SKILL-RELATED PERFORMANCE IN SOCCER:
A SYSTEMATIC REVIEW

ABSTRACT
The aim of the study was to evaluate and organize systematically the available literature on skill-related performance in young and adult male soccer players in an attempt to identify the most common topics, ascertain the weaknesses, and elucidate the main contributions of the scientific papers on this issue. A systematic review of the Institute for Scientific Information (ISI) Web of Knowledge database was performed in accordance with the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) guidelines. The keywords ‘football’ and ‘soccer’ were used, each associated with the following terms: ‘technical analysis,’ ‘technical performance,’ ‘technical activity,’ ‘technical skill,’ ‘technical demands,’ ‘technical profiles,’ ‘technical characteristics,’ ‘technical actions,’ ‘technical scores,’ ‘technical ability,’ ‘motor skills,’ and ‘skill acquisition’. From the 2830 papers, only 60 were reviewed, of which 75% had been published in years 2011–2015 and 53.3% concerned professional or seniors players (above the U-20 category). Out of the 41 papers that analysed the skill-related performance in the match, 48.8% evaluated the performance in small-sided and conditioned games. Among the 27 papers that used validated instruments, 88.9% assessed technical actions outside the match context (e.g. dribbling, shooting tests). Future research should pay attention to the definition and classification of the skill-related variables under investigation in match context and propose tests for measured skill-related performance in soccer, considering that the representativeness task design allies the players’ possibilities of action to the situation of the match.

Key words: ecological approach, technical performance, representative design, team sports

INTRODUCTION
The pursuit of sporting success constantly leads the coaches, performance analysts, and sports researchers to explore methods to evaluate and promote performance. In this sense, match analysis investigates the performance of teams with regard to the different scales of analysis, from the individual level (micro) towards the collective level (macro). Moreover, it provides informational knowledge regarding the development of the training process, as well as the competitive outcomes, considering various features displayed by teams in competitive matches [1]. It is a foundation for decision-making processes referring to the performance of players and sequentially enables the provision of feedbacks as part of the coaching process. However, accurate feedback on the actual players’ performance requires testing with the representative task design of the specific match demands (i.e. generalization of task constraints in experimental designs to the constraints in sports; for more details, see [2]).

The theoretical principles of ecological dynamics revealed that the most relevant information for decision-making and the regulation of action in dynamic environments is emergent during continuous performer-environment interactions [3]. In this approach, the environment provides information that directly influences the behaviour of the agent (i.e. player) [4]. This information, perceived by the players, enhances the possibilities of action (i.e. affordances). Therefore, the responses to the constraints imposed by the match context materialize through the execution of technical actions in order to achieve a certain objective [5]. These actions endue an adaptive character as a func-
tion of time and space in which they are performed. The ability to perform a technical action influences the possibilities of the player to choose the best option in the match situation. During matches, the interdependency between knowing ‘how to do’ (efficiency), obtaining the result accordant with the purpose of the action (efficacy), and the capability to adjust to different match scenarios (adaptation) are required from the player [6]. Thus, a successful technical action in team sports is sustained by a decision-making process that results from the exploitation of the possibilities of action (i.e. affordances) that emerge from the interaction between the player and the environment [7]. From the foregoing, the importance of the development and evaluation of technical actions in team sports (e.g. soccer) is clear.

With the advancement in the production of scientific knowledge concerning skill-related performance in soccer, notational analysis assumed an important role [8]. Notational analysis comprises the observation and the quantitative and qualitative analysis of the technical and tactical actions fulfilled during the match [9]. Quantitatively, it records the number of actions performed by players and their respective duration. Regarding the qualitative analysis, the objective is to verify the result of the action depending on its effectiveness [1]. Other forms of notational analysis focused on the actions and movements scrutinized by players that promote the emergence of different match patterns [9]. On the other hand, another approach studied in the analysis of skill-related performance in soccer refers to the analysis of technical actions outside the match context related to the efficiency of the players and teams [10–12]. This approach of evaluation has been described to conceive the identification and development of talents, as well as to allow the distinction between different levels of experience (e.g. [13–16]), although it is not clear how this dimension interacts with others or how it adapts to the play structure [17]. Vilar et al. [18] argued that the skill-related tests outside the match context (e.g. dribbling, passing, shooting) were not representative of competitive performance because they did not include critical perceptual variables that players usually use to control their actions during the match.

To date, a few review articles have explored the skill-related performance in sports (i.e. ecological dynamics approach to skill acquisition [7]) and specifically in soccer [19–21]. While one of these reviews focused on examining the validity, reliability, and sensitivity of the tests used to measure skill-related performance outside the soccer match context (i.e. juggling, heading, wall-volley, dribbling, shooting, passing, multifaceted tests [19]), others addressed critically [20] and systematically [21] the match performance analysis as a whole – without dividing it into skill-related thematic categories and without considering both in- and out-game context. Thus, the aim of this study was to evaluate and organize systematically the available literature on skill-related performance in young and adult male soccer players in an attempt to identify the most common topics, ascertain the weaknesses, and elucidate the main contributions of the scientific papers on this issue.

MATERIAL AND METHODS

The sample of the study comprised 60 exploratory papers (Table 1), indexed in the scientific journals of databases belonging to the Institute for Scientific Information (ISI) Web of Science. A systematic review was performed in accordance with the guidelines proposed by the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) statement.

Three evaluators conducted separately the analysis process on 19th of February, 2016. The descriptors ‘football’ and ‘soccer’ were used, each associated with the following terms: ‘technical analysis,’ ‘technical ability,’ ‘motor skills,’ and ‘skill acquisition.’ Three evaluators conducted separately the analysis process on 19th of February, 2016. The descriptors ‘football’ and ‘soccer’ were used, each associated with the following terms: ‘technical analysis,’ ‘technical ability,’ ‘motor skills,’ and ‘skill acquisition.’ All search procedures were performed in accordance with ethical guidelines (protocol number: 61884716.9.0000.5659).

Included were papers meeting the following criteria: (i) scientific, published up to 2015; (ii) exploratory; (iii) conducted with male soccer players; (iv) performed among players of all positions and functions, excluding goalkeepers; (v) written in English; (vi) presenting relevant data for the evaluation of technical actions. If there was any disagreement among the evaluators regarding the inclusion of a particular paper, the final decision would be performed by the senior evaluator, owing to more experience in the issue [21]. The papers were grouped in accordance with the main topics of skill-related performance that emerged from a detailed analysis and with the methodological strategies used; this allowed to organize the results.

RESULTS AND DISCUSSION

At the beginning of the search process, 2830 papers were found. Then, duplicate papers were removed (1785).
Figure 1. Systematic review process for the paper research

- Definition of the question being addressed by the paper and definition of search methods
- Researcher 1
- Researcher 2
- Researcher 3
- Removal of duplicates (1785)
- ISI Web of Knowledge (2830)
- Manual screening (title, abstract, and keywords) (1045)
- Papers included in the systematic review (60)

ISI – Institute for Scientific Information

Figure 2. Issues of skill-related performance analysis in soccer.

