Title: The influence of competition time in soccer players performance factors: A scoping review with evidence-gap map.

Short title: Performance factors in soccer.

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Abstract

The aims of this systematic scoping review with evidence-gap map (EGM) were: i) to provide a synthesis of findings from studies comparing performance factors of starters and nonstarters (separately or integrated); ii) to identify compensatory strategies for players with reduced playing time and the barriers to their implementation; and iii) to provide an evidence and gap maps in order to guide future research towards the most relevant gaps in current literature. This review was conducted following the PRISMA 2020 and the respective extension for scoping reviews (PRISMA-ScR). Electronic databases such as Cochrane Library, PubMed, Scopus, SPORTDiscus, and Web of Science (Core Collection) were searched on 31/08/2023. The risk of bias was assessed using the Risk of Bias Assessment Tool for Nonrandomized Studies (RoBANS). From 32,613 potentially relevant articles, 57 independent trials from 70 publications were considered eligible for inclusion in the review. The physical performance factor (k=56, 98.2%) has been extensively studied in relation to the differences between starters and nonstarters. On the other hand, few studies of technical and psychological performance factors were analyzed, while tactical factor has not been addressed in any study. Starters presented higher workloads and improvements in the exercise performance measurements compared to nonstarters. The day commonly used for compensatory training was 24 hours after the match (k=16; 37.5%). Several strategies attempting to reproduce competitive loads were used, such as small-sided games (k=9; 56.3%), small-positional games (k=3, 18.8%), tactical-technical drills (k=2, 12.5%), friendly matches (k=1, 6.5%), running-based-drills (k=8, 50.0%), or strength training (k=2, 12.5%). This scoping review supports the necessity of placing increased emphasis on technical, tactical, and psychological performance factors, compensatory training strategies (including training day and types of drills), and the categorization of player groups. These efforts aim to providing an adequate and consistent training stimulus to replicate the competitive match demands for nonstarters. This approach is important to sustaining the physical adaptations, psychological factors, and tactical-technical skills needed to obtain performance improvements throughout the season. This review proposes four main future research areas on the topic: i) exploring the combination of scenarios within the microcycle (e.g., a starter on Sunday and a nonstarter the following Sunday); ii) directing more studies towards female soccer players; iii) investigating the impact on the weekly load of nonstarters when compensatory training is conducted on multiple days of the week (distributed practice); iv) analyze the differences according to positional status (e.g., in EAI, IAI, the impact of substitution, and physiological measures) and situational factors (competitive schedule, type of competition, place of play, final result, and quality of the opponent) between

players groups. The protocol was registered in the Open Science Framework (project: https://osf.io/36pum/; registration: https://osf.io/9rmz6 and made public on December 30, 2021, before the searches were performed.

Key Points

- When comparing starters and non-starters, the physical performance factor has been extensively studied, while differences in technical, psychological and, especially, tactical factors are scarcely studied.
- Starters accumulated greater absolute external and internal intensity in the match, weekly microcycle and over the season and improved more in exercise performance measurements compared to nonstarters. However, nonstarters presented higher relative external and internal absolute intensity in a match compared to starters.
- Compensatory training was more commonly performed on MD+1 (24 hours after the match). Strategies attempting to reproduce competitive loads included small-sided games, small-positional games, tactical-technical drills, friendly matches, running-based-drills, and strength training.

1. Introduction

Performance emerges from the interaction of physical, technical, tactical, and psychological factors [1, 2], although questions remain regarding their relative weights in explaining individual and collective competitive performance [3-5]. In-depth knowledge of match and training demands provides coaches with important information for training monitoring and prescription and managing team volume in the training and competition process [6]. These insights are particularly relevant in soccer, where players are potentially exposed to up to 60 matches throughout the season, and players with regular participation accumulate 84% of all official match time [7-9]. There are several cases of teams and players being exposed to congested schedules that exceed even the most extreme limits recommended by players and coaches alike [10]. Differences in match exposure between players (i.e., higher vs lower match time) can be challenging for the coaching staff, given that players are likely to accumulate and experience different tactical, technical, psychological, and physical/physiological stimuli, which in turn may affect (positively or negatively) game-specific skills throughout the season [11].

The investigation on the effect of match playing time has mainly relied on physical and physiological factors [2, 11-14]. Several studies have recorded higher values of internal and external metrics of absolute and relative exercise intensities (i.e., sprint distance and TRIMP) in players with longer vs. shorter playing time (e.g., starters vs. nonstarters) [2, 11, 12, 15]. These differences between starters and nonstarters may be primarily attributed to match participation due to differential exposure to mechanical and metabolic stress [12, 15-18]. Starters are likely to accumulate more significant amounts of soccer-specific adaptive stimulus. Different acute and chronic responses should be expected under these conditions (i.e., starter vs nonstarter) [15]. Positive correlations were observed between individual in-season match playing time and the levels of physical capacities, especially those concerning sprint performance and muscle strength [16, 19, 20]. These discrepancies may have practical implications for prescribing compensatory programs that aim to maintain or increase the capabilities of nonstarters, with consequences on their readiness to play [2, 11, 13, 15, 16]. Therefore, coaches may want to implement strategies to mitigate the adverse effects of an insufficient match volume on a player's performance [17, 21-23].

In soccer, for the description of the microcycle, training sessions are usually categorized according to the temporal distance to the match day (MD); for example, MD+1 refers to one day after the match, while MD-5 refers to five days before the match [17, 24]. Some of these sessions may be used to implement compensatory training strategies for nonstarters [2, 13, 21, 23, 25]. In this context, the addition of

conditioning sessions immediately post-match has been suggested [21, 25, 26]. Any compensatory strategy is faced with practical and logistical considerations that may modulate the activities performed directly after a match (e.g., limited time for post-match training and hostility from supporters) [26, 27]. Alternative strategies have been proposed, such as compensatory training sessions at MD+1 and MD+2 [2, 13]. However, these sessions are limited to a few players (since the starters will likely benefit from one or more recovery days), influencing the type of drills used [13, 28].

Compensatory training practices tend to focus on running-based exercises [23] and game-based drills limited to small playing areas favoring low numerical relations [9, 17, 29]. These strategies primarily address the physical aspects of performance and perhaps some relatively limited tactical-technical factors. Wider-scale tactical principles, technical actions, as well as the psychological aspects involved with playing official matches (instead of teammates) should be considered [11, 16]. Introducing friendly matches on MD+1 has been suggested as a beneficial strategy that partly replicates the match demands not experienced by nonstarters [11, 16]. However, before exploring different possibilities regarding compensatory strategies for nonstarters, a first step would be to assess what is currently known regarding the disparities between starters and nonstarters and identify potential gaps in the literature.

The influence of competition time on soccer players' performance factors has been investigated [2, 20, 30], but the information available in the literature is scattered, without an organized body of evidence. Perhaps, in this context, it would be beneficial to elaborate on why the system is not organized, specifying the lacking aspects [31]. These can be complemented with evidence and gap maps (EGM) to highlight the gaps in knowledge and define future research needs in a user-friendly form [32, 33]. Thus, the aims of this systematic scoping review with evidence-gap map were to: i) to provide a synthesis of findings from studies comparing performance factors of starters and nonstarters (separately or integrated); ii) to identify compensatory strategies for players with reduced playing time and the barriers to their implementation; and iii) to provide an evidence and gap maps in order to guide future research towards the most relevant gaps in current literature.

2. Methods

We followed the PRISMA 2020 guidelines [34], but the former extension for scoping reviews (PRISMA-ScR) was also considered [35], as well as the Cochrane's guidelines [36].

2.1 Eligibility criteria

Studies "published" or "in press" in peer-reviewed journals were eligible if complying with the inclusion criteria, regardless of year of publication and language, thus reducing the likelihood of selection bias [37]. The inclusion criteria followed the PECOS approach [38]: (i) Participants: Soccer players fully integrated into team routines (i.e., not currently injured and fully available to play); (ii) Exposure: Training sessions and/or matches; (iii) Comparator(s): Players with longer and shorter exposures in the match, as defined by the authors of the included studies (e.g., starter ≥60 minutes versus nonstarter <60 minutes; other classifications are acceptable); (iv) Outcome(s): any outcomes related to the tactical, technical, psychological and/or physical/physiological factor; (v) Study design: observational studies or interventions (single-arm or multi-arm).

2.2 Information sources

The following databases were searched on August 31, 2023: Cochrane Library, PubMed, Scopus, SPORTDiscus and Web of Science (Core Collection). Additional searches were carried out from: (i) reference lists of included studies (identification of potentially relevant titles; elimination of duplicate titles; elimination of titles included in the original searches; screening of abstracts of remaining titles; if necessary, full-text analysis); (ii) snowballing citation tracking in Web of Science; (iii) consultation of two external experts (sixteen experts were contacted by ResearchGate and/or email and one accepted to participate); (iv) errata/retractions for included studies (in the case of retractions, these would be removed). For selected studies, when available, pre-registered and/or pre-published protocols were retrieved, primarily to facilitate the risk of bias analysis regarding selective reporting and missing data.

2.3 Search strategy

The Boolean Operators AND/OR were used. No filters were applied. The goal was to maximize the sensitivity of the search strategy [39], increasing the likelihood that all appropriate studies could be identified. Main search strategy:

[Title/Abstract] *Soccer* OR *Football*

AND

[All fields/Full text] *Start** OR *Nonstart** OR *Non-start** OR *Reserve** OR *Substitute** OR *Fringe** OR *Bench** *OR "Competition time" OR "Play* time"OR "Match* participation"*

The full search strategy for each database is available in electronic supplementary material (Supplementary table 1).

2.4 Selection process

Two authors (AM and JA) independently screened the retrieved records (titles and abstracts) and, in the second stage, the full texts of records passing the screening stage and decided on their inclusion or exclusion. Disagreements between the two authors were resolved in a joint re-analysis. A third author (JRS) made the final decision if a consensus could not be made. When necessary, the primary and corresponding authors were contacted for clarifications before deciding to include or exclude a study. The authors were given two weeks to provide the requested information. EndNote™ 20.2 for Windows (Clarivate™) was used to remove duplicates, but additional manual removal was required.

2.5 Data extraction process

A data extraction form was developed by the primary author (AM) and reviewed by two co-authors (FMC and IB). Disagreements resulted in joint re-analysis, and a third author (JA) provided the final decision in case consensus was not achieved. A proprietary Microsoft® Excel datasheet was created to extract all relevant information and is available as supplementary material. In case of relevant missing data (or presented in an unclear manner), the primary and corresponding authors of the original studies were contacted through email and, when available, ResearchGate. The authors were given two weeks to provide the requested information. If multiple studies report data from the same trial, they were treated as a single study. Method for grouping studies for the syntheses: when two published studies reported data from the same trial, they were grouped for data extraction and risk of bias assessment.

2.6 Data items

Primary outcomes for the performance factors and programming variables were extracted from each included study: tactical (i.e., decision-making, collective tactical assessment, offensive and defensive actions), technical (i.e., passing, dribbling, and shooting), psychological (e.g., stress, anxiety, and motivation), and physical (i.e., speed, power, strength, endurance, and flexibility). All measures and time points provided by the studies were recorded (i.e., number of weeks, number of training sessions/matches, or compensatory training), including any follow-up. However, the focus was on the nature of the variables and not the end product (in line to generate an evidence map).

Additional study information was included, but not limited to citation details, publication year, country of data collection, participants (i.e., sample size, age, sex, and competitive level), performance factors included (i.e., technical and physical), categorization of competitive time (i.e., acute and chronic[1]), period of analysis, funding sources, and competing interests. The competitive level categorization used in the study was: Tier 0: sedentary (not included in our context); Tier 1: recreationally active (not included in our context); Tier 2: trained/developmental; Tier 3: highly trained/national level; Tier 4: elite/international level; Tier 5: world class [40]. This characterization aims to standardize the categorization of the competitive level of all studies; therefore, it will supersede the original classification. Discussions resolved discrepancies until a consensus was reached before the final classification. All authors were involved in this stage.

2.7 Study risk of bias assessment

The risk of bias was assessed independently by two authors (AM and JA). In case of disagreements, the two authors re-analyzed the process; if no consensus was achieved, a third author (JRS) made the final decision. The risk of bias was assessed using a non-randomized studies tool (RoBANS) [41]. Multiple studies corresponding to a single trial were treated as a single study for risk of bias assessment. The risk of bias was assessed at the factor-level (i.e., physical factor), and a study-level assessment was provided, considering the worst-case scenario, i.e., the worst outcome assessment. Assessment of global risk of bias (labelled as unclear, high, or low) was intended to help interpret overall findings and contribute to assessing the strength of the body of evidence [42].

[1] Acute exposure allocated players according to the match participation (i.e., starter ≥60 min vs nonstarter <60min) and chronic exposure, according to playing time accumulated during a specific period of competition (i.e., total playtime; starter ≥60% vs. nonstarter <60%).

