of the offensive phase/ball recovery, development of defence/attack transition state, progress of ball possession, end of the offensive phase, patterns of pitch space position, centre of the game and spatial patterns of team interaction.	GK+3 vs 3+GK 36x27 m GK+4 vs 4+GK 47.72x29.54 m (representative SSG; maintaining ball possession; progression to target games)	94%
Machado et al. (2020)	48 players (U15/U17)	Tactical-technical: duration of ball possession, number of players involved, number of ball touches, number of passes, number of shots, players involved/duration of ball possession, ball touches/duration of ball possession, passes/duration of ball possession, ball touches/players	GK+3 vs 3+GK 36x27 m GK+4 vs 4+GK 47.72x29.54 m (structural SSG; manipulation SSG)	100%

		involved, passes/players involved, passes/ball touches and goals/shots, start of the offensive phase/ball recovery, development of defence/attack transition state, progression of ball possession, end of the offensive phase, patterns of pitch space position, centre of the game and spatial patterns of team interaction.		
Martone et al. (2017)	33 players (U12/U14)	Technical: passes, target passes, dribbles, crosses, headers, tackles, shots on goal. Physical: mean HR during small-sided games, reported as percent of maximal heart rate.	5 vs 5 (small goal 1.2x0.8 m) 20x20m/30x30 m 4 vs 4 (small goal 1.2x0.8 m) 20x20m/30x30 m 3 vs 3 (small goal 1.2x0.8m) 20x20m/30x30 m	88%
Moreira et al. (2016)	16 players (U15)	Physical: total distance covered (m), sprint ($> 18 \text{ km}\cdot\text{h}^{-1}$), accelerations and decelerations ($> 2.0 \text{ m}\cdot\text{s}^{-2}$ and $-2.0 \text{ m}\cdot\text{s}^{-2}$ respectively), HR (time spent in each of 5 HR predefined zones were calculated) Technical: total goal attempts, total number of tackles, interceptions, headers, passes, pass effectiveness, total involvement with the ball and overall involvement.	GK+4 vs 4+GK 45x60 m 2x8 min (data were analysed across 4 min quarters)	88%
Moreira et al. (2017)	40 players (U16)	Technical: involvement with the ball, goal attempts, complete tackles, incomplete tackles, total tackles, successful passes, unsuccessful passes, total number of passes, total headers, effectiveness.	GK+5 vs 5+GK 46x60 m	94%
Nunes et al. (2020)	52 players (U11/U15/U23)	Physical: total distance covered (m), distance covered at different speeds (walking $\leq 9 \text{ km}/\text{h}$; running 9-18 km.h; sprinting $> 18\text{km}\cdot\text{h}$), number of sprints (n), maximum sprint speed (km.h). Technical: number of passing (ball contacts) with a dominant and non-dominant foot (n), and maximum passing speed (km.h).	4 vs 4 (maintaining ball possession) Small playing area (20x15 m) Medium playing area (25x20 m) Large playing area (30x25 m)	88%
Oh et al. (2018)	79 players (U12)	Physical: total distance covered (m), distance covered at different speeds (walking 0-6.9 km.h; jogging 7-9.9 km.h; low speed running 10-12.9 km.h; moderate speed running 13-15.9 km.h; high speed running 16-17.9 km.h; sprinting $\geq 18 \text{ km}\cdot\text{h}$) number of sprints, acceleration ($\geq 1\text{m}/\text{sec}^2$), deceleration ($\leq -1 \text{ m}\cdot\text{sec}^2$), explosive effort (sum of high intensity running $\geq 2.5 \text{ m}/\text{sec}^2$ and jumping $> 20\text{cm}$), repeated high intensity efforts (high speed runs $\geq 14.4 \text{ km}/\text{h}$; rapid acceleration $\geq 2.79 \text{ m}/\text{sec}$; rapid deceleration $\leq -2.79 \text{ m}/\text{sec}$) and HR. Technical: number of ball touches, successful dribbles, crosses, cutbacks, aerial duels, 12 pass variables (all; in defence; offense and 1/3 area; successful passes in each area; 1-touch passes; forward passes; short distance passes; middle distance passes; long distance passes) and three shot variables (all goal shots; shots in penalty area; valid goal shots).	GK+7 vs 7+GK 62x51 m GK+10 vs 10+GK 80x54 m	88%
Olthof et al. (2018)	148 players (U13/U15/U17/U19)	Tactical: inter team distance (m), goalkeeper-defender distance (m), stretch index X and Y (m), surface area (m ²), length and width (AU). Physical: distance covered per minute (m/min); distance covered at high intensity ($\geq 19.8 \text{ km}\cdot\text{h}$) number of sprints ($\geq 25.2 \text{ km}\cdot\text{h}$).	GK+4 vs 4+GK 40x30 m/68x47 m	88%
Olthof et al. (2019)	280 players (U13/U15/U17/U19)	Tactical: interpersonal distance (m), team length and width (m), player's surface area (m ²).	Gk+4 vs 4+GK 68x47 m Gk+6 vs 6+GK 80x56 m Gk+8 vs 8+GK 91x63 m	94%
Praça et al. (2019)	18 players (U17)	Tactical: offensive tactical behaviour (penetration, offensive coverage, depth mobility, width and length and offensive unity); defensive tactical behaviour (delay, defensive coverage, balance, concentration, and defensive unity) and game tactical performance; social network analysis (density and clustering coefficient).	GK+3 vs 3+GK 36x27 m	94%
Praxedes et al. (2018)	19 players (U12)	Tactical-technical: decision making (passing to a teammate who is unmarked; passing to a player who is marked closely or there is a defensive player in a position to cut off the pass; passing to an area of the pitch where no team-mate is positioned); execution (successful pass to a teammate (to his body if he is stationary, lead pass if he is running); appropriate length and speed; interception; pass is too hard, out of play; pass is too far behind or in front of a teammate).	GK+3 vs 2+GK GK+3 vs 3+GK 30x15 m GK+4 vs 3+GK GK+4 vs 4+GK 35x20 m	94%