- Skill-related analysis in soccer
- Descriptive analysis
- Comparative analysis
- Other
  - Talent development
  - Predictors of technical performance
- Effects of small-sided and conditioned games
- Effects of training exercise
- Competitive level
- Playing position
- Playing system

Adapted from [21]
Table 1. Exploratory papers published on skill-related performance in male soccer players

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Aim</th>
<th>Methods</th>
<th>Main findings</th>
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</thead>
<tbody>
<tr>
<td>Almeida et al. [24]</td>
<td>28 U-15 male players, divided into 2 groups: non-experienced and experienced</td>
<td>To analyse the interaction and main effects of deliberate practice experience and SSCG format (3 vs. 3 and 6 vs. 6 + GKS) on the offensive performance of young soccer players</td>
<td>Offensive Sequences Characterization System was used. Duration of ball possession, number of players involved, number of ball touches, number of passes, number of shots, and result of the offensive sequence</td>
<td>– Experience level had a significant effect on performance indicators that characterize the development of offensive sequences, especially in 6 vs. 6 + GKS</td>
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<tr>
<td>Aslan [34]</td>
<td>10 male recreational soccer players</td>
<td>To determine the cardiovascular, perceived exertion, and technical effects of altering pitch size and number of players in recreational soccer match-play</td>
<td>4 variations of SSCG (except for GKS, 5-a-side and 7-a-side on small and large pitches). Ball possession, dribbling, successful pass, unsuccessful pass, tackle, and shooting</td>
<td>– The players performed more dribbling and successful passes, but fewer unsuccessful passes during 5-a-side games</td>
</tr>
<tr>
<td>Bradley et al. [63]</td>
<td>20 FAPL matches (n = 153 players)</td>
<td>To examine the effect of playing formation on high-intensity running and technical performance during elite soccer matches</td>
<td>Number of passes and percentage completion rate, passes received, touches per possession, dribbles, crosses, final third entries, possession won and lost, and total ball possession</td>
<td>– Overall ball possession did not differ between 1-4-4-2, 1-4-3-3, and 1-4-5-1 formations</td>
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<tr>
<td>Bradley et al. [85]</td>
<td>FAPL (n = 190), Championship (n = 155), and League 1 (n = 366)</td>
<td>To compare the match performance and physical capacity of players in the top 3 competitive standards of English soccer</td>
<td>Number of passes, successful passes, forward passes, balls received, touches per ball possession, dribbles, tackles, interceptions, headers, crosses, shots, clearances and final third entries</td>
<td>– Technical indicators such as pass completion, frequency of forward passes and total passes, balls received, and average touches per possession were 4–39% higher in the Premier League compared with lower standards</td>
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<td>Bradley et al. [28]</td>
<td>Professional players in FAPL (n = 810)</td>
<td>To examine the effects of HPBPt and LPBPt on physical and technical profiles in elite soccer matches</td>
<td>Number of passes, successful passes, received passes, touches per possession, dribbles, crosses, events of tackles/tackled, crosses, final third entries, possession won and lost</td>
<td>– Players in HPBPt performed 44% more passes than those in LPBPt</td>
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<tr>
<td>Bradley et al. [67]</td>
<td>54 EPL matches (n = 810 players)</td>
<td>– To examine the influence of situational variables on ball possession in elite soccer – To quantify the variables that discriminate between HPBPt and LPBPt across different playing positions</td>
<td>Successful and unsuccessful passes, crosses, dribbles, shots, events of tackles/tackled, corners, goals, free kicks, fouls, fouled, interceptions, and clearances</td>
<td>– Possession was increased when losing as compared with winning or drawing – The variables that discriminated performance between HPBPt and LPBPt were different for various playing positions, although the number of successful passes was the most common discriminating variable</td>
</tr>
<tr>
<td>Bullock et al. [25]</td>
<td>42 high-level amateur male soccer players</td>
<td>To evaluate the effect of 45 min of soccer-specific exercise in RMST, a novel test which measures sprint, passing, and reactive agility performance</td>
<td>Participants undertook 10 repetitions of RMST before and after 45 min of soccer-specific exercise using LIST</td>
<td>– The exercise protocol resulted in moderate decreases of sprint and reactive agility performance, but improved passing task time and passing accuracy</td>
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<td>Bush et al. [62]</td>
<td>EPL seasons (2005–2006 to 2012–2013), 451 individual players across 3016 observations</td>
<td>To investigate match-to-match variability of physical and technical performances in EPL players and quantify the influence of positional and contextual factors</td>
<td>Number of passes attempted, passing success, number of passes received, interceptions, number of tackles completed per player and number of times the player was tackled, number of possessions won/lost, and average number of touches per possession</td>
<td>– Technical indicators such as tackles, possessions won, and interceptions illustrated substantial variability for attackers compared with all other positions – Central defenders demonstrated large variability for the number of times tackled per match and passes attempted and received compared with other positions</td>
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<tr>
<td>Study</td>
<td>Sample Description</td>
<td>Methods</td>
<td>Key Findings</td>
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<tr>
<td>Bush et al. [86]</td>
<td>7 consecutive EPL seasons (2006–2007 to 2012–2013), 1036 individual players across 22,846 observations</td>
<td>To investigate the position-specific evolution of physical and technical performance parameters in the EPL</td>
<td>Number of passes (short, medium, long), passing successful</td>
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<td>Carling [35]</td>
<td>45 French League 1 matches over 3 competitive seasons (2007–2008 to 2009–2010)</td>
<td>To examine the influence of opposition team formation on physical and skill-related performance in a professional soccer team</td>
<td>Frequency of passes and forward passes, mean length of passes, percentage of passes played with one touch, frequency of ball possessions, mean time and number of touches per possession, and frequency of ground and aerial duels</td>
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<tr>
<td>Carling and Dupont [29]</td>
<td>35 French League 1 matches and 2 UEFA Europa League matches over 3 seasons (2007–2008, n = 16; 2008–2009, n = 15; 2009–2010, n = 6)</td>
<td>To determine whether declines in physical performance in a professional soccer team during match play were associated with reductions in skill-related performance</td>
<td>Total number of passes, percentage of completed or uncompleted passes, number of ball possessions and possessions gained or lost, number of touches per possession, number of duels, and percentage of duels won or lost</td>
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<tr>
<td>Carling et al. [32]</td>
<td>38 league matches per season over 5 consecutive seasons (2008–2009 to 2012–2013; 190 matches)</td>
<td>To investigate a squad management, injury, as well as physical, tactical, and technical match performance in a professional soccer team across 5 consecutive league seasons</td>
<td>– Analysis of skill-related measures revealed no significant decline between halves, across 15-min intervals, or in the 5-min period following that of peak high-speed activity compared with the mean frequency for other 5-min periods</td>
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<td>Clemente et al. [22]</td>
<td>Male amateur soccer players from the Portuguese regional league (n = 10)</td>
<td>To examine the effect of differences in the number of players and scoring method on heart rate responses, time-motion characteristics, and technical and tactical performance during SScG</td>
<td>9 different SScGs (i.e. 3 formats × 3 scoring methods). Conquered ball, lost ball, neutral ball, pass, successful shot on goal</td>
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<td>Da Silva et al. [39]</td>
<td>16 male young soccer players completed two bouts of 3 vs. 3 (SSCG3), 4 vs. 4 (SSCG4), and 5 vs. 5 (SSCG5) training</td>
<td>To examine the effect of varying the number of players on exercise intensity and technical actions during SScG in young soccer players</td>
<td>– No effects of number of players were found in involvements with the ball, passes, target passes, tackles, or headers</td>
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<td>Dellal et al. [87]</td>
<td>3540 professional soccer players’ activities during the 2005–2006 season</td>
<td>To analyse the physical and technical activities of elite soccer players from the French First League, depending on their playing positions</td>
<td>Percentage of successful passes, total duration of individual ball possession, and the number of ball touches per individual possession</td>
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</table>