2.8 Synthesis of results

Evidence and gap maps are systematic evidence synthesis products that display the available evidence relevant to a specific research question [32]. An evidence gap map was developed to visually present the evidence and identify research gaps for new primary research and synthesis [33]. Due to the potentially large number of studies, extent and heterogeneity of information included in a scoping review, different formats were used to report the results. When appropriate, the evidence gathered was presented in narrative, table, and/or visual formats (i.e., map or diagram).

3. Results

3.1 Study identification and selection

The flowchart of the search and selection process of studies is presented in Figure 1. An initial search returned 32,613 results, and 58 studies were considered eligible for inclusion in our scoping review. The reference lists of all studies were examined to identify other eligible studies, and one study was considered eligible for inclusion in our scoping review [43]. Snowball citation tracking was performed for the 58 included studies, and 11 were considered eligible for inclusion in our scoping review [44-54]. Twenty studies presented results from the same trial, which were considered a single work [2, 12, 14, 44, 49, 51, 53, 55-67]. Therefore, 57 independent trials corresponding to 70 publications were considered eligible for inclusion in our review [1, 2, 11-15, 19, 20, 43-103]. The complete studies' search and selection process are presented in ESM (subsection 1.1.).

3.2 Study characteristics and context-related information

Figure 2 presents the included trials published yearly relating to playing time in different performance factors. Most studies (k=48, 68.6%, corresponding to 37 trials) were published in the last five years (2019 to 2023). Figure 3 presents the distribution of the included studies per continent, age group and sex. Thirty-three trials were performed in Europe (57.9%), 10 in North America (17.5%), 6 in South America (10.5%), 4 in Asia (7.0%), 1 in Oceania (1.8%), while 3 trials did not report location information (5.3%). Thirty-nine trials included male adults (68.4%), 9 trials included female adults (15.8%), and 9 trials included male non-adults (15.8%; < 18 years of age).

Studies' characteristics are presented in Table 1. The sample size ranged from 11 to 1,077 participants per trial, the age ranged from 13.5 to 29.5 years, the mean age of the trials was 21.7±2.3 and a

mode of 20.0. Twelve trials did not report age (21.1%), and one did not report sample size. Regarding the competitive level, 17 trials were categorized as Tier 2 (29.8%), 17 trials as Tier 3 (29.8%), 21 trials as Tier 4 (36.8%), and 2 trials as Tier 5 (3.5%). All details regarding the study characteristics and context-related information are presented in ESM (subsection 1.2).

3.3 Categorization of playing time

Table 2 presents the different division categories of starters and nonstarters. The inclusion of players in the different categories of match participation time followed two approaches: (i) acute exposure (i.e., starter ≥60 min vs nonstarter <60min); and (ii) chronic exposure (i.e., total playtime; starter ≥60% vs. nonstarter <60%). The most adopted categorization was the allocation of players based on match participation (k=33, 57.9%) [1, 2, 13-15, 19, 44, 47-49, 52, 53, 55-60, 62-64, 67-69, 71, 72, 74, 76, 79, 84, 86, 88, 90, 91, 94-100, 102]. The primary threshold to categorize starter was having played equal or above 66.7% of the match time, with players having a match volume below this cut-off being considered nonstarters (14.0%) [13, 14, 19, 44, 55-58, 62-64, 76, 90, 91, 96]. All details regarding the different categorizations are presented in ESM (subsection 1.3.).

3.3.1 Acute trials

Several cut-off values defined the players with distinct match participation volumes. When assigning players according to the acute exposure, 20 trials were categorized (35.1%) in two groups (e.g., ≥66.7% vs. <66.7%), for starters vs. nonstarters, respectively [1, 2, 13-15, 19, 44, 50, 53, 55-58, 62-64, 67, 69, 76, 79, 84, 90, 91, 95-99]. Nine trials (15.8%) categorized players into three groups (e.g., ≥50% vs. <50% vs. 0%) for starters vs. replaced/fringe vs. substitute/nonstarter, respectively [47, 52, 59, 60, 71, 86, 88, 94, 100, 102] and four trials (8.8%) in four distinct profiles (100% vs. ≥66.7% vs. <66.7% vs. 0%) for starters vs. replaced vs. substitute vs. nonstarters, respectively [48, 49, 68, 72, 74]. Six trials (10.5%) analyzed groups of players; however, individual playing time was not reported [50, 86, 88, 94, 100, 102].

Six trials (10.5%) used other acute definitions to differentiate starters vs. nonstarters, such as: i) a starter had to complete a minimum of 60 minutes in each of the three consecutive matches; players who did not achieve this duration were considered nonstarters [46, 51, 65, 66, 93]; ii) starters would have to start the match (first eleven), and nonstarters were considered who participated in the match or did not play any

minute [81]; iii) players were considered nonstarters when playing a minimum of 10 minutes per match [73] and 15 minutes per match [75].

3.3.2 Chronic trials

Concerning chronic exposure, 14 trials (24.6%) assigned different categories of match participation during the observation period [11, 12, 43, 45, 54, 61, 70, 77, 78, 83, 85, 87, 89, 92, 101]. Three trials (5.3%) examined the effect of chronic exposure and divided players into starters and nonstarters based on a number of matches where players acted as starters in the observation period and accumulated playing time during the season minutes (e.g., ≥60% vs. <60%, respectively) [12, 43, 61, 89]. Five trials (8.8%) have categorized players only by the amount of total playing time (e.g., ≥50% vs. <50%, respectively) [45, 78, 83, 85, 87] and two trials (3.5%) by the percentage of matches started (e.g., ≥80% vs. ≤50%, respectively) [92, 101], for starters and nonstarters, respectively. Four trials have categorized players into three cut-offs. Two trials (3.5%) grouped by the amount of total playing time (e.g., ≥66.7% vs. <66.7% vs. 0%, respectively) [54, 77], while two trials (3.5%) showed players starting status cut-offs (e.g., ≥60% vs. 30% to 60% vs. <30%, respectively) [11, 70], for starters, substitutes and nonstarters, respectively.

Four trials (7.0%) used other chronic definitions to differentiate starters vs. nonstarters, such as: i) a starter had to play ≥95% of all official matches and nonstarters ≥95% of all friendly matches during a season [20]; ii) according to the playing time during each mesocycle (two blocks of 21 days) using a median-split approach [80]; iii) starters have to participate in all matches and completed a minimum of 75% of the total time of the match and the remainder were considered nonstarters [103]; iv) starters if they played >50% of all matches, >50% of playing time in each match, and >50% in the starting eleven [82].

3.4 Compensatory Training for nonstarters

Table 3 presents information related to compensatory training. Sixteen trials (28.1%) reported compensatory activity. Three of the 16 trials (18.8%) carried out a compensatory training session after the official match [2, 49, 60, 68]. Six of the 16 trials (37.5%) performed supplementary work at MD+1 [13, 72, 74, 76, 81, 96], and one of the 16 trials (6.3%) carried out complementary training at MD+2 [54]. Two of the 16 trials (12.5%) performed additional training on match day and throughout the week (MD+1 and MD+2) [67, 80]. Five of the 16 trials (31.3%) did not provide information on which day compensatory training was performed for nonstarters [19, 20, 87, 99, 101]. The different strategies used to increase the

weekly load of nonstarters were mainly based on small-sided game (56.3%) [13, 54, 60, 74, 76, 80, 87, 96, 99] and running-based-drills (25.0%) [19, 54, 76, 96]. One of the 16 trials (6.3%) performed friendly matches to attempt to reproduce competitive loads [20]. Five of the 16 trials (31.3%) did not provide information on which strategies were used for nonstarter [2, 49, 67, 68, 72, 101].

3.5 Performance factors

Regarding performance factors, 49 trials (85.9%) presented data exclusively on the physical element [1, 2, 11-15, 19, 20, 43-51, 53-70, 72-76, 78, 80-85, 87, 89, 91-101, 103] and one trial (1.8%) on the psychological factor [77]. Several trials used integrated approaches: six trials (10.5%) investigated technical and physical factors [52, 71, 79, 86, 88, 90], and one trial (1.8%) investigated psychological and physical variables [102]. Regarding the outcomes of the investigations, 245 variables for each performance factor were extracted from the studies (Supplementary Table 2). No study examined the tactical factor. All details regarding the outcomes of the analysis of playing time in different performance factors are presented in ESM (subsection 1.4.).

3.5.1 Physical Factors

Fifty-six trials (98.3%) analyzed 211 different physical variables (external and internal absolute intensity, physiological determinants, exercise performance measurements, and anthropometric measurements) [1, 2, 11-15, 19, 20, 43-76, 78-103].

External absolute intensity indicators. Sixty-three external absolute intensity (EAI) variables (e.g., total distance, sprint distance, and accelerations) were observed in 35 trials (61.4%) [1, 11-15, 19, 44, 46-48, 51, 52, 55-58, 61-64, 66, 70-76, 78-81, 83, 86, 88, 90, 93, 94, 98, 100-103]. Nonstarters presented higher EAI in total distance, in speed distances at 3.3 to 7 m/s^{-2}, accelerations, decelerations, and high metabolic load distance during friendly soccer matches [1] and in the sessions after the match (MD+1) [13, 81], and two trials demonstrated no significant differences were detected in total distance, very high-intensity running, accelerations and decelerations between playtime status [66, 103]. Thirteen trials showed that substitute players covered greater total distance, distance in a range of speed zones (1.7 to 7 m/s^{-2}), accelerations, and player load relative to playing time than the players who were replaced or completed the entire match [48, 52, 71, 72, 75, 78, 79, 86, 88, 94, 98, 100, 102]. Sixteen trials observed starters accumulated higher EAI compared to nonstarters (total distance, distance in a range of speed zones (2 to 7

m/s^{-2}), number of accelerations and decelerations, player load, in a weekly microcycle and over the season [11, 12, 14, 15, 19, 44, 47, 51, 55-58, 61-64, 70, 74-76, 78, 80, 83, 93, 98].

Internal (subjective and objective) absolute intensity indicators**.** The categorization of the internal absolute intensity (IAI) metrics was divided in two distinct dimensions: subjective IAI (e.g., muscular and respiratory perceived of effort) and objective IAI (e.g., cardiac indices). Concerning subjective IAI, 16 variables were examined in 22 trials (38.6%), using the scale of Borg or Foster, wellbeing index, hooper index and total quality recovery (TQR) [1, 2, 45-47, 49, 50, 53, 54, 59-61, 65-68, 76, 80, 83, 84, 91-93, 100-102]. Regarding objective IAI, 24 variables (e.g., Akubat's, Banister's and Edward's TRIMP) were analyzed in six trials (10.5%) [12, 15, 61, 69, 78, 83, 101].

Regarding objective internal absolute intensity, two trials presented higher accumulated TRIMP during training sessions for nonstarters [12, 15], and one trial demonstrated a significant difference in high-intensity heart rate, with starters averaging less high-intensity heart rate minutes compared with nonstarters during the match [61]. One trial showed an increase in mean time spent in higher intensity zones (Zone 4: 90% to 95% HR_{max} and Zone 5: 95% to 100%HR_{max}) and a decrease in mean time spent in lower intensity zones (Zone 1: <70% HR_{max} and Zone 2: 70% to 85%HR_{max}), after player substitutions [69]. Three trials showed starters accumulated higher heart rate-based measures (70% to 100% HR_{max}) compared to nonstarters during a weekly microcycle and over the season [12, 15, 83].

Relating to subjective internal absolute intensity indicators, three trials demonstrated that respiratory perceived effort was higher in starters, while the muscular effort was greater in players with fewer minutes [49, 68, 100]. Starters reported higher perceived effort than the substitute players after the match [102]. Nonstarters presented a significantly higher value of session rating of perceived effort in acute:chronic workload ratio throughout the season [93] and in training sessions after the match (+48 hours) [91]. Ten trials showed starters accumulated higher perceived effort, training monotony and training strain of fatigue, stress, muscle soreness and quality of sleep than nonstarters in a weekly microcycle and over the season [2, 47, 53, 54, 60, 61, 65, 80, 92, 102]. In addition, the levels of alertness appear to decrease from preseason to postseason more in starters than in nonstarters [84].

Anthropometric measurements. Twenty-one anthropometric variables (e.g., body composition, maturation factors and somatic maturation) were examined in 10 trials (17.5%) [43, 45, 82, 85, 87, 90, 95, 96, 99, 103]. One trial showed that fat-free mass and body mass in young male players was higher in starters compared to nonstarters players [82]. On the other hand, in collegiate female soccer players starters weighed

less [95]. Two trials observed that nonstarters had a significant increase in body fat compared to starters [85, 96]. One trial presented that stature does not impact the duration of match-playing time or performance on an elite Women's World Cup soccer team [90].