Pulling et al. (2016)	8 players (U13)	Technical: pass forwards, pass sideways, pass backwards, successful pass, unsuccessful pass, penetrating pass, turning, dribbling, shot, goal. Tactical: Offensive scenarios (overlap, one-two ad 1 vs 1).	4 vs 4 (small goals 1.83 m) 45.72x36.58 m two goal posts centred in the end line. four goal posts in each side of the end line. two goal posts infield from the end line. four goal posts infield from the end line.	88%
Rodenas et al. (2021)	22 players (U15)	Tactical-technical: possession type, type of attack, possession width, passes per possession, penultimate action, penultimate player, penultimate invasive sub-scape, last player, last action, offensive performance, last invasive zone.	GK+7 vs 7+GK (+1floater) 53x38 m (standard configuration) 63x32 m (long configuration) 43x47 m (wide configuration)	94%
Sanchez-Sanchez et al. (2019)	12 players (U12)	Physical: total distance (m), total distance relative to match duration (m/min), peak velocity, total distance in acceleration ($> 1.5 \text{ m.s}^{-2}$), deceleration ($> -1.5 \text{ m.s}^{-2}$) and distance covered at different velocities (standing 0-0.4 km.h; walking 0.5-3 km.h; jogging 3.1-8 km.h; medium intensity running 8.1-13 km.h; high intensity running 13.1-18 km.h; sprinting $\geq 18.1 \text{ km.h}$; high intensity running and sprinting activities $\geq 13.1 \text{ km.h}$).	6 vs 6 (maintaining ball possession) 20x32 m GK+6 vs 6+GK 20x32 m	88%
Santos et al. (2022)	10 players (U15)	Tactical: distance from each player to the team centroid and distance from each player to the opponent team centroid. Technical: total number of shots on and off-target while considering the dominant and non-dominant foot; No of successful and unsuccessful dribbles; No of ball touches when considering the dominant and non-dominant foot; total number of successful and unsuccessful passes while considering the dominant and non-dominant foot. Physical: total distance covered; distance covered at different movement speed categories walking (0-6.9 km.h); light jogging (7.0-9.9 km.h); faster jogging (10.0-12.9 km.h); running (13.0-15.9 km.h); sprinting (16.0-17.9 km/h); and maximal speed ($> 18.0 \text{ km.h}$).	GK+4 vs 4+GK 40x30 m/50x35 m 2x5 min (normal condition; visual occlusion)	87.5%
Silva et al. (2014)	18 players (U11)	Tactical: offensive tactical behaviour (penetration, offensive coverage, depth mobility, width and length and offensive unity); defensive tactical behaviour (delay, defensive coverage, balance, concentration, and defensive unity) and game tactical performance	GK+3 vs 3+GK 30x19.5 m GK+6 vs 6+GK 60x39 m	94%
Silva et al. (2011)	16 players (U14)	Technical: involvements with the ball, passes, target passes (%), crosses, dribbling, shot on goal, tackles, headings. Physical: exercise intensity (mean HR).	3 vs 3 (small goal 1.2x0.8 m) 30x30 m 4 vs 4 (small goal 1.2x0.8 m) 30x30 m 5 vs 5 (small goal 1.2x0.8 m) 30x30 m	88%
Towilson et al. (2021)	44 players (U13)	Tactical: network density, network intensity, closeness centrality, betweenness centrality, page rank.	4 vs 4 (small goals 2x1 m) small (17x17 m) medium (24x24 m) large (29.5x29.5 m) expansive (34x34 m).	94%