**References:**

- Bush et al. [86]
- Carling [35]
- Carling and Dupont [29]
- Carling et al. [32]
- Clemente et al. [22]
- Da Silva et al. [39]
- Dellal et al. [87]
### Dellal et al. [41]

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<tr>
<th>Observations</th>
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<th>Findings</th>
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<tr>
<td>20 international soccer players</td>
<td>To examine the influence of the number of ball touches authorized per possession on the physical demands, technical performances, and physiological responses throughout the bouts within 4 vs. 4 SSGC</td>
<td>3 different 4 vs. 4 SSGCs (4 x 4 min) in which the number of ball touches authorized per possession was manipulated (1 touch = 1T, 2 touches = 2T, free play = FP). Number of duels, percentage of successful passes, number of ball losses, and total number of ball possessions were compared.</td>
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### Dellal et al. [42]

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<tr>
<td>International players classified into 5 positional roles (n = 40)</td>
<td>To compare the effects of common rule changes on technical and physical demands for elite soccer players in 5 playing positions during various 4-min SSGCs in comparison with 11-a-side matches</td>
<td>3 different SSGCs 4 vs. 4 (1 ball touch = 1T, 2 ball touches = 2T, free play = FP), as well as 2 friendly matches. Successful passes, total number of lost balls, dribbling, passing, and total number of ball possessions were compared.</td>
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### Dellal et al. [88]

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<th>Observations</th>
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<th>Findings</th>
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<tbody>
<tr>
<td>5938 observations of match performance across the Spanish La Liga (n = 1896) and FAPL (n = 4704)</td>
<td>To compare match performance in professional soccer players across 2 major European championships: Spanish La Liga and FAPL</td>
<td>Heading and ground duels, passing, time in possession, and ball touches were compared. La Liga players won more heading duels (49.32% vs. 48.68%) and performed the same proportion of successful passes (76.17%). FAPL wide midfielders had 20% more ball touches per possession than their La Liga counterparts.</td>
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### Draganiòdis et al. [26]

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<tr>
<td>10 elite soccer players</td>
<td>To examine the relationship between the playing level in soccer (i.e., amateur vs. professional players) and the physiological impact, perceptual responses, time-motion characteristics, and technical activities during various SSGC</td>
<td>9 SSGCs (i.e. 2 vs. 2, 3 vs. 3, and 4 vs. 4) in which the number of ball touches authorized by possession varied (1 ball touch authorized = 1T; 2 ball touches authorized = 2T, and free play = FP). Duels, percentage of successful passes, number of lost balls per possession, and the total number of possessions were analyzed.</td>
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### Fanchini et al. [43]

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<th>Findings</th>
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<tr>
<td>19 adult soccer players: 3 bouts of a 5-a-side SSGC at 3 different bout durations: 2, 4, and 6 min</td>
<td>To determine the recovery rate of soccer skill performance following resistance exercise of moderate or high intensity</td>
<td>LSPT, long passing, dribbling, shooting, and heading were assessed.</td>
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### Fernandez-Gonzalo et al. [89]

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<th>Observations</th>
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<th>Findings</th>
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<tr>
<td>30 prepubescent young soccer players with the same experience in soccer training</td>
<td>To examine whether an increase in bout duration would affect exercise intensity and technical actions</td>
<td>Pass, successful pass, unsuccessful pass, tackle, header, turn, interception, dribbling, shoot, and shoot on target were analyzed.</td>
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### Garcia et al. [36]