Physiological determinants and performance measures. The categorization of the physical tests was divided into three distinct dimensions: neuromuscular physiological determinants (e.g., muscle architecture and function), neuromuscular performance measures (e.g., muscle and exercise tests), and endurance physiological determinants ($VO2_{máx}$, submaximal measures such as velocity at fixed blood La concentrations). Regarding neuromuscular physiological determinants, 18 variables (e.g., muscle thickness and testosterone concentrations) were examined in five trials (8.8%) [43, 45, 84, 85, 103]. Regarding neuromuscular performance measures, 54 variables (e.g., linear sprint, sit and reach and slalom test) were analyzed in 12 trials (21.1%) [19, 20, 45, 82, 84, 85, 89, 92, 95, 96, 99, 103]. With regard to endurance physiological determinants, 15 variables (e.g., maximum oxygen uptake, and velocity at 4mM of blood lactate) were examined in nine trials (15.8%) [20, 43, 45, 82, 84, 96, 97, 99, 103].

Concerning neuromuscular physiological determinants, starters have a greater change in muscle architecture (e.g., pennation angle and muscle thickness) and insulin-like growth factor concentration [45, 84]. Was observed no difference between starter and nonstarter for biomarkers (e.g. creatine kinase and indices testosterone/cortisol) [43].

Relating to neuromuscular performance measures, starters demonstrated significant increases compared to nonstarters in different physical tests: flexibility (sit and reach test) [20, 45, 84, 89, 95], strength (isometric knee extension), acceleration (0-20m) and maximal speed phase of sprinting (e.g. 30-m), agility (sprint with 90º turns) and power (CMJ and squat jump). One trial showed significant improvements in both starters and nonstarters in upper- and lower-body reactions to visual stimuli [84]. However, significant reductions in knee extension isokinetic peak torque (1.05 $rad \cdot sec^{-1}$), vertical jump and linear sprint tests (18.3 and 36.7 m) performances for both groups [85]. In addition, nonstarters experienced a slight decrement in power performances assessed by countermovement jump and continuous jumps with legs straight [20]. In contrast, starters experienced significant reductions in maximal power output during the second half of a collegiate soccer season [92].

Concerning to endurance physiological determinants, one trial observed greater $VO2_{max}$ in starters than nonstarters [45]. Starters and nonstarters showed statistically significant improvements in the velocity

at 4mM of blood lactate [97] and decreases in the aerobic capacity measured by $VO2_{max}$ by 0.35% and 2.66%, respectively [20].

3.5.2 Technical Factors

Six trials (10.5%) analyzed 22 technical variables (e.g., successful passes, number of shots and successful dribbles) [52, 71, 79, 86, 88]. No differences were evident for pass-completion rates in nonstarters compared starters [71]. Nonstarters in the Chinese Super League completed more technical actions than starters, but with a lower efficacy [79]. One study showed, nonstarters made more accurate passes than starters [86]. Moreover, was observed that differences in technical performance indices of starters, and nonstarters varied according to the playing positions [88]. Nonstarters in the position of central defender showed less involvements with the ball, but higher defensive performance, while the substitute players in the positions of central midfielder, wide midfielder, and attackers showed more possession, touches, and shots than starters [88]. Differences between starting status during FIFA World Cup showed to not be pronounced in technical actions [52].

3.5.3 Psychological Factors

The psychological factor of the players was analyzed in two trials (3.5%): the sport motivation scale (SMS) [77] and Brunel model scale (BRUMS) [102]. One trial showed starters obtained higher self-determination indexes, proving to be more intrinsically motivated for soccer practice compared to nonstarters [77]. No significant differences were observed in mood states for vigor and fatigue in relation to match playtime [102].

3.5.4 Integrated factors

Two trials (3.5%) performed an integrated analysis involving both technical and physical factors during exercise performance measures (slalom test with the ball (STB) and the sprint with 90º turns with the ball (S90ºB) [20] and competition performance measures (high-intensity running when the team is in ball possession [71]. Starters revealed superior performance during the STB and S90ºB and lower high-intensity running with the ball, relative to playing time, than nonstarters [20, 71].

3.6 Risk of Bias in Individual Studies

Table 4 presented the risk of bias of the seventy studies included. In synthesis: i) risk of bias in selection of participants was high in 39% of the studies, due to the inclusion/exclusion criteria not being provided; ii) risk of bias in confounding variables was high in 42% of the studies, because study period and team were not similar for the groups evaluated; iii) risk of bias in blinding of outcome assessments was high in 50% of the studies, because blinding was not performed, having a likely effect on outcome measures (i.e., countermovement jump test, percentage of body fat or subjective measures); iv) risk of bias in incomplete outcome data was high in seven trials (12%), due to missing data on the existence of participant dropouts; v) risk of bias in measurement of exposure and selective outcome reporting did not report high risk of bias; however, was unclear in twelve trials (21%), due to the lack of information on important assessment methods and the data obtained are from unreliable sources (i.e., details regarding the GPS procedure protocol) and forty-nine trials (86%), due to the absence of a pre-registered protocol, respectively. All details regarding the risk of bias of the studies included are presented in ESM (subsection 1.5.).

3.7 Synthesis of evidence

EGMs (Figure 4) were undertaken to synthesize the relevant available evidence to provide a visual presentation of the evidence. The EGM summarized the findings and provided a brief overview of the evidence and research gap [104-106]. Figure 4 presents an example how information was collected regarding the scoping review context and outcomes.

The EGM highlights that the physical performance factor (k=56, 98.2%) has been extensively studied in relation to the differences between starters and nonstarters. Most of these investigations were registered on the European continent (k=33, 57.9%), involving adult male players (k=39, 68.4%) and the most common competitive level was Tier 4 (k=21, 36.8%). Predominantly, the commonly utilized classification was acute approach trials (k=33, 57.9%) with two categories of analyses (≥66.7% vs. <66.7%), for starters vs. nonstarters, respectively. Notably, the most frequent day to perform compensatory training was at MD+1 (k=6, 10.5%).

On the other hand, technical and psychological performance factors were analyzed in eight trials (14.0%), and it is noteworthy that the tactical factor has not been addressed in any study. The continents of North America (k=10, 17.5%), South America (k=6, 10.5%), Asia (k=4, 7.0%), and Oceania (K=1, 1.8%) have scarce investigations, and the African continent did not present any studies. Additionally, there is a limited of research specifically targeting female players (k=9, 15.8%), and the competitive levels of Tier 2

(k=1, 1.8%) and Tier 5 (k=2, 3.5%) demonstrate a scarcity of studies. Furthermore, classifications with three or more player analysis categories (k=19, 33.3%), resulted in a lower number of analyses. Sixteen out of 57 trials (28.1%) implemented compensatory training for nonstarters.

4. Discussion

The objective of this scoping review with evidence-gap map was to provide an EGM that guides future research towards the most relevant gaps in current literature. Comparative analyses were performed between starters and nonstarters in terms of the different performance factors. This analysis was also carried out to identify compensatory strategies for players with reduced playing time. The physical performance factor has been extensively studied in relation to the differences between starters and nonstarters, with EAI, exercise performance measurements and physiological determinants being the most studied metrics. On the other hand, few studies of technical and psychological performance factors were analyzed, while tactical factor has not been addressed in any study. Starters accumulated, in absolute terms, higher EAI and IAI in a match, weekly microcycle and over the season and improved in the exercise performance measurements compared to nonstarters. However, nonstarters presented, in relative terms, higher EAI and IAI in a match compared to starters. The day most used for compensatory training was MD+1 and several strategies to attempt to reproduce competitive loads were used as small-sided games, small-positional game, tactical-technical drills, friendly matches, high-intensity running or strength training. It is noteworthy that sixteen trials reported that there was compensatory training for nonstarters [2, 13, 19, 20, 49, 54, 60, 67, 68, 72, 74, 76, 80, 81, 87, 96, 99, 101].

4.1 Performance Factors

Soccer, through the years, has formed into a more complex game in which ideal performance relies on upon the cooperation of five factors: specifically technical skills, tactical strategies, physiological component, psychological factors and team factors (e.g., group elements and cohesion) [107]. In a competitive week, match typically represents the highest external and internal absolute intensity of the week [2, 11, 19, 20, 59-61, 65, 70, 72, 74, 76, 80, 82, 83, 89, 91, 92, 96, 97]. When considering that only eleven players can start each official game, indicating that a considerable number of players per team are not exposed to the match [2]. As a result, within the same team, considerable physical and physiological demands differences can be found [11, 12, 15, 52, 61, 76, 78, 80, 98]. This suggests that competition seems

to constitute an important training stimulus for the maintenance/improvement of the player's ability to perform high intensity displacements [20, 97]. Therefore, differences between groups are largely reflect of differences in match time as opposed to training time [11]. However, Palmer, Akehi [95] mentioned technical, tactical, and psychological factors may also influence playing status. A variable that may differentiate physical training is the amount of playing time, as during competitive periods, some players may accumulate more playing time compared to others for technical or tactical reasons [96]. The task of selecting which players are starters and in the bench on a team is typically conducted by the coaching staff. Coaches often select players based on their performance level, as top performers would be selected to start games over lower performers [95]. Such selection may also depend on tactical beliefs or strategies for each specific match played by the team or specific in-season periods [11, 95].

Although most of the soccer training session during the training week is designed to improve players' tactical and technical competence and prepare for the upcoming matches [60, 96], there is limited information on technical, psychological and, especially, tactical factors regarding nonstarters. Nevertheless, tactical and technical factor are a central component for success in modern elite soccer [79, 88, 108]. Until recently, there have been few detailed scientific investigations of team tactics and one reason in this regard has been the lack of available, relevant data [108]. Several studies have addressed the technical and psychological factors [52, 71, 77, 79, 86, 88, 90, 109]. Focusing on technical performance, the research literature has demonstrated that some technical variables, such as ball possession, pass accuracy, and shots, could accurately discriminate between successful and unsuccessful teams [79, 110]. More specifically, number of shots, shots on target (shot success), number of passes and pass completion rates (pass success) were positively correlated with team success [5, 79]. Several trials demonstred the total number of short passes, successful passes, and involvements with the ball decreases between the first and second half of soccer matches, probably as aconsequence of players' fatigue [3, 79, 86, 88]. In this sense, the substitutions appear to be a good strategy to counteract this decline in technical performance since the substitute players showed more possession, touches, shots, and defense actions per minute in comparison with the players who were replaced and those who completed the entire match [79, 86, 88].

Psychological factor, motivation, confidence, anxiety control, mental preparation, team emphasis, concentration, and cognition tend to help players retain expertise, focus on the maintenance of the possessed expertise and perform an important role in the improvement of the performance of soccer players [109]. Filho et al. [77] reported starters were more intrinsically motivated by soccer and indicated more behavior

towards playing soccer compared to nonstarters. Specifically in soccer, motivation has been correlated with several psychological constructs such as commitment, mental resistance, burnout and perfectionism, and with variables of tactical and technical performance [77, 109, 111, 112]. Despite the significant role of psychological factors in the successful performance of soccer matches, those factors alone cannot determine performance in the match [109]. Moving forward from this deduction, all performance factors seem to have a certain level of importance in the players' performance. Given that special attention should be given to nonstarters, it would be paramount for coaches to promote a balanced training stimulus for starters and nonstarters [45]. Discrepancies between players could lead to differences in important components of soccer-specific fitness that may subsequently present on match day when players are not accustomed to match loads and are now required to complete the habitual physical demands performed by regular starting players [11]. Furthermore, discrepancies in match-time have been shown to directly influence aspects of physical fitness and various aspects of tactical and technical skill, thus creating a challenging scenario for those managing player workloads to overcome [12, 16]. Therefore, coaches and support staff may need to adopt specific strategies to ensure that the players are ready to cope with the match demands [2, 11, 19, 45, 47, 62, 70, 72, 74, 76, 78, 80, 81, 83, 100, 101, 109].

4.2 Categorization of playing time and compensatory training

Several trials organized compensatory strategies for players who did not participate in the match or who played a few minutes (e.g., < 60 min) to compensate for the missing demands [47]. In this regard, playing time is typically the main criterion to decide who should participate in the compensatory training session [68]. Different categorizations were made based on playing time, players' starting status, or the total accumulation of matches during the competitive season, dividing players into two or more playing-time groups [11, 46, 54, 74]. Nevertheless, the literature appears inconclusive regarding the optimal categorization of player groups to replicate the workload of nonstarters. Furthermore, diverse strategies were employed with respect to compensatory training sessions, with regard to the training day and type of drills [13, 19, 20, 49, 54, 60, 68, 74, 76, 80, 81, 87, 96, 99]. Several trials examined in this investigation introduced compensatory training strategies capable of sustaining or surpassing the weekly workload of starters [66, 67, 76, 80, 101]. Díaz-Serradilla et al. [76] reported that the compensatory session, which incorporated running-based-drills and small-sided games during the MD+1 session for nonstarters female soccer players (<60 minutes accumulated), exposed the players to match demands. Gualtieri et al. [80]

observed that professional male soccer players with more playtime produced higher total exposure and total distance. However, non-significant differences between groups were found for very high-intensity running and sprint distance. The training strategy used for nonstarters (median-split approach in each mesocycle) was, after the game, performing low-volume high intensity aerobic training without very high-speed running. Later, on MD+1 these players performed a combination of small-sided games and power training in the gym, and on MD+2, following the first part of the session, nonstarters continued their compensatory training program with low-intensity tactical-technical drills [80]. The training strategies implemented may have compensated for the differences between groups during the microcycle [76, 80].