Geographical distribution

The studies were published across four continents, Europe (n=29), America (n=13), Oceania (n=1) and Asia (n=2). Within Europe, studies were conducted in Portugal (n=13), Spain (n=9), Netherlands (n=2), United Kingdom (n=2) Turkey (n=1), Italy (1), Austria (n=1). All studies from America were conducted in Brazil (n=13). In Asia two studies were performed in South Korea (n=2). Finally, one was conducted in Oceania (1).

Sample size and age groups

In total, 1628 young football players were evaluated: U11 (n=66), U12 (n=215), U13 (n=193), U14 (n=77), U15 (n=492), U16 (n=160), U17 (n=472). Investigators analysed various age groups, either individually or grouped into different categories: U11 (n=4), U12 (n=8), U13 (n=6), U14 (n=5), U15 (n=11), U16 (n=10) and U17 (n=9).

Instruments and study designs

The most used instruments were the video camera recorder (n=27), global positioning system (GPS) (n=24), polar system (n=7), video-tracking system (n=4), and the RPE scale (n=4).



Concerning the studies design and analytical approaches, all studies employed a cross-sectional design; the majority adopted comparative procedures between groups (n=41), but some employed correlational (n=3) and predictive analyses (n=1).

Performance assessment

The analysed studies investigated technical (n=22), tactical (n=23), and physical (n=25) dimensions both collectively and independently. The frequency of technical actions such as passes, receptions, dribbles, and shots were the variables most explored (n=24), while the analysis of tactical variables relied heavily on offensive and defensive tactical principles (n=9) and inter-team distances (n=14). The physical variables most studied were total distances covered (n=20) and distances covered at different velocities (n=21).

Constraints

The examination of constraints revealed that the manipulation of pitch configurations and pitch sizes (n=17), were the most explored conditions. Additionally, other factors such as the number of players (n=8), objectives of the game (n=6), game time/rest time (n=5), and age groups (n=6), were also manipulated and studied.

Number of players

Regarding the number of field players, the following game formats were analysed: 3 vs 3 (n=16), 4 vs 4 (n=16), 5 vs 5 (n=13), 6 vs 6 (n=7), 7 vs 7 (n=4) and 8 vs 8 (n=1). Some studies (n=6) analysed the players responses with unbalanced team composition in two different ways, with a floater to create superiority in the team with ball possession (n=3) or promoting a temporarily team superiority (n=3).

Pitch configuration

Regarding game spaces, the area per player ranged between 37.5m² and 399m² per player and, many studies (n=9) analysed differences between two or more game spaces. Concerning pitch configuration, some studies (n=3) analysed the impact of marks on the pitch, others (n=3) explored the manipulation of goals posts positioning and analysed the impact of different pitch configurations or orientations (n=2).

Objective of the game

Concerning to the objective of the game, some studies focused on scoring goals using goals with goalkeepers (n=37), some approaches used small goals without goalkeepers (n=4). In five papers, maintaining ball possession was the objective of the game.

Game rules

Regarding game rules, some studies (n=6) used floaters (i.e. a special player who belongs to the team in ball possession) to create superiority to the team in ball possession, other studies (n=4) used limitative rules of players behaviours, and one study explored different game types (only offense/only defence).