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<th>Findings</th>
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<tr>
<td>54 young soccer players (U-9 and U-14)</td>
<td>To quantify and analyze offensive situations in different formats of SSGC</td>
<td>54 SSGCs played in 3 different formats (5 vs. 5, 7 vs. 7, and 9 vs. 9). Ball out of play, touches per game, touches per outfield player, touches per minute, defensive half, attacking half, attempts at goal, shots per minute, goals per minute, penalty area entries, unsuccessful dribbles, successful dribbles, unsuccessful passes, successful passes were measured.</td>
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<tr>
<td>Study</td>
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<td>Guilherme et al. [23]</td>
<td>Young soccer players ( \text{(n = 71)} ), randomly divided into experimental group ( \text{(n = 35)} ) and control group ( \text{(n = 36)} )</td>
<td>To ascertain whether a specific technical training programme for the non-preferred foot has implications in the increasing utilisation rate of the respective limb during the game</td>
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<tr>
<td>Harper et al. [30]</td>
<td>18 matches involving professional European teams played between 2010 and 2014</td>
<td>To examine the influence of prolonged durations of professional soccer match-play on markers of technical ( \text{(i.e. skilled)} ) performance</td>
</tr>
<tr>
<td>Hodgson et al. [37]</td>
<td>8 university-level male soccer players</td>
<td>To quantify the time-motion characteristics and technical demands of SSGC played on small, medium and large pitches</td>
</tr>
<tr>
<td>Höner et al. [10]</td>
<td>Highly selected players ( \text{(the top 4% of their age groups, U12–U15)} ) at 17 measurement points between spring 2004 and spring 2012 ( \text{(n = 68,138)} )</td>
<td>To examine the reliability, differential stability, and validity of the motor diagnostics conducted nationwide with the German soccer talent identification and development programme and to provide reference values for a standardized interpretation of the diagnostics results</td>
</tr>
<tr>
<td>Huijgen et al. [15]</td>
<td>Talented soccer players ( \text{(n = 131, 14–18 years of age)} ); professional ( \text{(n = 54)} ) or amateur ( \text{(n = 77)} )</td>
<td>To investigate the development of the technical skill of dribbling</td>
</tr>
<tr>
<td>Huijgen et al. [14]</td>
<td>Talented soccer players ( \text{aged 12–19 years} ) ( \text{(n = 267)} )</td>
<td>To assess the development and determine the underlying mechanisms of sprinting and dribbling needed to compete at the highest level in young soccer players</td>
</tr>
<tr>
<td>Huijgen et al. [16]</td>
<td>Talented adolescent soccer players of professional soccer clubs in the Netherlands ( \text{(n = 113)} )</td>
<td>To examine whether performance characteristics discriminated between selected and deselected players in talent development programmes</td>
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<tr>
<td>Study</td>
<td>Participants</td>
<td>Description</td>
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<tr>
<td>Impellizzeri et al. [50]</td>
<td>26 junior soccer players: control group or aerobic interval training group</td>
<td>To examine the effects of aerobic interval training on the decline in short-passing ability caused by a short bout of high-intensity intermittent activities</td>
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<tr>
<td>Juárez et al. [90]</td>
<td>Young top-class soccer players (n = 21)</td>
<td>To describe the kinematic pattern of the kicking movement of young top-class soccer players focusing on examining the linear joint markers velocity of the leg kick and the segments angular position</td>
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<tr>
<td>Katis and Kelly [40]</td>
<td>34 young soccer players</td>
<td>To examine (1) the movement actions performed during 2 different SSGCs and (2) their effects on a series of field endurance and technical tests</td>
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<tr>
<td>Kelly and Drust [44]</td>
<td>8 young male soccer players</td>
<td>To examine the impact of changes in pitch size on heart rate responses and technical requirements of SSG</td>
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<tr>
<td>Köklü et al. [45]</td>
<td>Young soccer players (n = 12)</td>
<td>To investigate the effects of recovery durations between bouts in 4 × 4-min 3-a-side SSG on time-motion analysis, technical actions, and physiological responses of players</td>
</tr>
<tr>
<td>Lago-Peñas and Lago-Ballesteros [68]</td>
<td>380 matches of the Spanish professional men’s league</td>
<td>To identify the soccer match-related statistics that best differentiate between home and visiting teams as for the team quality</td>
</tr>
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<td>Lizana et al. [46]</td>
<td>24 athletes assigned to 6-player teams</td>
<td>To investigate, through videogrammetry, if the technical and tactical principles promoted through the adoption of distinct rules from 2 different SSGs (game 1: maintaining ball possession, game 2: progression to the target) would actually be achieved</td>
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<tr>
<td>Malina et al. [73]</td>
<td>69 players aged 13.2–15.1 years from 3 clubs that competed in the highest division for their age group</td>
<td>To estimate the contribution of experience, body size, and maturity status to variation in sport-specific skills of adolescent soccer players</td>
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Matta et al. [74] 119 soccer players, U-15 (n = 74) and U-17 (n = 45) To describe the association between chronological age, morphology, biological maturation, and sports experience in relation to technical performance in young Brazilian soccer players Data were analysed with the use of the multiple linear regression model. Ball control test, number of touches on the ball, dribbling test, kicking accuracy test – Adiposity was negatively associated with technical performance regardless age category – Weight was associated with technical performance: negatively in U-15 and positively in U-17 category – U-17 biological maturation was negatively related to the dribbling test and positively associated with the ball control test – Years of experience proved to be positively associated with technique taught to soccer players in the U-17 category

Miranda et al. [51] 30 young soccer players To verify the influence of a 10-week soccer training programme on anthropometric, psychological, and technical skills, as well as specific performance parameters in young players 10-week soccer training. The players were evaluated 2 times along the experiment (T1: before training, and T2: after training). Slalom dribble, lob pass, juggling test – 10-week soccer training programme with similar characteristics of volume and intensity may lead to significant changes in slalom dribble and lob pass tests (T1 vs. T2)

Le Moal et al. [57] 87 players aged 14–17 years; elite (n = 44), sub-elite (n = 22), and non-elite (n = 21) To examine the validity and reliability of LSPT in adolescent soccer players Two attempts of LSPT were performed at baseline. Players then completed 10 attempts over 3 weeks to familiarize themselves with the test. Subsequently, 2 main trials, separated by 1 week, were performed; the mean of the 2 attempts was recorded as the performance score – LSPT seems to be a valid and reliable protocol to assess differences in soccer skill performance in adolescent players and can distinguish players depending on their playing level

Morgans et al. [33] 11 male professional outfield soccer players To investigate if differences in physical and technical performance occurred across a season among 11 English Championship League soccer players who played the majority of matches in the season Number of individual passes, individual passes completion, team possession, sprint and high-intensity running in possession of the ball – Passes made and pass success rate per match were 55 ± 3 and 85 ± 1%, respectively, across the season – Passes made and pass success rate were relatively stable and did not significantly differ across the season – Collectively, the team kept possession of the ball for a median of 62% of total match time – Maintaining possession during matches may reduce physical demands imposed on players and help preserve performance throughout the season

Nassis et al. [91] 64 matches of the 2014 FIFA World Cup Brazil; temperate to tropical environmental conditions To analyse performance data in relation to the environmental conditions to identify potential association Environmental stress was estimated (low, moderate, and high) for each match. Number of passes, percentage of successful passes – Number of passes was not different but the rate of successful passes was higher under high (76.8 ± 4.4%) than under low (73.6 ± 10.8%) environmental stress

Owen et al. [92] 15 male soccer players from a Scottish Premier League team To examine the difference in heart rate responses and technical activities in European elite players when exposed to 2-sided games differing in the number of players and playing area Small (3 vs. 3 plus GKs) and large (9 vs. 9 plus GKs) sided games, each lasting 3 × 5 min, interspersed with 4-min passive recovery. Block, dribble, header, interception, pass, receive, shot, turn, tackle – Technical performance analysis revealed a large practical difference between SSGs and LSGs: smaller number of blocks, headers, interceptions, passes, and receives, but more dribbles, shots, and tackles in SSG – SSG induced significantly fewer total ball contacts per game, but significantly more ball contacts per individual when compared with LSG

Radziminski et al. [53] 20 young soccer players (U-16), divided into 2 groups (running group, SSGC group), completed two different 8-week training programmes To investigate the effects of high-intensity interval running and SSG training programmes on the physical capacity and the level of soccer-specific technical skills in young soccer players 2 training sessions a week (running group – 5 × 4 min running, with an active recovery period of 3 min; SSGC group – 3 vs. 3 games or 3 vs. 3 with a neutral player for 5 × 4 min, with an active recovery period of 3 min). Technical actions: battery of 7 tests proposed by the German Soccer Federation (420 points in total) – A significant improvement in soccer-specific technical skills level was noted only in the SSGC group