However, the training intensity and volume of compensatory sessions may not be enough to compensate for low or nonexistent match demands [2, 60, 68, 72, 74]. In this way, replicating the physical, tactical, and technical levels seems complex and dependent on various factors, such as the compensatory training mode, the playing position, the player, the team playing style, and others [70, 91]. Moreover, certain studies encountered organizational and conventional training challenges [11, 12, 48]. In the English Premier League, players are not permitted to train on the same pitch where the match was played for more than fifteen minutes post-match [11]. Additionally, it is often common practice for the entire playing squad to be given one to two days of recovery after each game [11]. In American collegiate soccer, the congested schedule presents limited time to implement additional training for nonstarters between matches [12]. Garcia et al. [47] reported days after the away matches, the coaches were unable to compensate for the missing match load, mainly due to the travel and/ or the logistics of the training (e.g. space, number of players available to train). Concerning compensatory training strategies, Martin-Garcia et al. [13] demonstrated that MD+1 for players without match time exceeds 50% of match play values (total distance covered, number of accelerations, and decelerations). However, these strategies did not contribute to developing the players' high-speed running and sprinting qualities [13, 74]. Otherwise, the study by Stevens et al. [17] showed that nonstarters compensatory training revealed significantly lower values (e.g., lower TD, time spent above 90%HR_{max}, and fewer accelerations and decelerations) than those obtained by starters. These sessions comprise a smaller number of players (~9 vs. ~18 in regular training) and an increase in ball touches, dribbles and duels, but lower physical demands [113]. Considering training strategies designed for players with less or no playtime, implemented post-match, first or second training sessions of the week, are not sufficient to compensate for the effects of participation in weekly EAI and IAI, it may be advisable for

technical staff to contemplate the incorporation of compensatory training strategies across multiple days of the week (distributed practice) [11, 60, 67, 114].

Therefore, discrepancies throughout a season may pose challenges to coaches regarding the management of workloads in starters while also providing an adequate and consistent training stimulus for nonstarters to maintain the physical adaptations, psychological factors and tactical-technical skills required to elicit improvements in performance throughout the season.

4.3 Limitations

Several limitations were presented by the studies. The main limitation is common to studies in sports sciences – the small sample size and the specificity of the team (age, gender, and competition), which may limit the generalization of the results to other scenarios. This limitation is common to longitudinal studies of professional teams in a competitive season, and so replication studies with different samples are warranted. Regarding the monitoring of the external absolute intensity, the simultaneous use of different data collection instruments (i.e., GPS and Prozone), may have implications for data compatibility and lead to overestimation or underestimation of results, potentially introducing bias to the measurement of the absolute external intensity during both training and matches. Concerning internal absolute intensity, the use of pre-season values to establish maximum heart rate, which may not record variations in cardiovascular capacity throughout the season or improperly scheduling physical tests (i.e., starting the battery of tests with maximal aerobic effort). With regard to performance measurements, using 2 to 3 physical test evaluations during the competitive season in the analysis of the studies, as the absence of continuous monitoring may present bias into the results. Another limitation was not considering the effective differences in minutes that may exist within the same groups (e.g., >60min; 61 minutes vs. 89 minutes) or the use of match data with reduced times (e.g., 5 minutes).

A limitation of this review relates to the participation of players with less playtime, as the match time variable typically defines those engaging in additional training (e.g., <60 min). However, the terminology "starter and nonstarter" may be reductionist in the sense of individualizing training. Despite playing time strongly influencing the total external and internal absolute intensity, a player with 45-50 minutes of match time may have the same or higher exposure to specific parameters as one who played 60-65 minutes. Nevertheless, in practice, the primary concern is the accumulated volume and intensity over the week.

5. Conclusion

The current scoping review provided an EGM that may guide future research towards the most relevant gaps in current literature regarding the influence of competition time in soccer players. The physical performance factor has been widely studied in relation to the differences between starters and nonstarters. However, tactical, technical, and psychological performance factors require further investigation to obtain more information about possible differences between groups. Starters accumulated higher absolute EAI and IAI in a match, weekly microcycle and over the season and improved in the exercise performance measurements compared to nonstarters. On the other hand, nonstarters presented higher relative EAI and IAI in a match compared to starters. Although coaches incorporate post-match practices to compensate for missing match demands for players with less playtime, it seems insufficient to mitigate the effects of match participation. Technical staff should take advantage of every opportunity window to train nonstarters, especially in the 48 hours following a match. In addition, the literature appears inconclusive regarding the strategies employed in compensatory training sessions (training day and type of drills) and the categorization of player groups to attempt to reproduce the competitive match demands of nonstarters. Potential avenues for future research include: i) exploring the combination of scenarios within the microcycle that may influence the weekly volume of players engaged in compensatory training (e.g., a starter on Sunday and a nonstarter the following Sunday); ii) directing more studies towards female soccer players; iii) investigating the impact on the weekly load of nonstarters when compensatory training is conducted on multiple days of the week (distributed practice); iv) analyze the differences according to positional status (e.g., in EAI, IAI, the impact of substitution, and physiological measures) and situational factors (competitive schedule, type of competition, place of play, final result, and quality of the opponent) between players groups.

6. References

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Manuscript Figures

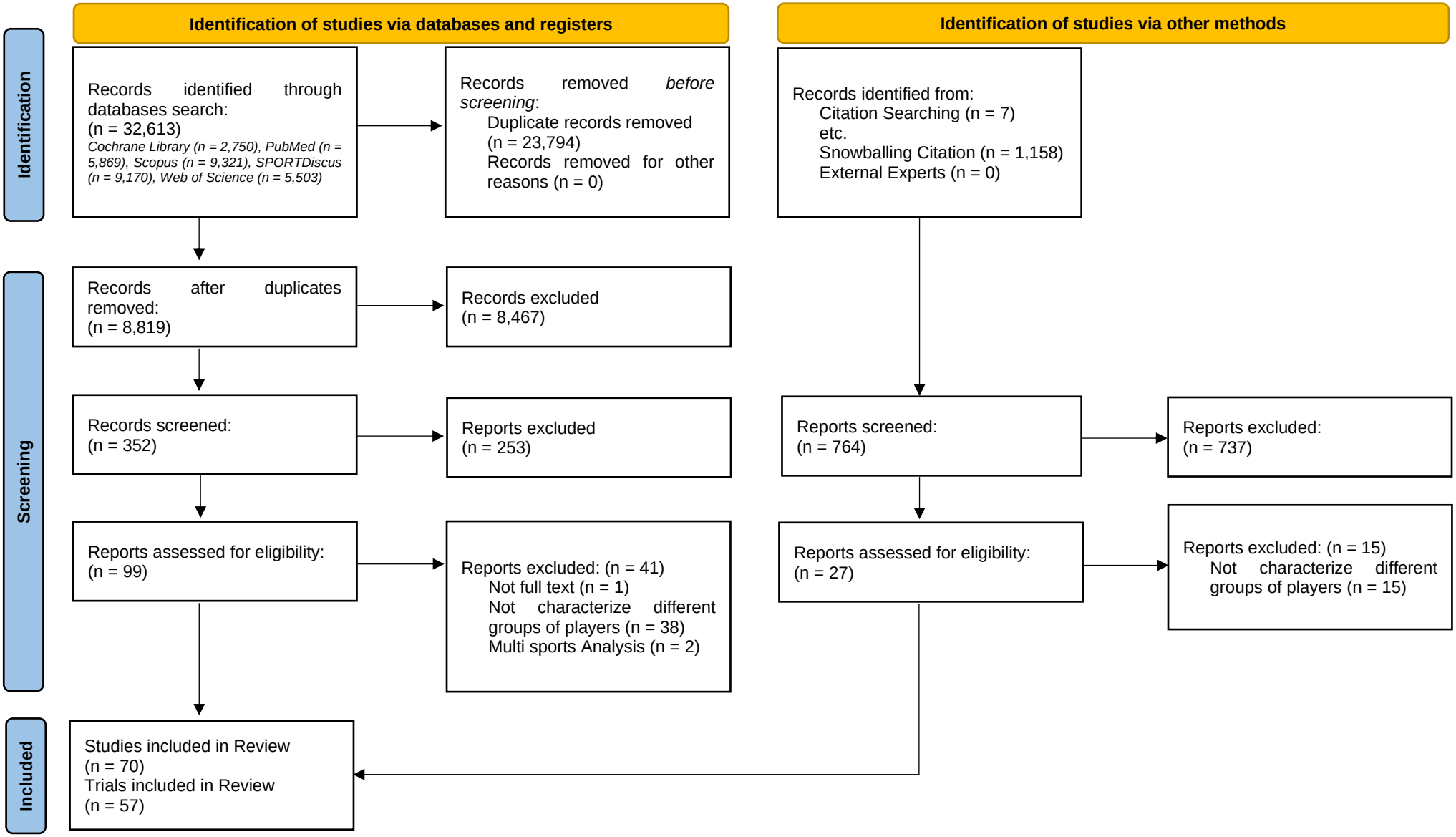

Fig 1. Process of identifying eligible studies for a Scoping Review

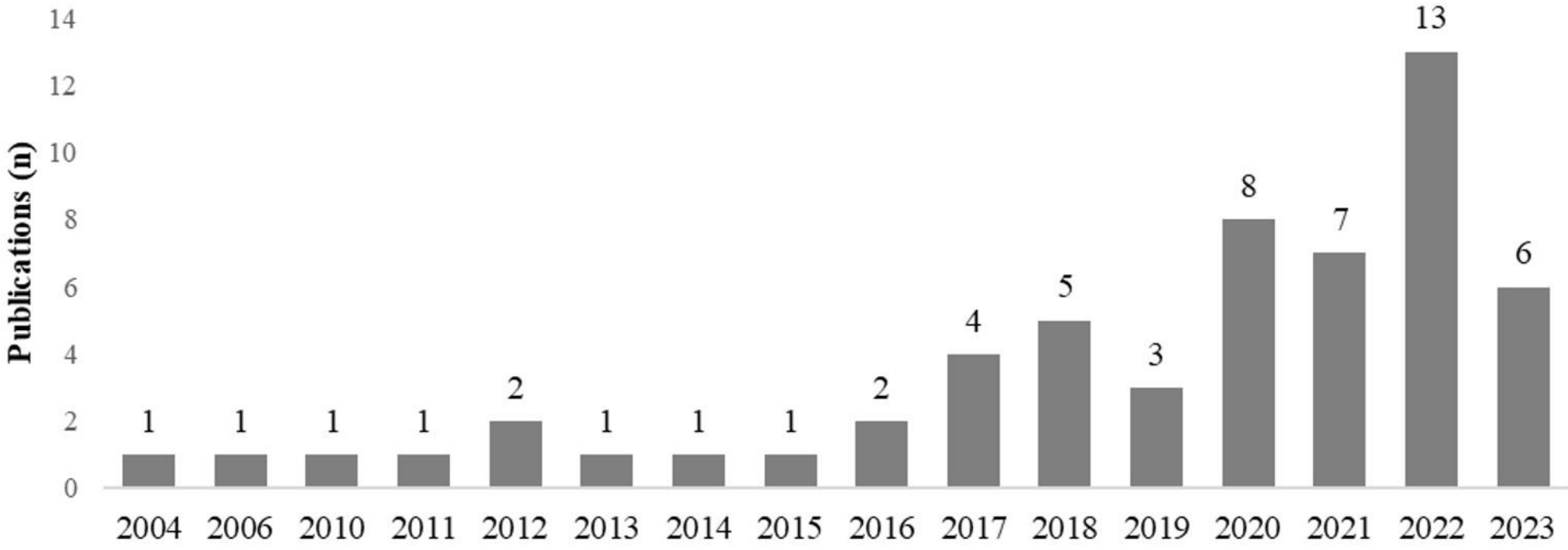

Fig 2. Studies published per year relating to playing time in different performance factors