Game time/rest time

Regarding the time manipulation, some studies (n=2) manipulated the bouts durations, other studies analysed the impact of time rests (n=2) and a study examined the temporal changes across periods.

Individual variables

Some studies compared the players' responses across different ages (n=6). These papers explored the differences in playing area (n=3), others analysed collective behaviours (n=2) and manipulated game rules (n=1). Other studies explored the differences across different skill levels (n=4), analysed differences across players with different tactical knowledges (n=1), level of sport expertise (n=1) and aerobic powers (n=1). Three studies explored differences across anthropometric profiles.

Studies limitations

Several studies presented limitations regarding sample size (n=8); others considered themselves insufficiently comprehensive in terms of performance dimensions assessed (n=6). Variables such as age category (n=7) or competitive level (n=7) were also pointed as limitations of some studies. In addition,



independent variables like players' number, playing area, SSG format, goal format, pitch configuration, players positional roles, among others were assumed as limitations of studies by the authors.

Overall, these studies compared the variability and reliability of performance indicators within different game configurations (n=2), analysed the effects of different training programs based on small-sided football games (n=1), explored the influence of affective decision makings (n=1), and evaluated the effects of positional roles (=1).

Discussion

This systematic review aimed to provide a comprehensive synthesis of the methodologies, variables, and procedures employed to analyse the tactical, technical, and physical performance of youth football players aged between 10 and 17 years old within the context of small-sided games.

Geographical distribution

In relation to the characteristics of the studies, the analysis of geographical distribution enabled us to understand the global representation of research in this field by categorizing them by continent and country. Most of the studies were developed in Southern Europe, particularly in Portugal and Spain. However, South America, namely Brazil, also contributed significantly to the literature on this topic.

Sample size and age groups

The results also provided insights into the research methodologies prevalent in this field, including the sample sizes, age groups, instruments, and data analysis techniques. Specifically, roughly half of the players who composed the samples of studies belonged to U15 and U17 age categories, following the U12 players. Therefore, there appears to be greater interest in analysing players' performance in the beginning and at the end of pubertal period, as well as in the beginning of final phase of training period.

Instruments and study designs

The video camera recorder was the instrument most used to register technical and tactical variables, the global positioning system (GPS) was largely used to register physical and tactical indicators. The polar system and the rating of perceived exertion (RPE) scale were used to analyse physiological indicators and, video tracking system was used to analyse all performance dimensions.

Concerning the study design, all studies employed a cross-sectional design; the majority adopted comparative procedures between groups (n=41), some employed correlational (n=3) and predictive analyses (n=1). All articles expressed data as means and standard deviations. Concerning to the aim of the studies, the majority adopt comparative procedures between groups, however, some studies embrace correlative and predictive analysis.

Performance Assessment

Pertaining to performance assessment, we can ascertain that the study of different dimensions (i.e., technical, tactical, physical) is balanced, as similar numbers of studies were investigated in each of the technical, tactical, and physical areas. This suggests that there is balanced interest in understanding and addressing each important aspect of youth football player performance, allowing for a more comprehensive and integrated view of player development and performance.

With respect to the most studied variables in each dimension, technical aspects including passing, receiving, dribbling, and shooting, alongside offensive and defensive tactical principles, and inter-team distances, were commonly examined. The primary physical variables investigated were the total distances covered, and distances covered at different velocities. The most analysed technical variables were mainly related to the offensive phase, however defensive indicators, as tackles and interceptions were also registered. Regarding the physical and tactical indicators, were analysed both in offensive and defensive phase. Thus, was verified a natural higher interest in indicators related to the offensive phase in the technical analysis, once many skills performed by players happens when teams have ball possession, meanwhile in the physical and tactical analysis the same trend was not observed.

Constraints

The present review examined the procedures and constraints involved in analysing performance indicators, providing valuable insights into how players respond to diverse conditions. The more commonly studied constraints encompassed variations in the number of players and pitch configurations (game space features). Additionally, aspects such as game objectives, game time, and game rules were also examined.