R. Aquino, E.F. Puggina, I.S. Alves, J. Garganta, Performance analysis in soccer players
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Methods</th>
<th>Findings</th>
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<tr>
<td>Rampinini et al. [78]</td>
<td>Young soccer players (n = 16)</td>
<td>To examine whether the fatigue accumulated during match play or determined by short bouts of high-intensity intermittent activities affects short-passing ability in junior soccer players.</td>
<td>LSPT. Players completed the LSPT in 2 sessions during a 1-week control period, followed by 2 unofficial matches with which LSPT was performed during and after the first and the second halves. The change in LSPT performance was determined after 5 min of high-intensity simulation activities.</td>
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<tr>
<td>Rampinini et al. [31]</td>
<td>416 individual matches, 186 professional soccer players</td>
<td>To examine the changes in technical and physical performance between the first and second half during official matches of the Italian Serie A league. To compare the technical and physical performance of the players of the more successful teams (ranked in the first 5 positions) with those of the less successful teams (ranked in the last 5 positions).</td>
<td>Short passes, successful short passes, long passes, successful long passes, crosses, headers, tackles, dribbling, shots, shots on target.</td>
</tr>
<tr>
<td>Rebelo et al. [58]</td>
<td>Elite (n = 95) and non-elite (n = 85) soccer players</td>
<td>To compare anthropometric characteristics, physical fitness, and technical skills of the U-19 soccer players by competitive level and playing position (GK, central defender, fullback, midfielder, forward).</td>
<td>Soccer-specific skills included ball control and dribbling.</td>
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<tr>
<td>Reilly et al. [60]</td>
<td>31 (n = 16, elite; n = 15, sub-elite) young soccer players (15–16 years of age)</td>
<td>To apply a comprehensive test battery to young players with a view to distinguishing between elite and sub-elite groups on the basis of performance on the test items.</td>
<td>Soccer-specific skills: a shooting test and a slalom dribble test.</td>
</tr>
<tr>
<td>Rostgaard et al. [59]</td>
<td>Young elite (n = 14) and sub-elite (n = 7) soccer players</td>
<td>To develop and examine a test for evaluating the physical and technical capacity of soccer players.</td>
<td>Players performed a physical and technical test consisting of 10 long kicks interspersed with intense intermittent exercise. A control test without intense exercise was carried in the relative physical and out. The test result was evaluated by technical test results the precision of the 10 kicks.</td>
</tr>
<tr>
<td>Russell et al. [11]</td>
<td>20 soccer players (professional, n = 10; recreational, n = 10)</td>
<td>To examine the reliability and construct validity of new soccer skills tests.</td>
<td>Passing, shooting, and dribbling skills tests. Each trial consisted of 28 passes, 8 shots, and 10 dribbles.</td>
</tr>
<tr>
<td>Russell et al. [12]</td>
<td>15 academy soccer players in a soccer match simulation</td>
<td>To examine the effects of exercise-induced fatigue on soccer skills performed throughout simulated match play.</td>
<td>Precision, success rate, and ball speed were determined via video analysis for all skills.</td>
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<tr>
<td>Study Authors</td>
<td>Sample Description</td>
<td>Methodology</td>
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<tr>
<td>Sinclair et al. [93]</td>
<td>Academy-level soccer players ($n = 22$)</td>
<td>To identify important technical aspects of kicking linked to the generation of ball velocity with the use of regression analysis</td>
<td>Maximal in-step kicks were obtained with a 10-camera motion capture system sampling at 300 Hz. Three-dimensional kinematics of the lower extremity segments was registered. Regression analysis was used to identify the kinematic parameters associated with the development of ball velocity.</td>
</tr>
<tr>
<td>Stone and Oliver [49]</td>
<td>9 semi-professional soccer players</td>
<td>To examine the effect of fatigue, developed during prolonged high-intensity intermittent exercise, on the performance of soccer shooting and dribbling skill</td>
<td>Salom dribble test and LSST, before and directly following the performance of three 15-min bouts of a modified version of LSST.</td>
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<tr>
<td>Taylor et al. [65]</td>
<td>40 matches from the 2002–2003 and 2003–2004 domestic league seasons</td>
<td>To examine the effects of match location, quality of opposition, and match status on the technical aspects of performance within a single professional British soccer team</td>
<td>The LIST slalom dribbling time increased significantly by 4.3 ± 4.0%</td>
</tr>
<tr>
<td>Tessitore et al. [94]</td>
<td>Young male soccer players ($n = 22$)</td>
<td>To compare the heart rate responses and match analysis parameters of official 5-a-side young male soccer matches played over 2 pitch surface (i.e. clay vs. artificial turf) conditions</td>
<td>The mean values of $r_{Dipass}$ were significantly higher in 5 vs. 3 than in 5 vs. 5 conditions and significantly lower in 5 vs. 5 than in 5 vs. 4 and 5 vs. 3 conditions and</td>
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<tr>
<td>Vaeyens et al. [13]</td>
<td>Elite, sub-elite, and non-elite young players in 4 age groups: U-13 ($n = 117$), U-14 ($n = 136$), U-15 ($n = 138$), and U-16 ($n = 99$)</td>
<td>To determine the relationships between physical and performance characteristics and level of skill in young soccer players aged 12–16 years</td>
<td>The findings emphasize the need for notational analysts and coaches to consider the potential independent and interactive effects of match location, quality of opposition, and match status when assessing the technical components of soccer performance, particularly those relating to behaviour occurrence.</td>
</tr>
<tr>
<td>Vilar et al. [95]</td>
<td>15 amateur standard male soccer players</td>
<td>To examine the influence of pitch dimensions in SSCG on shaping opportunities for performers to maintain ball possession, pass to teammates, and shoot at goal</td>
<td>Fewer opportunities to maintain ball possession on smaller pitches compared with medium and larger ones.</td>
</tr>
<tr>
<td>Vilar et al. [96]</td>
<td>15 male young soccer players</td>
<td>To examine the effects of the numbers of players involved in SSCG (under-loading and overloading) on opportunities for maintaining ball possession, shooting at goal, and passing to teammates during training</td>
<td>The mean ID values were significantly lower in 5 vs. 5 than in 5 vs. 4 and 5 vs. 3 conditions and significantly lower in 5 vs. 4 than 5 vs. 3.</td>
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</table>

*HUMAN MOVEMENT*

The next stage comprised reading the title, abstract, and key words. As a result, 954 papers were excluded owing to various criteria, such as other issue, other sport, lack of full text online, inadequate sample (e.g. women, referees, goalkeepers), the character of a review article, and other language. After these eliminations, 91 full texts were read, which showed that 31 of them were not relevant to the review. Summing up, out of the 2830 initial papers researched, only 60 met all the inclusion criteria (Figure 1). For each paper, the authors (year of publication), participants, aims, methods, and the main findings related to technical actions were recorded (Table 1).

Regarding the chronological analysis of the published papers, it was found that 15 articles (25%) that were relevant to the scope of this review came from before 2010. The remaining 45 gathered papers (75%) were published in the five years of 2011–2015 (2011 = 13 papers; 2012 = 3 papers; 2013 = 8 papers; 2014 = 12 papers; 2015 = 9 papers), which highlights the recent substantial growth of interest in skill-related performance in soccer. Considering the age group of the participants, 32 articles (53.3%) referred to professional or senior players (above the U-19 category). The other 28 papers (46.7%) concerned young players (the U-20 or lower category), which shows a certain equivalence.

Additionally, 41 papers studied skill-related performance in match context, out of which 20 (48.8%) described small-sided and conditioned games (SSCG) and 21 (51.2%) friendly and official games. The total of 27 recruited papers carried out an analysis of technical actions with the use of validated instruments; 3 of them (11.1%) employed the following instruments in match context: Team Sport Assessment Procedure (TSAP) [22], system of assessment of functional asymmetry of the lower limbs in football (SAFALL-FOOT) [23], Offensive Sequences Characterization System (OSCS) [24]; 24 (88.9%) assessed technical actions outside the match context, applying the reactive motor skills test (RMST) [25], as well as dribbling, shooting, heading, and Loughborough passing tests [10–12, 26].