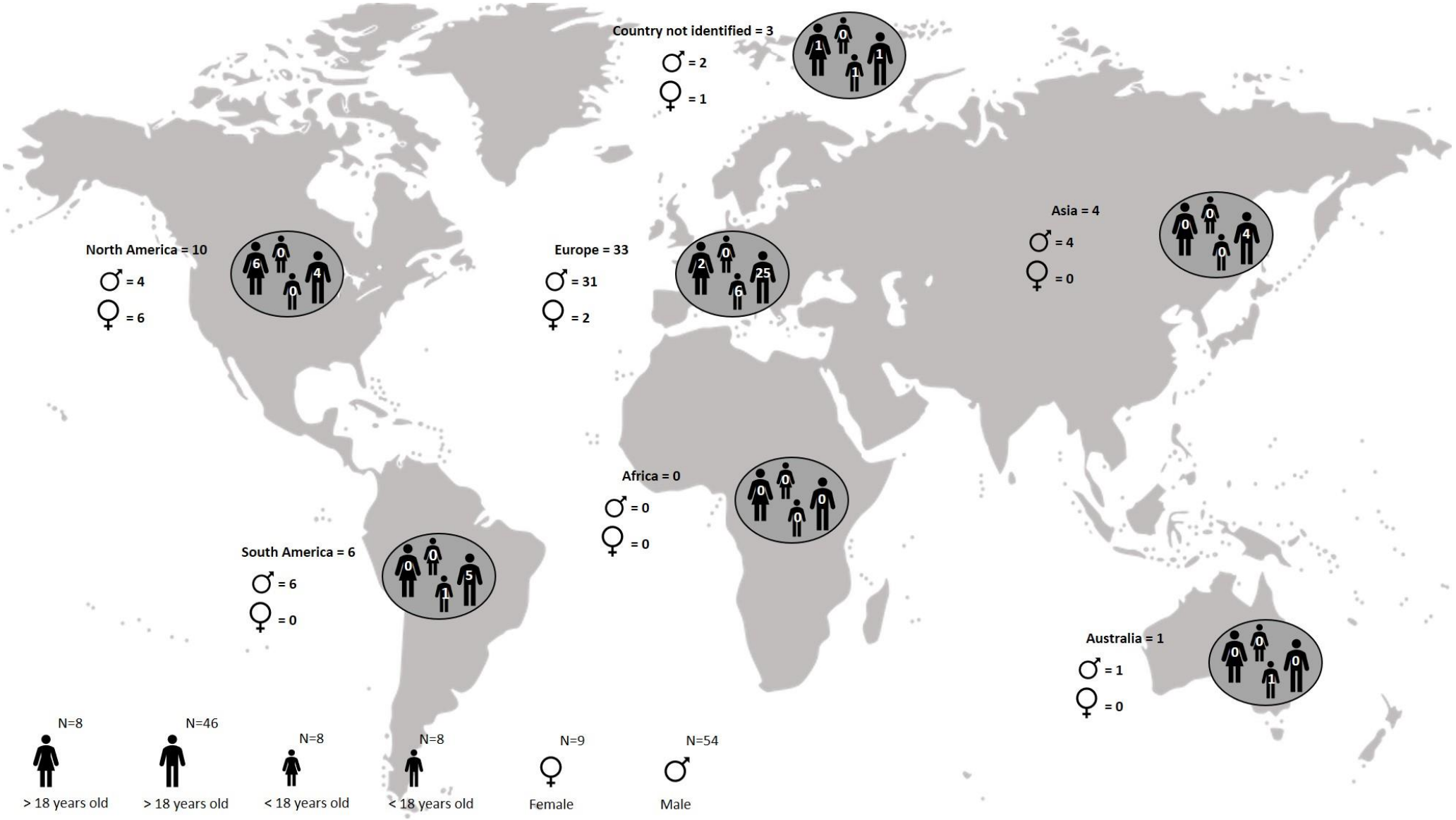

Fig 3. Distribution of the included studies per continent, age-group and sex

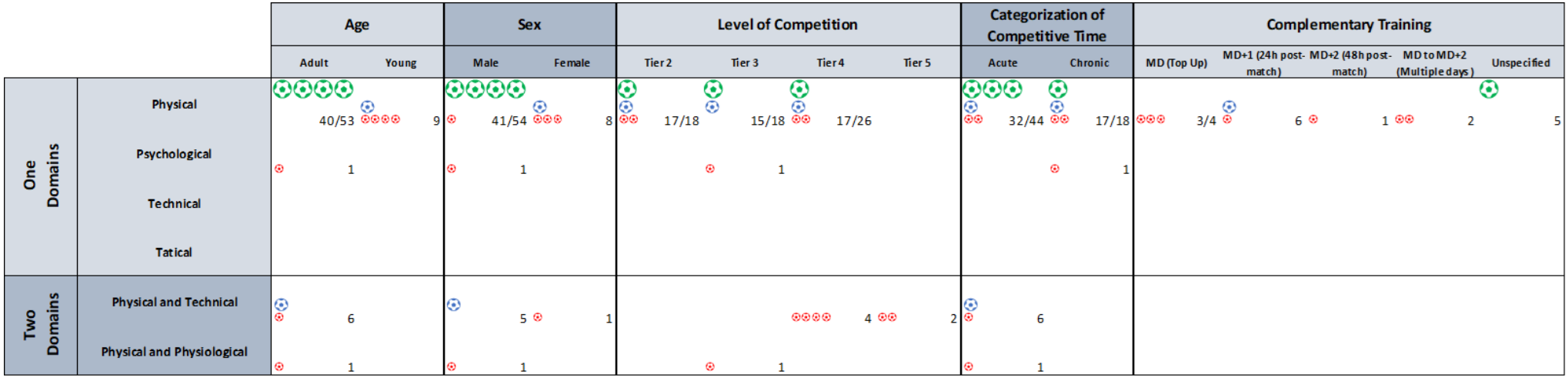

Fig 4. = Represents 10 trials; = Represents 5 trials; = Represents 1 trial; Tier 2: trained/developmental; Tier 3: highly trained/national level; Tier 4: elite/international level; Tier 5: world class; Acute: players according to the match participation

Manuscript Tables

Table 1 – Studies characteristics.

Citation Details	Country	Sample Size	Sex	Age (Mean ± SD)	Competitive level	Categorization of Competitive Time	Performance Factors	Compensatory Training	Period of Observation	Funding Sources	Competing Interests
Alijanpour et al. [44]	Iran	19	M	28,0 ± 4,6	Tier 4	Acute	Physical	No	43 Weeks	No Funding Source	No Conflict of Interest
Anderson et al. [11]	England	19	M	25,0 ± 4,0	Tier 4	Chronic	Physical	No	39 Weeks	Unreported	Unreported
Arcos et al. [49]	Spain	40	M	Unspecified	Tier 3	Acute	Physical	Yes	2 Seasons	Unreported	Unreported
Azcarate et al. [59]	Spain	21	M	26,7 ± 3,1	Tier 3	Acute	Physical	Yes	16 Weeks	Unreported	No Conflict of Interest
Azcarate et al. [60]	Spain	17	M	27,1 ± 3,3	Tier 3	Acute	Physical	No	8 Weeks	Received External Funding	No Conflict of Interest
Barbosa et al. [69]	Brazil	55	M	24,0 ± 2,4	Tier 4	Acute	Physical	No	Unspecified	Received External Funding	Unreported
Barreira et al. [70]	Portugal	35	M	19,7 ± 1,2	Tier 3	Chronic	Physical	No	35 Weeks	No Funding Source	No Conflict of Interest
Bradley et al. [71]	England	1382	M	Unspecified	Tier 4	Acute	Physical & Technical	No	1 Season	Unreported	No Conflict of Interest
Calderon et al. [72]	Spain	Unspecified	M	Unspecified	Tier 4	Acute	Physical	Yes	3 Seasons	No Funding Source	No Conflict of Interest
Carling et al. [73]	French	25	M	Unspecified	Tier 4	Acute	Physical	No	Unspecified	No Funding Source	Unreported
Casamichana et al. [74]	Spain	24	M	20,0 ± 2,0	Tier 4	Acute	Physical	Yes	42 Weeks	Received External Funding	No Conflict of Interest
Castillo-Rodríguez et al. [75]	Spain	22	M	26,1 ± 5,7	Tier 3	Acute	Physical	No	7 Mouths (October to April)	Received External Funding	No Conflict of Interest
Curtis et al. [12]	USA	82	M	20,0 ± 2,0	Tier 2	Chronic	Physical	No	4 Mouths (August–November)	Received External Funding	No Conflict of Interest
Curtis et al. [61]	USA	107	M	20,0 ± 2,0	Tier 2	Chronic	Physical	No	4 Mouths (August–November)	Received External Funding	No Conflict of Interest
Dalen et al. [15]	Norway	18	M	15,7 ± 0,5	Tier 2	Acute	Physical	No	10 Weeks	No Funding Source	No Conflict of Interest
Díaz-Serradilla et al. [76]	Spain	14	F	21,7 ± 1,7	Tier 3	Acute	Physical	Yes	Competitive midseason period	Received External Funding	No Conflict of Interest
Eskandarifard et al. [45]	England	24	M	15,6 ± 0,2	Tier 2	Chronic	Physical	No	8 Mouths (August-March)	Received External Funding	No Conflict of Interest
Fernandes et al. [46]	Portugal	19	F	24,1 ± 2,7	Tier 3	Acute	Physical	No	10 Weeks	Received External Funding	No Conflict of Interest
Filho et al. [77]	Brazil	112	M	18,6 ± 1,1	Tier 3	Chronic	Psychological	No	Unspecified	Unreported	Unreported
Furtado Mesa et al. [78]	USA	19	F	20 ± 1,61	Tier 2	Chronic	Physical	No	4 Mouths (August–November)	No Funding Source	No Conflict of Interest
Gai et al. [79]	China	9507	M	Unspecified	Tier 4	Acute	Physical & Technical	No	1 Season	Received External Funding	No Conflict of Interest
Garcia et al. [47]	Brazil	29	M	26 ± 4,0	Tier 3	Acute	Physical	No	21 Weeks	Received External Funding	No Conflict of Interest
García-Aliaga et al. [48]	Spain	1007	M	Unspecified	Tier 3	Acute	Physical	No	Unspecified	No Funding Source	No Conflict of Interest
Gholizadeh et al. [62]	Iran	19	M	28 ± 4,6	Tier 4	Acute	Physical	No	43 Weeks	Received External Funding	No Conflict of Interest
Gimenez et al. [1]	Spain	14	M	23,2 ± 2,7	Tier 4	Acute	Physical	No	2 Weeks	No Funding Source	Unreported
Gualtieri et al. [80]	Italy	20	M	28,4 ± 4,3	Tier 4	Chronic	Physical	Yes	42 Days	Unreported	No Conflict of Interest
Hernandez et al. [81]	Spain	18	M	26,2 ± 3,9	Tier 3	Acute	Physical	Yes	7 Weeks	Unreported	No Conflict of Interest
Hoppe et al. [82]	Germany	92	M	17,7 ± 0,2	Tier 2	Chronic	Physical	No	7 Seasons	Received External Funding	No Conflict of Interest
Jagim et al. [83]	USA	22	F	Unspecified	Tier 2	Chronic	Physical	No	1 Season	No Funding Source	No Conflict of Interest.
Jajtner et al. [84]	USA	28	F	20,5 ± 1,2	Tier 2	Acute	Physical	No	12 Weeks	Unreported	Unreported
Kraemer et al. [85]	USA	25	M	19,3 ± 0,9	Tier 2	Chronic	Physical	No	11 Weeks	Unreported	Unreported
Kubayi et al. [86]	Unspecified	252	M	Unspecified	Tier 4	Acute	Physical & Technical	No	UEFA Euro Tournament	No Funding Source	No Conflict of Interest
Lopez et al. [87]	Spain	20	M	27,2 ± 13,2	Tier 4	Chronic	Physical	Yes	10 Mouths (August-May)	Unreported	Unreported