Concerning the manipulation of the number of players, the results suggested that fewer players promote higher frequency and variability of technical actions (Abrantes et al., 2012; Alcántara et al., 2021; Bravo-Sánchez et al., 2017; Clemente et al., 2019; Garcia et al., 2020; Machado et al., 2020). Players tend to behave more aggressively in smaller formats than in larger ones and, the number of players increases, team distances also increase, while tactical variability decreases (Olthof et al., 2018; Silva et al., 2014). Smaller formats have been associated with a greater number of physical skills and higher exercise intensity (Abrantes et al., 2012; Alcántara et al., 2021; Bravo-Sánchez et al., 2017; Silva et al., 2011), so 3 vs 3 and 4 vs 4 formats seem more adequate to coaches optimize aerobic performances of their players.

Continuing with the focus on the number of players, Lozano et al. (2020) analysed physical indicators during the return-to-play process, specifically assessing the role of a floater (special player who belongs to the team in ball possession), and analyse the differences in physical indicators of regular players and floaters, among small-sided games and official matches. Their findings showed that the use of floaters decreases the physical demands in comparison to those encountered by regular players and, suggest that this approach may serve as an appropriate procedure for the gradual reintroduction to training. Additionally, Canton et al. (2019) investigated the utilization of temporary numerical oscillations (game situations of numerical superiority/inferiority) during small-sided games. Their research indicates that this strategy could be beneficial for youth football players, facilitating the execution of a more diverse range of exploratory behaviours parallel to those observed in real game scenarios.

Coutinho et al. (2019); Coutinho et al. (2020); Coutinho et al. (2017) found no effects of mental fatigue or differences in technical, tactical, and physical performance when exploring different external boundary conditions such as lines, dashes and corners. Nevertheless, when analysing spatial references (e.g., pitch divided into sectors and corridors), they observed an increase in regularity in the zones occupied and in the distance between teammates' dyads.

Folgado et al. (2019) compared the responses of players during two different pitch orientations small-sided games: 40x30m; and 30x40m. In 40x30m, pitch players performed more passes, dribbles, and a showed a higher synchronization in longitudinal axis. In turn, in 30x40m field, players displayed a higher number of shots, more lateral passes and a lower distance between team centroids. In a similar vein, Rodenas et al. (2021) explored standard, wide, and long pitch configurations, and found that more goal opportunities, counterattacks, and offensive penetration displacements occurred in long and wide configurations, compared to the standard format. The wide configuration generated a greater number of crosses but fewer assists through passes behind the defence than the long and standard formats.

Furthermore, Pulling et al. (2016) found significant associations between small-sided games and the number and positioning of goal posts, observing variations in the frequency of turns, dribbles, shots, goals, and overlaps performed. Canton et al. (2021) demonstrated that modifying the goal position can promote different behaviours and improve players tactical knowledge but doesn't affect players' exploratory behaviour. Another study by Canton et al. (2022) showed that positioning the goals diagonally improve the variability of the length variable.

As researchers explored the impact of pitch configuration on players' performance, the examination of pitch size across different age groups has been another aspect worthy of investigation, revealing significant information about player performance. Specifically, studies have shown, in a consistent manner, that reducing the field size promotes more technical actions variability among players and simultaneously, a significant increase in the passes through defensive lines and a greater number of actions in the offensive zones (Bravo-Sánchez et al., 2017; Garcia et al., 2020; Joo et al., 2016; Nunes et al., 2021; Oh & Joo, 2018). Along the same lines, research testing the variability between small and large field formats and the reliability of different formats relating them to official matches, showed moderate variability in technical actions performed between different formats, suggesting that 6 vs 6 is an alternative tool to stimulate game-related physical performance in youth football players (Olthof et al., 2018).



Moreover, enlarging the pitch size seems to provide players with more available time to practice skills without pressure of opponents (Joo et al., 2016), enhance both inter-team and intra-team distances (contributing to increased variability in intra-team distance) (Canton et al., 2022), facilitate high-intensity running (which emphasizes the importance of increasing pitch dimensions for designing drills with greater physical impact) (Castillo et al., 2021; Martone et al., 2017; Nunes et al., 2021; Olthof et al., 2018). However, it's worth noting that one study found a reduced impact of pitch size manipulation on players' behaviour (Lemes et al., 2020a), suggesting that other factors may influence outcomes.

Finally, when comparing small-sided games and real football games, it was found that players covered significantly greater distances during various intensities of running and sprinting (low, moderate, and high speed) in small-sided games (Oh & Joo, 2018).