After a detailed analysis of each paper, a categorization system was applied, contemplating two levels of analysis [21, 27]: the first level encompassed the topic of analysis (descriptive or comparative) and the second level comprised the skill-related variables employed in the analysis (Figure 2).

DESCRIPTIVE ANALYSIS

The exploratory papers framed by the descriptive analysis usually aimed to verify the technical actions during an official match. In general, the studies demonstrate that: (i) teams with higher ball possession performed more passes (44%) compared with teams with less ball possession [28]; (ii) in the last 15 min of the match, there occurred lower frequency of passes, successful passes, and dribbles as compared with other match periods, i.e. 0–15 min, 15–30 min, 30–45 min, 45–60 min, and 60–75 min [29–31]. Some studies of descriptive analysis aimed to assess the differences in skill-related performance within one or more seasons. Carling et al. [32] investigated the skill-related performance of a team in a sample of 190 matches for 5 consecutive seasons (2008–2013). The authors found that in the 2010/2011 season (champion), especially in its second half, the team conceded fewer goals, showing an increase in the number of passes, percentage of completed passes, forward passes, and percentage of completed forward passes across the seasons. Morgans et al. [33] verified the differences in skill-related performance during the whole season of the English Championship League, and concluded that successful passes were relatively stable throughout the season.

These papers resorted to notational analysis, with the main skill-related variables of the number of passes, successful passes, received passes, short passes, successful short passes, long passes, successful long passes, touches per possession, dribbling, shooting, clearances, events of tackles/tackled, headers, ball interceptions, and crosses. However, there is a lack of
transparency regarding the definitions and classifications of skill-related performance during in-game context. Considering all the papers that performed analysis of the skill-related performance in the match (i.e. SSCG, friendly and official matches), 63.4% provided no definitions or classifications for the analysed variables (e.g. [29, 34–37]). Subsequently, it becomes difficult to compare the results derived from different studies, so that reproducibility can be ensured, an essential feature of scientific research, as exposed by O’Donoghue [38]: ‘it is essential for system operators and the eventual consumers of the information generated by performance analysis to have a shared understanding of the variables used’ (p. 36).

A positive example of this question refers to the study of Rampinini et al. [31], which provides the definitions of the skill-related variables under investigation: short passes – number of short foot passes (length < 37 m) performed by a player; long passes – number of long foot passes (length > 37 m) performed by a player. As stated by Mackenzie and Cushion [20], different interpretations of definitions (e.g. successful or unsuccessful pass) can generate different results and conclusions. Therefore, on the basis of the literature research, we proposed definitions of 5 offensive and 2 defensive skill-related performances for soccer players (Table 2).

Furthermore, the search for quantitative information that depicts the match (e.g. notational analysis), despite continuing to be an important approach, has the potential to augment its relevance when associated with methodologies that embrace the dynamics presented in the coordination of players’ actions across the match [9].

Table 2. Proposed definitions for skill-related performance in soccer based on literature search

<table>
<thead>
<tr>
<th>Skill-related performance</th>
<th>Definitions</th>
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<tbody>
<tr>
<td>Goal attempts</td>
<td>Directing the ball into the opposing goal, with any part of the body allowed by the game rules, in an attempt to make it cross the line between the goalposts. Successful: results in a goal. Unsuccessful: does not result in a goal</td>
</tr>
<tr>
<td>Passes</td>
<td>Transferring the ball from one player to another of the same team, using the body parts allowed by the game rules (long passes: &gt; 37 m; short passes: ≤ 37 m). Successful: the team continues with the ball possession. Unsuccessful: the team does not continue with the ball possession</td>
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<td>Carry/protect the ball</td>
<td>(i) Progressing in any direction when carrying the ball; (ii) when carrying the ball, making one or more contacts with it without progressing on the field, but in order to protect it from the opponent. Successful: the team continues with the ball possession. Unsuccessful: the team does not continue with the ball possession</td>
</tr>
<tr>
<td>Received balls (oriented / not oriented)</td>
<td>Receiving and controlling the ball from a teammate, in a way: (i) oriented, allowing to continue sequentially the other actions with the ball possession; (ii) not oriented, not allowing to continue sequentially the other actions. Successful: the team continues with the ball possession. Unsuccessful: the team does not continue with the ball possession</td>
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<tr>
<td>Dodge/feint</td>
<td>When carrying the ball, overtaking the direct opponent in an attempt to: (i) overtake and promote an offensive advantage for the team; (ii) create an imbalance for the defence opponent. Successful: the team maintains the ball possession. Unsuccessful: the team does not maintain the ball possession</td>
</tr>
<tr>
<td>Crosses</td>
<td>Action of the player who is to take the ball from the player in possession of the ball impeding him to continue his action. Successful: the team wins the possession of the ball. Unsuccessful: the team does not win the possession of the ball</td>
</tr>
<tr>
<td>Interceptions</td>
<td>Anticipation of the pass/goal attempt trajectory performed by the opponent, not allowing the ball to reach the destination when transmitted by the opponent. Successful: the team takes ball possession. Unsuccessful: the team does not take ball possession</td>
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</table>
Comparative analysis

Effects of small-sided and conditioned games

Some practice effects induced by different task constraint manipulations (e.g. number of players or field dimensions) in SSCG on skill-related performance are often studied. In these investigations, the main findings are as follows:

1. Decrease in the field size dimensions with the same number of players promotes an increase of technical actions [22, 34, 36, 37]. According to Hodgson et al. [37], ‘the smaller pitch size reduces the active playing area and requires players to make faster decisions and execute skills with higher frequency’ (p. 31).

2. Decrease in the number of players prompts an increase of technical actions [36, 39, 40]. A possible explanation of this refers to the fact that a bigger playing area can facilitate technical actions performed in more space (e.g. crosses, dribbling, and shots).

3. When restrictions are applied in the number of ball touches during the SSCG, the restriction to one ball touch results in a high level of difficulty regarding the performance of successful technical actions, while exercises without restrictions in the number of ball touches weakly affect the realization of successful passes and loss of ball possession [41]. Dellal et al. [41] clarify that players have a reduced time to make decisions and to analyse the game, which explains the lower quality of their technical actions in one-touch form as compared with the two-touches and free play.

4. The application of SSCG promotes a higher frequency of technical actions compared with friendly matches [42], probably owing to a smaller area per player, as aforementioned.

5. The duration of the SSCG does not influence the number of technical actions per minute or the proficiency [43]. Two reasons can explain this behaviour: first, the authors normalized the data as number of technical actions per minute; second, they applied 3 bouts (the previous study demonstrated a decrease in technical action with 4 bouts [44]).

6. SSCG with higher recovery time between sets promotes an increase in the number of technical actions [45].

7. SSCG with the objective of maintaining ball possession contributes to an increase in the total number of successful passes and decrease in the number of shots, compared with SSCG whose objective comprehends the progression towards the goal [46], i.e. the players only progress to goal-scoring situations when they are able to create safer options for the play, which results in fewer shots.