Citation Details	Country	Sample Size	Sex	Age (Mean±SD)	Competitive level	Categorization of Competitive Time	Performance Factors	Compensatory Training	Period of Observation	Funding Sources	Competing Interests
Lorenzo-Martinez et al. [88]	Germany	431	M	Unspecified	Tier 4	Acute	Physical & Technical	No	1 Season	Unreported	Unreported
Los Arcos et al. [49]	Spain	40	M	20,3 ± 2,0	Tier 3	Acute	Physical	Yes	9 Weeks	Unreported	No Conflict of Interest
Los Arcos et al. [2]	Spain	24	M	UI	Tier 3	Acute	Physical	Yes	30 Weeks	Unreported	Unreported
Magrini et al. [89]	USA	18	F	19,5 ± 1,2	Tier 2	Chronic	Physical	No	Spring off-season	Unreported	Unreported
Manning et al. [90]	Unspecified	556	F	27,14 ± 4,0	Tier 5	Acute	Physical & Technical	No	Women's FIFA World Cup	No Funding Source	Conflict of Interest
Marqués-Jiménez et al. [50]	Unspecified	35	M	14,33 ± 0,9	Tier 2	Acute	Physical	No	2 Seasons	Unreported	No Conflict of Interest
Martin-Garcia et al. [13]	Spain	24	M	20,0 ± 2,0	Tier 4	Acute	Physical	Yes	42 Weeks	No Funding Source	No Conflict of Interest
Martins et al. [91]	Portugal	11	M	16,2 ± 0,3	Tier 3	Acute	Physical	No	50 Weeks	Received External Funding	No Conflict of Interest
McLean et al. [92]	USA	16	F	19,9 ± 1,2	Tier 2	Chronic	Physical	No	16 Weeks	No Funding Source	No Conflict of Interest
Morgans et al. [19]	England	15	M	25,8 ± 4,1	Tier 4	Acute	Physical	Yes	Unspecified	Unreported	Unreported
Nobari et al. [14]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	Received External Funding	No Conflict of Interest
Nobari et al. [56]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	Received External Funding	No Conflict of Interest
Nobari et al. [57]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	Received External Funding	No Conflict of Interest
Nobari et al. [55]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	Received External Funding	No Conflict of Interest
Nobari et al. [58]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	No Funding Source	No Conflict of Interest
Nobari et al. [93]	Iran	20	M	29,4 ± 4,4	Tier 4	Acute	Physical	No	20 Weeks	Received External Funding	Conflict of Interest
Nobari et al. [63]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	Received External Funding	No Conflict of Interest
Nobari et al. [64]	Iran	21	M	28,3 ± 3,8	Tier 4	Acute	Physical	No	48 Weeks	Received External Funding	No Conflict of Interest
Nobari et al. [51]	Iran	19	M	27,5 ± 4,7	Tier 4	Acute	Physical	No	43 Weeks	Funding	No Conflict of Interest
Oliveira et al. [65]	Portugal	17	M	25,4 ± 4,0	Tier 4	Acute	Physical	No	41 Weeks	Received External Funding	No Conflict of Interest
Oliveira et al. [66]	Portugal	17	M	25,4 ± 4,0	Tier 4	Acute	Physical	No	40 Weeks	Received External Funding	No Conflict of Interest.
Padrón-Cabo et al. [94]	Spain		M	Unspecified	Tier 4	Acute	Physical	No	10 Mouths (August-May)	Received External Funding	No Conflict of Interest
Palmer et al. [95]	USA	24	F	29,7 ± 2,5	Tier 2	Acute	Physical	No	Pre-Season	Received External Funding	Unreported
Papadakis et al. [96]	Greek	21	M	23,6 ± 4,2	Tier 4	Acute	Physical	Yes	11 Mouths (July-May)	Unreported	Unreported
Paraskevas et al. [97]	Cyprus	17	M	29,5 ± 4,0	Tier 3	Acute	Physical	No	17 Weeks	Unreported	Unreported
Rago et al. [52]	Unspecified	453	M	Unspecified	Tier 5	Acute	Physical & Technical	No	Men´s FIFA World Cup	Unreported	Unreported
Raya-Gonzalez et al. [67]	Spain	19	M	18,5 ± 0,5	Tier 3	Acute	Physical	Yes	30 Weeks	Unreported	No Conflict of Interest
Raya-González et al. [53]	Spain	19	M	18,0 ± 0,6	Tier 3	Acute	Physical	No	9 Mouths (September-May)	No Funding Source	No Conflict of Interest
Reche-Soto et al. [98]	Spain	22	M	22,6 ± 4,8	Tier 3	Acute	Physical	No	1 Season	No Funding Source	No Conflict of Interest.
Sams et al. [54]	USA	30	M	18 to 23	Tier 2	Chronic	Physical	Yes	14 Weeks	Received External Funding	No Conflict of Interest
Silvestre et al. [99]	USA	25	M	19,9 ± 1,3	Tier 2	Acute	Physical	Yes	16 Weeks	Unreported	Unreported
Sporis et al. [20]	Croatia	64	M	18,2 ± 0,6	Tier 3	Chronic	Physical	Yes	260 Days	Unreported	Unreported
Sydney et al. [100]	Australia	21	M	15,6 ± 0,7	Tier 2	Acute	Physical	No	13 Mouths	Unreported	No Conflict of Interest
Teixeira et al. [101]	Portugal	60	M	15,2 ± 1,8	Tier 2	Chronic	Physical	Yes	6 Weeks	Received External Funding	No Conflict of Interest.
Titton et al. [102]	Brazil	17	M	18,5 ± 0,7	Tier 3	Acute	Physical & Psychological	No	20 Days	Unreported	No Conflict of Interest
Vilamitjana et al. [43]	Argentina	22	M	23,4 ± 2,4	Tier 4	Chronic	Physical	No	10 Weeks	Unreported	Unreported
Zanetti et al. [103]	Brazil	21	M	13,5 ± 0,7	Tier 2	Chronic	Physical	No	5 Days	Received External Funding	Unreported

M: Male; F: Female; SD: Standard Deviation; USA: United States of America; Tier 2: trained/developmental; Tier 3: highly trained/national level; Tier 4: elite/international level; Tier 5: world class; Acute: players according to the match participation; Chronic: playing time accumulated during a specific period of competition.

Table 2 - Categorization of playing time.

Studies	Acute:Chronic Categorization	Categories of Analyses	Categorization of playing time (Original)	Starter (%)	Replaced (%)	Substitute more Playtime (%)	Substitute less playtime (%)	Nonstarter (%)	Nonselected (%)
Alijanpour et al. [44]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Anderson et al. [11]	Chronic	3 categories of analyses	Players' starting status; Category 1: ≥60%; Category 2: 30% to 60%; Category 3: <30%	≥60%	30% to 60%			<30%	
Arcos et al. [49]	Acute	4 categories of analyses	Accumulated minutes; Category 1 >70 min; Category 2: 45 to 70 min; Category 3: 20 to 45 min; Category 4: <20 min	≥77,8%	50% to 77,8%	22,2% to 50%	<22,2%		
Azcarate et al. [59]	Acute	3 categories of analyses	Accumulated minutes; Category 1: ≥ 45 min; Category 2: < 45 min; Category 3: 0 min	≥50%				<50%	0%
Azcarate et al. [60]	Acute	3 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: 70 to 90 min; Category 3: <70 min	100%	77,8% to 100%	<77,8%			
Barbosa et al. [69]	Acute	2 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: <90 min	100%				<100%	
Barreira et al. [70]	Chronic	3 categories of analyses	Players' starting status; Category 1: ≥55%; Category 2: 30 to 54%; Category 3: <30%	≥55%	30% to 54%			<30%	
Bradley et al. [71]	Acute	3 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: 75 to 90 min; Category 3: 15 to 75 min	100%	83,3% to 16,7%	<16,7%			
Calderon et al. [72]	Acute	4 categories of analyses	Accumulated minutes; Category 1: ≥ 45 min; Category 2: 30 to 45 min; Category 3: 15 to 30 min; Category 4: 5 to 15 min	≥50%	50% to 33%	33% to 17%	17% to 6%		
Carling et al. [73]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥10 min	≥100%				≥11%	
Casamichana et al. [74]	Acute	4 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: >60 min; Category 3: <60 min; Category 4: 0 min	100%	≥66,7%			<66,7%	0%
Castillo-Rodríguez et al. [75]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥15 min					≥17%	
Curtis et al. [12]	Chronic	2 categories of analyses	Total play time and Players' starting status; Category 1: ≥60%; Category 2: <60%	>60%				<60%	
Curtis et al. [61]	Chronic	2 categories of analyses	Total play time and Players' starting status; Category 1: ≥60%; Category 2: <60%	>60%				<60%	
Dalen et al. [15]	Acute	2 categories of analyses	Accumulated minutes; Category 1: 60 to 80 min; Category 2: 0 to 30 min	75% to 100%				0% to 37,5%	
Díaz-Serradilla et al. [76]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Eskandarifard et al. [45]	Chronic	2 categories of analyses	Total play time; Category 1: ≥50%; Category 2: <50%	≥50%				<50%	

Studies	Acute:Chronic Categorization	Categories of Analyses	Categorization of playing time (Original)	Starter (%)	Replaced (%)	Substitute more Playtime (%)	Substitute less playtime (%)	Nonstarter (%)	Nonselected (%)
Fernandes et al. [46]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥60 min (3 consecutive matches); Category 2: <60 min (3 consecutive matches)	≥180%				<180%	
Filho et al. [77]	Chronic	3 categories of analyses	Total play time; Category 1: ≥75%; Category 2: >25% to <75%; Category 3: ≤25%	≥75%	>25% to <75%	≤25%			
Furtado Mesa et al. [78]	Chronic	2 categories of analyses	Total play time; Category 1: ≥50% (78 ± 13,7 min); Category 2: <50% (36 ± 13,9 min)	≥50%				<50%	
Gai et al. [79]	Acute	2 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: <90 min	100%				<100%	
Garcia et al. [47]	Acute	3 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min; Category 3: 0 min	≥66,7%				<66,7%	0%
García-Aliaga et al. [48]	Acute	4 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: ≥76 min; Category 3: 61 to 75 min; Category 4: 46 to 60 min	100%	≥84,4	67,8% to 83,3%	50% to 67,7%		
Gholizadeh et al. [62]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Gimenez et al. [1]	Acute	2 categories of analyses	Accumulated minutes; Category 1: >65 min; Category 2: <65 min	≥72,2%				<72,2%	
Gualtieri et al. [80]	Chronic	2 categories of analyses	Specific categorization; Category 1: Median-split approach for defining Starter and Nonstarter in each mesocycle						
Hernandez et al. [81]	Acute	2 categories of analyses	Specific categorization; Category 1: Starting the match; Category 2: Substituted, replaced or nonselected						
Hoppe et al. [82]	Chronic	4 categories of analyses	Specific categorization; Category 1: >50% of all matches; Category 2: >50% of playing time in each match; Category 3; >50% in the starting eleven; Category 4: other players						
Jagim et al. [83]	Chronic	2 categories of analyses	Total play time; Category 1: ≥50%; Category 2: <50%	≥50%				<50%	
Jajtner et al. [84]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥40 min; Category 2: ≤40 min	≥44,4%				<44,4%	
Kraemer et al. [85]	Chronic	2 categories of analyses	Total play time; Category 1: 83,06%; Category 2: 16,95%	83,06%				16,95%	
Kubayi et al. [86]	Acute	3 categories of analyses	Accumulated minutes; Category 1: Entire match; Category 2: Replaced; Category 3: Substitute						
Lopez et al. [87]	Chronic	2 categories of analyses	Total play time; Category 1: >50%; Category 2: <50%	≥50%				<50%	
Lorenzo-Martinez et al. [88]	Acute	3 categories of analyses	Accumulated minutes; Category 1: Entire match; Category 2: Replaced; Category 3: Substitute						

Studies	Acute:Chronic Categorization	Categories of Analyses	Categorization of playing time (Original)	Starter (%)	Replaced (%)	Substitute more Playtime (%)	Substitute less playtime (%)	Nonstarter (%)	Nonselected (%)
Los Arcos et al. [49]	Acute	4 categories of analyses	Accumulated minutes; Category 1 >70 min; Category 2: 45 to 70 min; Category 3: 20 to 45 min; Category 4: <20 min	≥50%				<50%	
Los Arcos et al. [2]	Acute	2 categories of analyses	Accumulated minutes; Category 1: >45 min; Category 2: <45 min	≥77,8%	50% to 77,8%	22,2% to 50%	<22,2%		
Magrini et al. [89]	Chronic	2 categories of analyses	Accumulated playing time and Players' starting status (M±SD, respectively); Category 1: 1633,8 ± 478,2; Category 2: 158,2 ± 269,3	1633,8 ± 478,2*				158,2 ± 269,3*	
Manning et al. [90]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Marqués-Jiménez et al. [50]	Acute	2 categories of analyses	Specific categorization; Category 1: Starting the match; Category 2: Substitute						
Martin-Garcia et al. [13]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Martins et al. [91]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥6 0min; Category 2: <60 min	≥66,7%				<66,7%	
McLean et al. [92]	Chronic	2 categories of analyses	Players' starting status; Category 1: >80%; Category 2: <50%	>80%				<50%	
Morgans et al. [19]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Nobari et al. [14]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥6 0min; Category 2: <6 0min	≥66,7%				<66,7%	
Nobari et al. [56]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Nobari et al. [57]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Nobari et al. [55]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <6 0min	≥66,7%				<66,7%	
Nobari et al. [58]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <6 0min	≥66,7%				<66,7%	
Nobari et al. [93]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥60 min (3 consecutive matches); Category 2: <60 min (3 consecutive matches)	≥180%				<180%	
Nobari et al. [63]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Nobari et al. [64]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60 min	≥66,7%				<66,7%	
Nobari et al. [51]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥60 min (3 consecutive matches); Category 2: <60 min (3 consecutive matches)	≥180%				<180%	