Regarding the objective of the game, many of the studies used goals with goalkeepers and analysed technical, tactical, and physical performance in the same extent. The studies that used small goals manipulated the pitch size, players number, goals positioning, and assess the effect of players maturation (Clemente et al., 2019; Martone et al., 2017; Pulling et al., 2016; Silva et al., 2011; Towlson et al., 2021). The studies that used maintaining ball possession manipulated the area per player, recovery time and assess the differences between this playing condition and others (Koklu et al., 2015; Lozano et al., 2020; Nunes et al., 2021; Sanchez et al., 2019). Sanchez et al. (2019) found differences between the physical demands imposed by maintaining ball possession formats and 7 – soccer matches in U12 players. Their results evidenced a low stimulation of the actions performed at high-speed in maintaining ball possession drills, but an acceleration-deceleration adequate stimulation.

The manipulation of game time was explored through different methods, including changes to bout duration and rest periods. Regarding bout duration, the studies reported higher values of total distance and distance at higher velocities in shorter formats (Alcântara et al., 2021). Apparently, prescribing tasks with short duration requires lower physical effort (Castillo et al., 2021). On the other hand, reducing rest time revealed a negative impact on technical performance, a decrease in the number of goals scored, an increase in the RPE and maximum HR (%HR), and a negative effect on distances covered at high intensity running and total distance covered (Christopher et al., 2016; Koklu et al., 2015).

Moreira et al. (2017) explored the influence of temporal changes across 4x4 minutes and verified notable decreases in total distance covered, metabolic power and frequency of sprints, accelerations, and decelerations. However, technical performance parameters did not vary.

Concerning game rules manipulation, Abrantes et al. (2012) examined the impact of different constraints on technical and physical performance in various game situations: only offensive, only defensive, and both. The authors found that "both situations" were more physically intense. Hill-Haas et al. (2010) mentioned that physiological, perceptual, and time-motion responses can be influenced by changes in small-sided games playing rules, and reinforced that rules related to scoring chance may improve player motivation. In addition, in a study by Sanchez et al. (2019) comparing the activity profile of players, between football 7 competition and 6 vs 6 small-sided games (maintaining ball possession), the demands imposed during small-sided games reduced stimulation in high-speed actions but sustained an adequate stimulation of acceleration-deceleration actions. Lastly, Coutinho et al. (2023) analysed the response of young players displacement to individual and collective variability and reported that it was more appropriate to use the individual variability condition to improve the players' technical actions and the collective variability condition to develop players' performance ability in different playing positions and team structures.

In addition to the investigations analysed throughout this section, a set of studies have been focusing on different variables or employing various procedures to study the impact of small-sided games on football players' performance. For instance, Machado et al. (2019) examined the effects of positional role in small-sided games among U17 players, revealing that forwards exhibited lower quality tactical behaviour in the defensive phase compared to fullbacks; besides, they performed less effectively in actions far-off from the ball (Martone et al., 2017). Furthermore, Santos et al. (2022) explored the effects of visual occlusion in different pitch sizes on youth players' technical, physical, and positional performance. While no statistically significant differences were identified between occlusion conditions for technical performance and tactical behaviour, the study found that visual occlusion resulted in a lower number of

successful passes and higher regularity in the distance to the opponent's team centroid. Finally, investigating the influence of affective decision-making on tactical behaviour, Gonzaga et al. (2014) found that players with superior defensive and game tactical behaviour achieved better results on a neuropsychological test (IGT) than those with lower values in this parameter.

Some studies compared the players' responses of different: (i) ages; (ii) skill levels; and (iii) maturational and anthropometric profiles. Some of these studies compared the variability and reliability of performance indicators with different game configurations, analysed the effect of different training programs based on small-sided football games, explored the influence of affective decision-making, evaluated the effects of positional role, and examined temporal changes.