These results may help coaches directly in the preparation of training sessions. For example, a coach who aims in his training session to increase the technical actions might use SSCG with smaller dimensions (e.g. 30 × 20), smaller number of players (3 v 3), without limitations regarding the number of ball touches and exercises with longer recovery periods between sets (e.g. 3 × 4 min with 3–4 min of recovery). This topic of comparative analysis (e.g. effects of SSCG) represented the highest frequency of occurrence in 15 papers. The scenario can be explained by the growing interest in verifying the effects of these training tools in soccer [47]. Furthermore, it is considered that SSCG promotes the increase of the number of actions with the ball, as well as the participation of all players during the matches [5]. A recent narrative review (Serra-Olivares et al. [48]) referring to the tactical assessment of soccer training with the use of representative tasks to measure the tactical expertise of young soccer players during SSG is an important study that gives an overview of the ecological approach to training and the principles of a representative task design, providing relevant contribution and the direction for future research into the assessment of tactical expertise in young soccer players.

Therefore, on the basis of the ecological approach and the idea of representative task design, it is possible to recommend the development of measured skill-related performance with SSCG for future research.

Effects of training-exercise

Several researchers have studied the effects of training and exercises on the skill-related performance of soccer players. The main conclusions of the studies on this subject are the following:

1. Passing and shooting performance declines after low- and high-intensity acute strength exercises [26, 49] and after a simulated soccer match (induced fatigue protocol) [12]. The skill to pass and shot is based on inter-segmental coordination; therefore, following strength exercises, muscle fatigue induces a negative effect on motor coordination [26].

2. The use of the non-preferred foot increases with analytical technical training [23]. According to the ecological dynamic approach, because the non-preferred foot was less stimulated during the daily practice, it is not perceptibly accessible (i.e. it is not a relevant option to make part of the decision-making
and performed actions [23]). Therefore, the functional asymmetry of the lower limbs tends to reduce with the increase in specific training for the non-preferred limb.

3. Aerobic interval training (4 × 4 min at 90–95% of maximum heart rate [HR\text{MAX}] with 3 min of recovery between series) attenuated the deterioration in Loughborough Soccer Passing Test (LSP\text{T}) time after a simulated high running protocol [50]. Ten weeks of soccer training (continued running, 70–80% HR\text{MAX} + sprints + soccer-specific activities) affect positively slalom dribble and lob pass in young soccer players [51]. Short-term training (plyometric + acceleration + dribbling + shooting) positively influences shooting speed [52]. This suggests that the trained players probably experienced less fatigue and, consequently, a lower impairment of skill-related proficiency.

4. Significant improvement of soccer-specific technical skill level in a battery of tests proposed by the German Soccer Federation (i.e. juggling, passing, dribbling) was higher in SSG (3 vs. 3 or 3 vs. 3 with joker player; 5 × 4 min with 3 min of active recovery) than high-intensity running training (5 × 4 min at 90% HR\text{MAX} with 3 min of active recovery between series) [53]. Therefore, SSGs are more highly recommended training drills than the generic (e.g. interval) training by engaging physical, technical, and tactical aspects simultaneously [54].

Competitive level

The informational knowledge derived from studies that examine different competitive levels may provide useful and valuable insights for coaches who search for more appropriate conditions to help their players reach high performance levels [21, 55]. Almeida et al. [24] verified that high level youth soccer players performed more passes and had more ball possession in SSG (i.e. 3 vs. 3; 6 vs. 6) than low level players. In addition, Dellal et al. [56] observed that amateur players completed less successful passes and exhibited less ball possession when compared with professional players, regarding various configurations of SSG (i.e. 2 vs. 2; 3 vs. 3; 4 vs. 4). Furthermore, other research performed in the same scope of analysis revealed the existence of differences in skill-related performance (e.g. shooting, slalom dribbling, ball control, LSP\text{T}) between competitive levels, to the advantage of elite players and elite teams [11, 57–60]. Experience is an aspect influencing the competitive performance that is directly related to the time of practice/competition in soccer [61]. Nevertheless, Almeida et al. [24] complement: ‘it seems that it does not require long periods of deliberate practice in order to verify differences in the collective performance comparatively to youngsters who only play the game for enjoyment and fun (i.e. deliberate play)’ (p. 102).

Playing position and playing system

Another important issue that emerged from the comparative analysis of exploratory research refers to the playing position and different systems. Some discrepancies were observed regarding the designations adopted in different studies to tactical positions, which makes it difficult to compare the results between the papers. However, in general, one can distinguish 3 main tactical positions [21]: defenders, midfielders, and forwards. In summary, the research shows that forwards have a higher coefficient of variation (match-to-match) for performed passes, received passes, and number of times tackled as compared with other positions; they also exhibit higher coefficient of variation for tackles and interceptions than midfielders and defenders. The ability of forwards to hold up play will be affected by the number and quality of possessions won along with the aptitude and tactics of the opposition defenders, thus influencing the variability in performance. Midfielders performed higher successful passes (75–78%) than forwards (71%) and defenders (63%) (i.e. players in this position frequently gain the ball in the attacking area and are responsible to create finishing situations for the forwards, which results in more passes) [62]. These outcomes show that the frequency, variation, and efficacy of technical actions vary depending on the role and specific tactical position of each player on the field.

In addition, studies that analyse skill-related performance and playing systems are scarce in literature. In the course of this review, it was noticed that only 2 papers reported on these issues. Bradley et al. [63] highlighted that ball possession maintenance usually did not differ between the 1-4-4-2, 1-4-3-3, and 1-4-5-1 systems. However, the fraction of successful passes was higher in the 1-4-4-2 system compared with the 1-4-3-3 and 1-4-5-1 systems. Furthermore, the authors mentioned that caution was needed when interpreting the findings, as a relatively small number of matches (n = 20) were analysed. Carling [35] found that, in general, players performed more passes against teams in the 1-4-4-2 than in the 1-4-2-3-1 system. Additionally, the same author reports the existence of more duels, those that result with the ball in an aerial trajectory, as well as those derived, for example, from 1 vs. 1 situations, against teams in the 1-4-2-3-1 when
compared with the 1-4-4-2 system. Finally, the author reports that more one-touch-ball passes against teams occur in the 1-4-2-3-1 as compared with the 1-4-4-2, 1-4-3-3, and 1-4-5-1 systems (e.g. the higher frequency of one-touch passes against teams with the 4-2-3-1 formation suggests that players in the reference team could have benefited from performing one-touch passing drills in preparation for matches against this particular formation).

Clearly, there is a need to perform more studies emphasizing the role of the playing system, as well as the skill-related performance. Furthermore, it is substantial to describe how players are positioned on the field in each playing system (e.g. 1-4-4-2, ‘diamond’ or ‘square’) and to analyse the differences in skill-related performance at each playing position in accordance with the team playing system (e.g. 1 defender in the 1-4-4-2 system cannot perform the same functions and technical actions if the team plays in the 1-3-5-2 system).