Studies	Acute:Chronic Categorization	Categories of Analyses	Categorization of playing time (Original)	Starter (%)	Replaced (%)	Substitute more Playtime (%)	Substitute less playtime (%)	Nonstarter (%)	Nonselected (%)
Oliveira et al. [65]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥60 min (3 consecutive matches); Category 2: <60 min (3 consecutive matches)	≥180%				<180%	
Oliveira et al. [66]	Acute	2 categories of analyses	Specific categorization; Category 1: ≥60 min (3 consecutive matches); Category 2: <60 min (3 consecutive matches)	≥180%				<180%	
Padrón-Cabo et al. [94]	Acute	3 categories of analyses	Accumulated minutes; Category 1: Entire match; Category 2: Replaced; Category 3: Substitute						
Palmer et al. [95]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥40 min; Category 2: <40 min	≥44,4%				<44,4%	
Papadakis et al. [96]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: <60min	≥66,7%				<66,7%	
Paraskevas et al. [97]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥60 min; Category 2: ≤40 min	≥66,7%				<44,4%	
Rago et al. [52]	Acute	3 categories of analyses	Accumulated minutes; Category 1: 90 to 120 min; Category 2: 45 to 75 min; Category 3: <30 min	≥75% to 100%	<70%	<25%			
Raya-Gonzalez et al. [67]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥45 min; Category 2: ≤45 min	≥50%				<50%	
Raya-González et al. [53]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥45 min; Category 2: ≤45 min	≥50%				<50%	
Reche-Soto et al. [98]	Acute	2 categories of analyses	Accumulated minutes; Category 1: ≥90 min starting-up players; Category 2: ≥45 min played in the second half of the match	≥100%				<50%	
Sams et al. [54]	Chronic	3 categories of analyses	Total play time; Category 1: ≥60 min; Category 2: <60 min; Category 3: 0 min	≥66,7%				<66,7%	0%
Silvestre et al. [99]	Acute	2 categories of analyses	Accumulated minutes; Category 1: 90 min; Category 2: ≤90 min	≥100%				<100%	
Sporis et al. [20]	Chronic	2 categories of analyses	Specific categorization; Category 1: ≥1,000 min of total playtime; Category 2: <1000 min of total playtime						
Sydney et al. [100]	Acute	3 categories of analyses	Accumulated minutes; Category 1: Entire match; Category 2: Replaced; Category 3: Substitute						
Teixeira et al. [101]	Chronic	2 categories of analyses	Players' starting status (M±SD, respectively); Category 1: ≥55% (73,82 ± 12,08 min); Category 2: <55% (24,06 ± 9,67 min)	≥55%				<55%	
Titton et al. [102]	Acute	3 categories of analyses	Accumulated minutes; Category 1: Entire match; Category 2: Replaced; Category 3: Substitute						
Vilamitjana et al. [43]	Chronic	2 categories of analyses	Accumulated playing time and Players' starting status (M±SD, respectively); Category 1: 531,6 ± 118,1; Category 2: 31,5 ± 42,8						
Zanetti et al. [103]	Chronic	2 categories of analyses	Specific categorization; Category 1: ≥75% of participation and total match time; Category 2: Other Players	≥75%				<75%	

M: Mean; SD: Standard deviation; Min: Minutes.

Table 3 - Information related to compensatory trainings.

Studies	Days of Compensatory Training	Integrated (Physical and Tactical/Technical)	Technical/Tactical Factors	Technical Factor	Physical Factor	Specific Training
Arcos et al. [49]	MD					Individual physical practice
Azcarate et al. [59]	MD		Small-sided game		Continuous running	
Calderon et al. [72]	MD+1					Unspecified
Casamichana et al. [74]	MD+1		Small-sided game & small-positional game	Technical circuit		
Díaz-Serradilla et al. [76]	MD+1	Small-positional game with running-based-drills	Small-sided game		Running-based drills	
Gualtieri et al. [80]	MD, MD+1, and MD+2	Combination of small-sided games and power training (MD+1)	Tactical-technical drills (MD+2)		Low volume high-intensity aerobic training (MD)	
Hernandez et al. [81]	MD+1				Specific circuits with high neuromuscular demand	
Lopez et al. [87]	Unspecified		Ball possession and small-sided game	Completions	Explosive strength and aerobic capacity	
Los Arcos et al. [49]	MD					Individual physical practice
Los Arcos et al. [2]	MD					Unspecified
Martin-Garcia et al. [13]	MD+1		Small-sided game and small-positional game	Technical circuit		
Morgans et al. [19]	Unspecified				High-intensity runnings	
Papadakis et al. [96]	MD+1	Combination of small-sided games and high-intensity aerobic runs	Small-sided games (3 vs. 3 to 7 vs. 7)			
Raya-Gonzalez et al. [67]	MD+1 or MD+2					Unspecified
Sams et al. [54]	MD+2		Small-sided game		High-speed runnings	
Silvestre et al. [99]	Unspecified		Small-sided game			
Sporis et al. [20]	Unspecified					Friendly matches
Teixeira et al. [101]	Unspecified					Unspecified

MD: Match Day; MD+1: One day after the match; MD+2: Two day after the match.

Table 4 – Risk of bias in studies.

Studies	Sample size	The selection of participants	Confounding variables	Measurement of exposure	Blinding of outcome assessments	Incomplete outcome data	Selective outcome reporting
Alijanpour et al. [44]	19	Low	Low	Low	Low	Low	Low
Anderson et al. [11]	19	Low	Low	Low	Low	Unclear	Unclear
Arcos et al. [49]	40	High	High	Low	High	Unclear	Unclear
Azcarate et al. [59]	21	Low	Low	Low	High	Low	Unclear
Azcarate et al. [60]	17	Low	Low	Low	High	High	Unclear
Barbosa et al. [69]	55	Low	Low	Unclear	Low	Unclear	Low
Barreira et al. [70]	35	High	Low	Low	Low	Unclear	Unclear
Bradley et al. [71]	1382	High	High	Unclear	Low	Unclear	Unclear
Calderon et al. [72]	1047	High	High	Low	Low	Unclear	Unclear
Carling et al. [73]	25	High	Low	Unclear	Low	High	Unclear
Casamichana et al. [74]	24	Low	Low	Low	Low	Low	Unclear
Castillo-Rodríguez et al. [75]	22	Low	Low	Low	Low	Low	Unclear
Curtis et al. [12]	82	High	High	Low	Low	High	Unclear
Curtis et al. [61]	107	High	High	Low	High	Unclear	Unclear
Dalen et al. [15]	18	Low	Low	Unclear	Low	Low	Unclear
Díaz-Serradilla et al. [76]	14	Low	Low	Low	High	Unclear	Unclear
Eskandarifard et al. [45]	24	Low	Low	Low	High	Low	Unclear
Fernandes et al. [46]	19	Low	Low	Low	High	Low	Unclear
Filho et al. [77]	112	High	High	Unclear	High	Unclear	Unclear
Furtado Mesa et al. [78]	19	Low	Low	Low	Low	Low	Unclear
Gai et al. [79]	9507	High	High	Unclear	Low	Unclear	Unclear
Garcia et al. [47]	29	High	Low	Low	High	Low	Low
García-Aliaga et al. [48]	1077	High	High	Unclear	Low	High	Unclear
Gholizadeh et al. [62]	19	Low	Low	Low	Low	Low	Unclear
Gimenez et al. [1]	14	Low	Low	Low	High	Unclear	Unclear
Gualtieri et al. [80]	20	Low	Low	Low	High	Low	Unclear
Hernandez et al. [81]	18	Low	Low	Low	Low	Low	Unclear
Hoppe et al. [82]	92	High	High	Low	High	Unclear	Unclear
Jagim et al. [83]	22	Low	Low	Low	Low	Low	Unclear
Jajtner et al. [84]	28	High	Low	Low	High	Low	Unclear
Kraemer et al. [85]	25	Low	Low	Low	High	Low	Unclear
Kubayi et al. [86]	252	High	High	Unclear	Low	Unclear	Unclear
Lopez et al. [87]	20	Unclear	Low	Unclear	High	Low	Unclear
Lorenzo-Martinez et al. [88]	431	High	High	Low	Low	Unclear	Unclear
Los Arcos et al. [49]	40	High	High	Low	High	Unclear	Unclear

ARTICLES	SAMPLE SIZE	THE SELECTION OF PARTICIPANTS	CONFOUNDING VARIABLES	MEASUREMENT OF EXPOSURE	BLINDING OF OUTCOME ASSESSMENTS	INCOMPLETE OUTCOME DATA	SELECTIVE OUTCOME REPORTING
Los Arcos et al. (2017)	24	Low	Low	Low	High	Low	Unclear
Los Arcos et al. [2]	18	Unclear	Low	Low	High	Low	Unclear
Magrini et al. [89]	556	High	High	Unclear	High	Unclear	Unclear
Manning et al. [90]	35	High	High	Low	High	Unclear	Unclear
Marqués-Jiménez et al. [50]	24	Low	Low	Low	Low	Low	Unclear
Martin-Garcia et al. [13]	11	Low	Low	Low	High	High	Unclear
Martins et al. [91]	16	Low	Low	Low	High	High	Unclear
McLean et al. [92]	15	High	Low	Low	High	Unclear	Unclear
Morgans et al. [19]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [14]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [56]	21	Unclear	High	Low	Low	Low	Unclear
Nobari et al. [57]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [55]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [58]	20	Low	Low	Low	High	Low	Unclear
Nobari et al. [93]	21	Unclear	High	Low	Low	Low	Unclear
Nobari et al. [63]	21	Unclear	High	Low	Low	Low	Unclear
Nobari et al. [64]	19	Low	Low	Low	Low	Low	Unclear
Nobari et al. [51]	17	Low	Low	Low	High	Low	Unclear
Oliveira et al. [65]	17	Low	Low	Low	High	Low	Unclear
Oliveira et al. [66]	943	High	High	Unclear	Low	Unclear	Unclear
Padrón-Cabo et al. [94]	24	Low	Low	Low	Low	Low	Unclear
Palmer et al. [95]	21	Low	Low	Low	Low	High	Low
Papadakis et al. [96]	17	Low	Low	Low	Low	High	Low
Paraskevas et al. [97]	453	High	High	Unclear	Low	Unclear	Unclear
Rago et al. [52]	19	Low	Low	Low	High	Low	Unclear
Raya-Gonzalez et al. [67]	19	Low	Low	Low	High	Low	Unclear
Raya-González et al. [53]	22	Low	Low	Low	Low	Low	Low
Reche-Soto et al. [98]	30	Low	Low	Low	High	Low	Unclear
Sams et al. [54]	25	High	Low	Low	High	Low	Unclear
Silvestre et al. [99]	64	High	High	Low	High	Unclear	Unclear
Sporis et al. [20]	21	Unclear	High	Low	High	Low	Unclear
Sydney et al. [100]	60	High	High	Low	High	Unclear	Low
Teixeira et al. [101]	17	Unclear	High	Low	High	Unclear	Low
Titton et al. [102]	22	Low	Low	Low	Low	Low	Unclear
Vilamitjana et al. [43]	21	Unclear	Low	Low	High	Low	Unclear

Supplementary Tables

Supplementary Table 1. Full Search Strategy for Each Database

Database	Specificities of the databases	Search strategy
Cochrane Library	Search for title and abstract also included keywords.	Soccer OR Football in Title Abstract Keyword AND Start* OR Nonstart* OR Non-start* OR Reserve* OR Substitute* OR Fringe* OR Bench* OR “Competition time” OR “Play* time” OR “Match* participation” in All Text
PubMed	None to report.	(Soccer [Title/Abstract] OR Football [Title/Abstract]) AND (Start* OR Nonstart* OR Non-start* OR Reserve* OR Substitute* OR Fringe* OR Bench* OR "Competition time" OR "Play* time"OR "Match* participation")
Scopus	Search for title and abstract also included keywords.	(TITLE-ABS-KEY (soccer OR football) AND ALL (Start* OR Nonstart* OR Non-start* OR reserve* OR substitute* OR fringe* OR bench* OR "Competition time" OR "Play* time" OR "Match* participation”))
SPORTDiscus	Searches for title and abstract were performed separately, requiring multiple searches.	*Title/Full Text* "TI (soccer OR football) AND TX (Start* OR Nonstart* OR Non-start* OR Reserve* OR Substitute* OR Fringe* OR Bench* OR "Competition time" OR "Play* time" OR "Match* participation”)" *Abstract/Full Text* "AB (soccer OR football) AND TX (Start* OR Nonstart* OR Non-start* OR Reserve* OR Substitute* OR Fringe* OR Bench* OR "Competition time" OR "Play* time" OR "Match* participation”)"
Web of Science	Search for title and abstract also included keywords and was designated by “topic”.	(TS= (Soccer OR Football)) AND ALL= (Start* OR Nonstart* OR Non-start* OR Reserve* OR Substitute* OR Fringe* OR Bench* OR "Competition time" OR "Play* time" OR "Match* participation")