Concerning age differences, research shows that the use of smaller playing areas seems to favour the increase of passing actions in U15 players, and alterations in the playing area impacted the time available for skill practice without pressure, particularly for U11 and U15 players (Nunes et al., 2021). In fact, the main results from the technical assessment revealed that U15 teams encountered more challenges in keeping ball possession in smaller formats compared to U17 teams and show that GK+4 vs. 4+GK configuration can be used to improve teams' tactical performance of younger players in representative SSG and in SSG that emphasize the tactical principle of maintaining ball possession (Machado et al., 2020). Furthermore, while there is evidence that U14 players demonstrated better adaptability to in area per player than U12 players (Martone et al., 2017), other studies showed that increasing the pitch area promoted high-intensity running and exercise intensity across all age groups, with a higher impact observed in U12 players compared to U14 players. Specifically, the results demonstrated that older players adapted better to changes when moving from smaller to larger areas per player (Martone et al., 2017; Nunes et al., 2021). On the other hand, Lemes et al. (2020b) found a limited effect of pitch size changes on the physical response of U13 and U14 players, leading to a small increase in the percentage of distance covered at highest speeds. In a study that compared the tactical collective dynamics of U13, U15 and U18 players in GK+4 vs. 4+GK format, the results revealed that older players occupy larger areas and presented greater mean distances between a team's centroids, larger distances between players and from players to the centroid (average position of the players) (Clemente et al., 2020).

Table 3. The main results of the studies according to age and game constraint.

Constraint	Dimension	U13	U15	U17
Players number	Technical	Players number reduction promote more actions and variability of actions (Angulo et al., 2020 & Bravo-Sanchez et al., 2017). Young soccer players performed a greater number of technical actions during 8 vs 8 small-sided games, compared to 11 vs 11 football games (Oh et al., 2018).	Significantly more successful passes, contacts with the ball, ball involvement, goals scored and shots on target were achieved in 3 vs 3, compared to 5 vs 5 small-sided games (Alcántara et al., 2021); When compared 3 vs 3, 4 vs 4 and 5 vs 5 small-sided games, no effects were found in involvements with ball, passes, target passes, tackles, and headers. Significantly more crosses, dribbling, and shots on goal were observed during 3 vs 3 compared to during 4 vs 4 or 5 vs 5 small-sided games (Silva et al., 2011).	3 vs 3 small-sided games presented higher frequencies of technical actions than 4 vs 4, there were no differences in effectiveness (Abrantes et al., 2012).
	Tactical	With an increase in the number of players, team distances increased, and tactical variability decreased (Olthof et al., 2018).	Analysis revealed similar team distances in official matches and small-sided games (Olthof et al., 2018).	Players behaved more aggressively in the 3 vs 3 and more safely in the 6 vs 6 small-sided games (Silva et al., 2014).
	Physical	The 7 vs 7 small-sided games included a greater number of physical skills compared to 8 vs 8 (Bravo-Sanchez et al., 2017).	Exercise intensity in 3 vs 3 small-sided games was higher than that in 5 vs 5 (Silva et al., 2011).	The 3 vs 3 small-sided games elicited higher Heart Rate and Rating of Perceived Exertion than 4 vs 4 and, the normal game was the most intense situation when compared with only offense and only defence (Abrantes et al., 2012); The use of floaters (i.e. a special player who belongs to the team in ball possession), decreases the physical

				demands in comparison to regular players in small-sided games (Lozano et al., 2020).
Pitch size	Technical	Increases in playing area appear to alter the available time for younger players to practice skills without the major constraint of pressing (Nunes et al., 2021) .	Technical action analysis evidenced that moving from smaller to larger pitch area, under-14 players adapted better to changes than under-12 players (Martone et al., 2017)	-----
	Tactical	On a larger pitch, inter-team and intra-team distances were significantly larger and tactical variability of intra-team distance measures significantly increased (Olthof et al., 2018).	Small-sided games modification strategies affected differently tactical performance and exploratory behaviour of teams composed of players of different skill levels (Machado et al., 2020).	Small-sided games modification strategy through rule manipulation provided players and teams with a higher level of difficulty, compromising their performance and inhibiting exploratory behaviour (Machado et al., 2020)
	Physical	Higher numbers of high-intensity activities were observed in small-sided games compared to regular soccer games (Olthof et al., 2018).	High intensity running proved to be facilitated by the use of larger playing areas, especially for under-15 players (Nunes et al., 2021).	Prescribe tasks in a small space and with short-duration bouts involve players in a lower physiological effort mainly in recovery or activation sessions (Castillo et al., 2021)
Game configuration	Technical	Players performed more turns in small-sided games with two small goals over the final line and more shots during small-sided games with two small goals inside the pitch (Pulling et al., 2016).	Players presented more passes and dribbles in 40x30m configuration compared with 30x40m configuration. In the 30x40m configuration presented higher number of shots, and more lateral passes (Folgado et al., 2019).	-----
	Tactical	Modifying the position of the goals can foster original behaviours of young athletes and increase the tactical repertoire of players (Canton et al., 2021).	Players were more synchronized in the longitudinal axis in 40x30m configuration compared with 30x40m. In the 30x40m configuration results showed a lower distance between team centroids; The long and wide configurations produced more counterattacks, higher offensive penetration, and more goal scoring opportunities than the standard format. The wide configuration produced more assists in the form of crosses than the long and standard formats, more utilization of wide sub-spaces to assist the final player, greater number of headers as the final action, and less assists in the form of passes in behind the defence than the standard configuration (Folgado et al., 2019).	The mental fatigue, influenced the players' ability to perceive and sustain their decisions based on the information from environment, which resulted in different positioning and collective synchrony (Coutinho et al., 2017).
	Physical	-----	-----	Independently of the pitch reference lines (corridors and sectors lines), similar physical game-related activity variables were observed with and without mental fatigue (Coutinho et al., 2017)