**Match situational variables**

In the soccer context, match location (home or away), quality of the opponent (strong or weak), and match status (winning, drawing, or losing) comprise the main situational variables that influence the performance of teams in competitive matches [64–66]. However, research on the skill-related performance appears to disregard these situational variables. In the presented review, among the papers referring to the analysis of skill-related performance in the official match context, 38.1% consider these situational variables (e.g. [65, 67, 68]). Lago-Peñas and Lago-Ballesteros [68] found that the teams playing at home had higher results in terms of ball possession, that home environment (i.e. social support) has a positive impact on the team's performance, and that the teams playing at home have a higher result in terms of ball possession. This finding is consistent with the work of Taylor et al. [65] who observed that the technical actions such as dribbling, passing, and shooting were significantly different between home and away games. However, it is important to note that the home advantage is not consistent across all teams, and that the quality of the opposition can also influence the outcome of a match [69].

In this context, the understanding of talent is largely linked with the idea that innate assignments are responsible for talent detection, and there is an evident concern to find players with physiological, motor, and psychological attributes above average [75]. However, as stated by Howe et al. [76], the conditions that lead to excellence are related with multidimensional characteristics in a multitude of factors, such as early experience, preferences, opportunities, habits, structured and sustained training to promote increased sports performance, resilience, and cultural aspects. Therefore, it becomes questionable to apply unrepresentative tests for ‘detecting’ talents, the more so young players not ‘detected’ as talents will be rejected by clubs and academies.
may leave practice earlier. In fact, the journey to sportsing excellence not only derives from talent identification, but mainly depends on a complex fusion of skills, capacities, and competences [77] related to the development of potential talent in response to training and other environmental conditions [75].

**LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH**

The main limitation of most studies mentioned in this review interferes with the principle of scientific reproducibility and the consistency of research findings [11, 12, 25], as already demonstrated in previous review studies [20, 21]. Particularly, it comes from: (i) the lack of definition and classification of the skill-related variables under investigation concerning match context (we proposed these definitions [Table 2] on the basis of the literature research); (ii) the contextualization of the sample omitted and the influence of match situational variables (e.g. location, quality of opponent, status); and (iii) the absence of representative task design to measure skill-related performance.

Few revised papers (36.6%) defined clearly the skill-related variables under investigation in match context (e.g. [23, 30, 31, 78]). Mackenzie and Cushion [20] reported that the intensive use of notational analysis through data generated by computational software (e.g. Amisco® Pro, GECA Sport®, ProZone®) can be considered as an explanatory factor that underpins this lack of definitions. Moreover, as already exposed, 38.1% of the papers comprehended in this review contemplated the effects of match situational variables on skill-related performance during official matches (e.g. [65, 67, 68]). There seems to be little agreement with regard to the sample size necessary for a power generalization of the results found in these examined studies.

Regarding the representative design of the tests used to measure skill-related performance in soccer, we consider it necessary to return to some approaches. An important task in sports science and performance analysis is to understand the relationship between the skill acquisition and development of players in order to achieve sporting excellence. Therefore, it is essential to develop theoretical principles that guide the concession of skill acquisition programmes, as well as to provide an informational base for the organization and implementation of evaluation tests concerning sports performance [7]. The ecological dynamics theory has revealed that the most relevant information for decision-making and regulation of action in dynamic environments (e.g. soccer) emerges from the continuous performer-environment interactions (for more details, see [3]). The opportunities for action (e.g. affordances) constantly shape players’ intentions and interfere with the decision-making processes by adjusting the key properties of the environment and organismic limitations inherent to each player [7, 79]. For example, performing a pass, dribble, or shot in the course of a soccer match, emerges owing to critical information on the relative positioning of the defenders, as well as the area of the field (e.g. identification of the opportunities for action to achieve the target performance). Thus, creating a rational basis to determine and manipulate the constraints acting on the players provides a fundamental principle for the development and implementation of tests to evaluate the skill-related performance in soccer (see [48]). For instance, 88.9% of the papers presented in this review evaluated skill-related performance through validated tests performed outside the match context (e.g. [10–12, 23, 26]). However, these tests are not representative of the actual skill-related performance of soccer players since they do not encompass critical perception variables (e.g. environmental contextual information) that players normally use to control their actions during the course of matches [18], which could compromise the ecological validity of the conclusions obtained in these studies. To achieve this representation, skill-related performance tests should incorporate the same informational variables that specify match contexts (e.g. friendly or official matches) or SSCG [80–82]. Furthermore, to ensure representativeness, the technical performance tests should not be limited to examining only the result of the action [20, 83], but also take into account the evaluation of representative tasks, which interact with each other and influence the behaviour displayed by players at the time of carrying out the action (e.g. possibilities for action, the positioning of opponents and teammates, spatial references). As exposed by Hayes [84], ‘show me the results of notational analysis, not the notational analysis results,’ (p. 4; apud Mackenzie and Cushion [20], p. 655). Moreover, notational analysis does not measure the possibilities of the participants’ action in relation to the selection of technical actions performed by players. For example, let us consider two match situations: (i) a midfield player performs a pass to a defensive player, while the team maintain the ball possession; (ii) the same midfield player performs a pass to an offensive player, which enables a finish to the goal. In the technical analysis used in the reviewed studies, both situations would be labelled as successful pass. However, it is understood that in situation (ii) the midfield player’s
pass to the offensive player resulted in the possibility of a goal, and thus in obtaining a score different from that in situation (i). Therefore, future research should propose tests to measure skill-related performance in soccer, considering that the representativeness contexts ally the players’ possibilities of action to the situation of the match (see a positive example of tactical expertise assessment during SSCG in a study by Serra-Olivares et al. [48]).

CONCLUDING REMARKS

The main purpose of the study was to evaluate and systematically organize the available literature on the skill-related performance in young and adult male soccer players. Furthermore, we identified the most common topics, as well as examined the weaknesses of the analysed papers and their main contributions to the technical performance. The emerging themes were: (i) descriptive analysis (e.g. characterizations of skill-related performance in championships); (ii) comparative analysis (e.g. effects of SSCG, effects of training-exercise, competitive level, playing position and playing system, match situational variables); and (iii) other issues (e.g. talent development, predictors of skill-related performance). The review has raised some methodological concerns regarding the use of scarce representativeness analysis for the skill-related performance of the players, e.g. dribbling, shooting, and passing tests without match context. In addition, notational analysis can augment its relevance when associated with methodologies that consider the dynamics inherent to the coordination of players in match situations, as well as the representative task design combined with the possibilities of the players’ action in each match situation. Some concerns evidenced in other studies were related to the absence of clarification of the definitions and of technical variables under investigation (see our proposed definitions in Table 2) and omission of the context of the sample (e.g. location, quality of opponent, status). These limitations can largely compromise the reproducibility of the reviewed studies. Finally, given the limitations presented in this review, it is suggested that future research may lead to a congruous understanding of the discussed topics, providing significant and substantial impact also on professional daily practice.

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