Supplementary Table 2. Variables of Each Performance Factor

Performance Factors	Abbreviation	Variable	Number of Metrics
Physical Factor			**533**
External Absolute Intensity (Distances Covered at Different Running Speeds)	%Sprint	Proportion of Total Distance Covered during Sprinting	1
	AMV	Average of Maximum Velocity	1
	AvS	Average Speed	1
	D>80% VHIR	Individual Very-High Distance	1
	Efforts >80% VHIR	Individual Very-High Number of Efforts	1
	FR	Number of fast runs	1
	HIR	High Intensity Running	5
	HSR	High Speed Running	15
	HSRd/TD	High Speed Running:Total Distance Ratio	1
	LIR	Low Intensity Running	3
	LSR	Low Speed Running	7
	MIR	Moderate Intensity Running	2
	MRS	Maximal Running Speed	7
	MSR	Moderate Speed Running	11
	NHI	Number of High-Intensity Runs	1
	NS	Number of Sprints	7
	NVH Efforts	Number of Very-High Efforts	1
	Peak MRS	Peak Maximal Running Speed	1
	Peak TD	Peak Total Distance	1
	Peak VHIR	Peak Very-High Intensity Running	1
	RS	Repeated Sprints	3
	SD	Sprint Distance	23
	SD Duration	Duration of Sprints	1
	STD/ TD	High Speed Running:Total Distance Ratio	1
	TD	Total Distance	35
	VHIR	Very-High Intensity Running	20
	VHSR	Very-High Speed Running	14
External Absolute Intensity (Changes in Running Kinetics)	ACC High	Accelerations High	1
	ACC Low	Accelerations Low	4
	ACC Moderate	Accelerations Moderate	11
	ACC Total	Total Accelerations	2
	ACC Total High	Accelerations Total High	16
	ACC Total Moderate	Accelerations Total Moderate	10
	DEC High	Decelerations High	2
	DEC Low	Decelerations Low	2
	DEC Moderate	Decelerations Moderate	7
	DEC Total	Total Decelerations	2
	DEC Total High	Decelerations Total High	11
	DEC Total Low	Decelerations Total Low	1
	DEC Total Moderate	Decelerations Total Moderate	7
External Absolute Intensity (Events derived from the use of inertial sensors / accelerometers)	AMP	Average Metabolic Power	3
	BL	Body Load	4
	DSL	Dynamic Stress Load	3
	ED	Explosive Distance	3
	EDI	Equivalent Distance Index	2
	EE	Energy Expenditure	2
	HMLD	High Metabolic Load Distance	5
	HMLE	High Metabolic Load Events	1
	MPA	Metabolic Power Average	1
	PL	Player load	6
	MP	Metabolic Power	4
External Absolute Intensity (Workload Indicators)	ACWR	Acute:Chronic Workload Ratio	3
	ACWR Coupled	Acute:Chronic Workload Ratio Coupled	2
	ACWR Uncoupled	Acute:Chronic Workload Ratio Uncoupled	2
	EI	Exertion Index	1
	EWMA	Exponentially Weighted Moving Averages	2
	TM	Training Monotony	5
	TS	Training Strain	5
	wAL	Weekly Acute Load	4
	wCL	Weekly Chronic Load	2
	WRR	Work Rest Ratio	1
	wTM	Weekly Training Monotony	1
	wTS	Weekly Training Strain	1
Internal Absolute Intensity (Subjective)	Alertness	Subjective Measure of Alertness	1
	Energy	Subjective Measure of Energy	1
	Fatigue	Fatigue	5
	Focus	Subjective Measure of Focus	1
	Mood	Mood	1
	MOT	Subjective Measure of Multiple object tracking	1
	Muscle Soreness	Muscle Soreness	3
	Overall Well-Being	Overall Well-Being	1

	Quality of Sleep	Quality of Sleep	3
	RPE	Rating Perceived of Exertion	7
	sRPE	Session Rating Perceived of Exertion	19
	sRPEmus	Muscular Session Perceived of Exertion	5
	sRPEres	Respiratory Session Perceived of Exertion	5
	Stress	Stress	3
	TL	Training Load	1
	TQR	Total Quality Recovery	2
Internal Absolute Intensity (Objective)	% players	Distribution of players according to soccer matches and field test	1
	%Hrmax	Percentage of Maximum Heart Rate	1
	Akubat TRIMP	Akubat´s Impulse Training	1
	AvHR	Average Heart Rate	1
	Banister's TRIMP	Banister's Impulse Training	1
	Edward's TRIMP	Edward's Impulse Training	1
	HI HRZ	High Intensity Heart Rate zone	1
	HR <50%	Heart Rate <50%	1
	HR <70%	Heart Rate <70%	1
	HR >90%	Heart Rate >90%	1
	HR 50 to 59%	Heart Rate 50 to 59%	1
	HR 50 to 60%	Heart Rate 50 to 60%	2
	HR 60 to 69%	Heart Rate 60 to 69%	1
	HR 60 to 70%	Heart Rate 60 to 70%	2
	HR 70 to 79%	Heart Rate 70 to 79%	1
	HR 70 to 80%	Heart Rate 70 to 80%	2
	HR 70 to 85%	Heart Rate 70 to 85%	1
	HR 80 to 89%	Heart Rate 80 to 89%	1
	HR 80 to90%	Heart Rate 80 to 90%	2
	HR 85 to 90%	Heart Rate 85 to 90%	1
	HR 90 to 100%	Heart Rate 90 to 100%	2
	HR 90 to 95%	Heart Rate 90 to 95%	1
	HR 95 to 100%	Heart Rate 95 to 100%	1
	HRmax	Maximal Heart Rate	2
Exercise Performance Measurements (Neuromuscular - Strenght, Speed and Power)	1RM BP	Bench Press Test	1
	CJS	Continuous Jumps with Legs Straight	1
	CMJ	Counter Movement Jump	6
	CMJ PP	Counter Movement Jump Peak Power	1
	IKE Peak RTD	Isometric Knee Extension Peak Rate of Torque Development	1
	IKE Peak Torque	Isometric Knee Extension Peak Torque	1
	IKE RTD100	Isometric Knee Extension Rate of Torque Development calculated at 0-100 ms	1
	IKE RTD200	Isometric Knee Extension Rate of Torque Development calculated at 0-200 ms	1
	IKF Peak RTD	Isometric Knee Flexion Peak Rate of Torque Development	1
	IKF Peak Torque	Isometric Knee Flexion Peak Torque	1
	IKF RTD100	Isometric Knee Flexion Rate of Torque Development calculated at 0-100 ms	1
	IKF RTD200	Isometric Knee Flexion Rate of Torque Development calculated at 0-200 ms	1
	ISKExt	Isokinetic Knee Extensors Strength	1
	ISKFlex	Isokinetic Knee Flexion Strength	1
	IsoSKExt	Isometric strength of the knee extensors	1
	KKBL	Kicking the ball with the lift leg KBL	1
	KKBR	Kicking the ball with the right leg KBR	1
	LBR	Lower Body Reaction	1
	LBW	Lower Body Power	1
	LS 10m	Linear Sprint (10 m)	2
	LS 18,3m	Linear Sprint (18,3m)	1
	LS 20m	Linear Sprint (20 m)	2
	LS 30m	Linear Sprint (30 m)	2
	LS 36,5m	Linear Sprint (36,5 m)	1
	LS 36,7m	Linear Sprint (36,7 m)	1
	LS 5m	Linear Sprint (5 m)	2
	LS 9,1m	Linear Sprint (9,1 m)	1
	Max CMJ	Counter Movement Jump Maximal	1
	MOT	Multiple Object Tracking	1
	MR LB	Motor Reaction of Lower-Body	1
	PMAX	Maximal Power Output	1
	SJ	Squat Jump	2
	SJ Height	Squat Jump Height	1
	SJ MP	Squat Jump mean power	1
	SJ MV	Squat Jump mean velocity	1
	SJ PP	Squat Jump peak power	1
	SJ PV	Squat Jump peak velocity	1
	TBP	Total Body Power	1
	VJ	Vertical Jump	2
	VJ MP	Vertical Jump - Mean power	1
	VJ PP	Vertical Jump - Peak Power	1
	VR LB	Visual Reaction of Lower Body	1
	Est VO2max	Estimated Maximal Oxygen Uptake	1

Exercise Performance Measurements (Endurance)	LD AT 200	Line drill - 200m shuttle runs - Average time	1
	LD FI 200	Line drill - 200m shuttle runs - Fatigue index	1
	LD FT 200	Line drill - 200m shuttle runs - Fastest time	1
	O2-pulse	Oxygen Pulse	1
	RE	Running Economy	1
	RER = 1	Time to reach a respiratory exchange ratio of 1	1
	RVO2max	Relative oxygen uptake VO2max	1
	Tlim	Time to Exhaustion	1
	V2	Velocity at 2mM of Blood Lactate	1
	V4	Velocity at 4mM of Blood Lactate	1
	VO2max	Maximal Oxygen Uptake	3
	vVO2max	Velocity at Maximal Oxygen Uptake	1
	Yo-Yo IR1	Yo-Yo Intermittent Recovery Test Level 1	2
	RST	7 Repeated Sprint Test	1
	Best RPT	Best of 7 Repeated Sprint Test	1
	Worst RST	Worse of 7 Repeated Sprint Test	1
Exercise Performance Measurements (Flexibility)	BLLP	Backward left leg lift from prone position	1
	BRLP	Backward right leg lift from prone position	1
	LLSP	Leg left lift from supine position	1
	LRSP	Leg right lift from supine position	1
	SAR	Sit-and-Reach	2
	SSP	Straddle in supine position	1
	V-SAR	V-Seat and Reach	1
Exercise Performance Measurements (Agility)	S180º	9-3-6-3-9 meters sprint with 180º turns	1
	S4x5	Sprint Test 4x5 meters	1
	S90º	Sprint with 90º turns	1
	SBF	9-3-6-3-9 meters sprint with backward and forward running	1
	ST	Slalom Test	1
Physiological Determinants (Biomarkers)	C	Cortisol	1
	CK	Creatine Kinase	1
	Indice T/C	Indices Testosterone/Cortisol	1
	LDH	Lactate Hydrogenase	1
	Scc	Serum Cortisol Concentration	1
	sT	Salivary Testosterone concentrations	1
	sTC	Serum Testosterone Concentrations	1
	TL	Free Testosterone	1
	GH	Growth Hormone	1
	IGF1	Insulin-like Growth factor-1	1
Physiological Determinants (Muscle Arquitecture)	CSA RF	Cross-sectional area of Rectus femoris	1
	CSA VL	Cross-sectional area of Vastus lateralis	1
	EI RF	Echo intensity of Rectus femoris	1
	EI VL	Echo intensity of Vastus lateralis	1
	MT RF	Muscle thickness of Rectus femoris	1
	MT VL	Muscle thickness of Vastus lateralis	1
	PANG RF	Pennation angle of Rectus femoris	1
	PANG VL	Pennation angle of Vastus lateralis	1
Anthropometric measurements (Body Composition)	BF	Body Fat	7
	BM	Body Mass	6
	FFM	Fat-free Mass	1
	Height	Height	3
	LL	Limb Length	1
	LLM	Legs Lean Mass	1
	LM	Lean Mass	1
	MM	Muscle Mass	1
	TLM	Trunk Lean Mass	1
	Standing height	Standing height	1
	Sitting height	Sitting height	1
Anthropometric measurements (Somatotype)	MS	Mean Somatotype	1
	S ECTO	Somatotype Ectomorph	1
	S ENDO	Somatotype Endomorph	1
	S MESO	Somatotype Mesomorph	1
	SDD	Somatotype Dispersion Distance	1
	SDI	Somatotype Dispersion Index	1
Anthropometric measurements (Maturation Factors)	PHV	Peak of Height Velocity	2
	Chorological age	Chorological age	1
	Skeletal age	Skeletal age	1
	Maturity offset	Maturity offset	1
Technical Factor			**31**
	Assists	Assists	1
	Attempts	Attempts	1
	Corners	Corners	1
	%CS	Cross Successful	1
	NCr	Number of Crosses	1

	Ndef	Defense	1	
	Sdrib	Successful Dribbles	2	
	%ACS	Aerial Challenge Success	1	
	%GCS	Ground Challenge Success	1	
	ADW	Aerial Duels Won	1	
	NAC	Number of Aerial Challenges	1	
	NGC	Number of Ground Challenges	1	
	Stack	Successful Tackles	1	
	NFC	Number of Fouls Committed	1	
	Goals	Goals	1	
	AP	Accurate passes	2	
	NFP	Number of Forward Passes	2	
	NP	Number of Passes	2	
	SP	Successful Passes	2	
	NSh	Number of Shots	3	
	ShS	Shot Successful	1	
	NTR	Number Touches	1	
	TR	Touches Ratio	1	
	Ball Possession	Ball Possession	1	
Psychological Factor				**9**
	Demotivation	Demotivation	1	
	Fatigue	Fatigue	1	
	EM of external regulation	Extrinsic Motivation of external regulation	1	
	EM of identified regulation	Extrinsic Motivation of identified regulation	1	
	EM of introjected regulation	Extrinsic Motivation of introjected regulation	1	
	IM to achieve goals	Intrinsic Motivation to achieve goals	1	
	IM to experience stimulation	Intrinsic Motivation to experience stimulation	1	
	IM to know	Intrinsic Motivation to know	1	
	MS Vigor	Mood state vigor	1	
Integrated				**3**
	HIR with ball	High Intensity Running with ball possession	1	
	S90ºB	Sprint with 90º turns with the ball	1	
	STB	STB: Slalom test with the ball	1	