Regarding tactical behaviour, many researchers used indicators based on players distance, revealing that older players tend to occupy larger areas, maintain larger distances between players and demonstrate greater attack-defence synchronization. In addition, the effect of different small-sided and conditioned games on the variety of exploratory teams' tactical behaviour between age categories was explored by Machado et al. (2019), with findings suggesting that younger players evidenced greater difficulties in maintaining ball possession drills in smaller formats. On the other hand, game configurations (e.g., GK+4vs4+GK configuration) could enhance the tactical performance of younger players under specific conditions (e.g., maintaining ball possession conditions).



Variations in game format and rules manipulation produced different effects on the tactical performance and exploratory behaviour of teams composed of players of different skill levels. The rules manipulation provided players and teams with a higher level of difficulty, compromising their performance and inhibiting exploratory behaviour (Machado et al., 2019; Machado et al., 2020). Additionally, research also showed that during 3 vs. 3 SSG, players with higher specific endurance presented higher speed and covered more total distance, as well as higher distance covered in accelerations above 1 m.s⁻², compared to less conditioned players (Lemes et al., 2020b). Praxedes et al. (2018) explored the influence of teaching programs based on different opposition levels (equality, inferiority, superiority) on technical performance and decision-making. Their findings highlighted the importance of designing training situations that foster numerical superiority in attack to enhance players' performance. Likewise, a study analysing the incidence of offensive and defensive tactical principles and network properties among young players with differing aerobic power levels revealed that the group with lower aerobic power presented a higher success rate in defensive tactical principles (Praca et al., 2019).

Reduced sample size was a common limitation to many analysed studies (Alcântara et al., 2021; Sanchez et al., 2019), which may limit the generalization of results and claim caution to making inferences of results, furthermore only the study of Machado et al. (2020) presented sample calculation in detail. For future studies, some authors suggested the analysis of technical, physical, tactical or physiological performance dimensions (Angulo et al., 2020; Lopes et al., 2020; Lozano et al., 2020) and, cross the information extracted of different performance dimensions. Others advise the analysis of different age categories and skill levels (Machado et al., 2019; Coutinho et al., 2020).

Finally, some investigations analysed the role of maturational and anthropometric characteristics on tactical performance. Towlson et al. (2021) for example, examined the effects of maturational status on passing networks, concluding that early mature players perform more collective behaviours than late mature players. Similarly, findings by various studies suggest that technical performance in small-sided games seems to be influenced by biological maturity level⁴⁶ and by changes in physical performance (Lopes et al., 2020).

In sum the results of the present review suggest that small-sided games can represent an interesting methodological resource to enhance technical, tactical, and physical performance in young players. Nonetheless, the methodological variability across studies regarding procedures, variables and instruments limits the possibility of extracting more reliable results increasing the likelihood of bias in their interpretation. Therefore, to ensure the reliability of future investigations, it would be beneficial to standardize the procedures and metrics used to analyse technical, tactical, and physical variables based on the specific age groups. This standardization would help in better understanding the effectiveness of small-sided games across different stages and facilitate comparisons between studies

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