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SYSTEMATIC REVIEW

The Influence of Competition Time on Soccer Players' Performance Factors: A Scoping Review with Evidence Gap Map

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Abstract

Background Performance in team sports is influenced by physical, technical, tactical, and psychological factors. Understanding the disparities in playing time between starters and nonstarters is crucial for optimizing training strategies and performance management.

Objectives This systematic scoping review with an evidence gap map (EGM) aimed to (i) synthesize findings from studies comparing the performance factors of starters and nonstarters, (ii) identify compensatory strategies for players with reduced playing times and barriers to the implementation of these strategies, and (iii) provide an EGM to guide future research toward addressing the most relevant gaps in the literature. This review followed the PRISMA 2020 guidelines and the respective extension for scoping reviews (PRISMA-ScR). Electronic databases such as the Cochrane Library, PubMed, Scopus, SPORTDiscus, and Web of Science (Core Collection) were searched on 31/08/2023. The RoBANS tool was used to assess the risk of bias. Among 32,613 articles, 57 trials from 70 publications were included.

Results Female soccer players were represented in only 15.8% of the trials. The physical performance factor ($k=56$, 98.2%) has been extensively studied in relation to the differences between starters and nonstarters. Few studies have analyzed technical and psychological performance factors, while tactical factors have not been addressed. Starters presented higher values of external absolute intensity (EAI, measured by the total distance and sprint distance), higher internal absolute intensity (IAI, assessed through heart rate-based measures as above 70% maximal heart rate), along with greater improvements in exercise performance measurements (countermovement jump and 20-m sprint), than nonstarters did. The most adopted categorization was based on match participation ($k=33$, 57.9%), with starters defined as players who played for ≥ 66.7% of a match time (14.0%). The day commonly used for compensatory training was 24 h after a match ($k=16$; 37.5%). Several strategies attempting to reproduce competitive loads were used, such as small-sided games ($k=9$; 56.3%), running-based drills ($k=8$, 50.0%), small-positional games ($k=3$, 18.8%), tactical-technical drills ($k=2$, 12.5%), strength training ($k=2$, 12.5%), and friendly matches ($k=1$, 6.5%).

Conclusion This scoping review highlights the necessity of placing increased emphasis on technical, tactical, and psychological performance factors and compensatory training strategies (including the day and types of exercise). These measures aim to replicate the competitive match demands for nonstarters, maintaining or enhancing the physical adaptations, psychological factors, and tactical-technical skills required for performance improvement throughout the season. This review proposes three main future research areas for the topic: (i) investigating the effects of compensatory training on nonstarters' weekly loads when distributed across multiple days; (ii) investigating additional cutoffs or more refined time classifications for nonstarters; and (iii) directing more studies toward female soccer players.

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, prior to being performed.

Extended author information available on the last page of the article

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Key Points

The physical performance differences between starters and nonstarters in soccer match-play have been extensively studied, while differences in technical, psychological, and, especially, tactical factors remain underexplored.

Starters typically present higher external absolute intensity (e.g., total distance, sprint distance, and accelerations) and internal absolute intensity (e.g., heart rate and rating perceived effort) across the match, weekly microcycle, and over the season and demonstrate greater improvements in exercise performance measures.

Compensatory training was most frequently performed 24 h after the match. It often included small-sided games, small-positional games, tactical-technical drills, friendly matches, running-based drills, and strength training to replicate competitive demands.

1 Introduction

In soccer, performance results from the interaction of physical, technical, tactical, and psychological factors [1, 2]. However, the extent to which each factor contributes to individual and team performance remains uncertain [3–5]. A thorough understanding of match and training demands provides coaches with essential information for monitoring training loads, designing effective training sessions, and balancing team workloads across trainings and competitions [6]. This understanding becomes even more crucial given the increasing number of matches played in a season. In professional soccer, players may participate in up to 60 matches throughout the season, with those participating regularly accounting for 84% of the total official playing time [7–9]. As a result, differences in match exposure between players (i.e., higher vs lower match times) can make maintaining balanced development across the squad challenging for coaching staff. Players with varying match times are likely to accumulate and experience different tactical (e.g., decision making), technical (e.g., dribbling), physical (e.g., endurance), and psychological (e.g., resilience) stimuli. These differences may, in turn, influence match-related adaptations throughout the season, either positively or negatively [10]. These skills can directly apply to gameplay, with players who spend more time on the field being more likely to develop these abilities than those who spend less time on the field [10].

Investigations of match playing time have focused mainly on physical and physiological factors [2, 10–13]. Several studies have recorded higher values of internal and external metrics of absolute and relative exercise intensities (i.e., sprint distance and Training Impulse [TRIMP]) in players with longer playing times than in their counterparts with shorter playing times (e.g., starters vs nonstarters) [2, 10, 11, 14]. These differences between starters and nonstarters may stem from differences in mechanical and metabolic stress exposure [11, 14–17]. Starters are subjected to a higher cumulative stimulus across the main performance factors (physical, technical, tactical, and psychological), leading to different acute and chronic adaptations. As a result, starters are more likely to display superior physical performance in the short and long term [14]. Positive correlations have been found between individuals' in-season match playing times and the key physical performance metrics, particularly sprint performance and muscle strength [15, 18, 19]. These discrepancies may have practical implications for prescribing compensatory programs that aim to maintain or increase the capabilities of nonstarters, bridging the gap between nonstarters and starters and impacting the ability of nonstarters to perform at the desired levels [2, 10, 12, 14, 15]. To address these disparities, coaches may need to implement strategies to mitigate the adverse effects of an insufficient match stimulus (e.g., volume) on a player's performance [16, 20–22].

In soccer, training sessions within a weekly cycle (often referred to as a 'microcycle') are usually categorized on the basis of their proximity to a match day (MD); for example, MD + 1 refers to 1 day after a match, whereas MD − 1 refers to 1 day before a match [16, 23]. This structure may incorporate compensatory training sessions for nonstarters to maintain or develop their performance levels [2, 12, 20, 22, 24]. While some teams have introduced conditioning sessions immediately postmatch, logistical constraints, such as limited time for postmatch training, often challenge implementation [20, 25, 26]. Alternative approaches include scheduling compensatory training sessions on MD + 1 or MD + 2 [2, 12]. These sessions are generally limited to a few players since starters will likely benefit from 1 or more recovery days [12]. Consequently, the type of drill is often adapted for a smaller group of players, which may influence the type of drill used [12, 27]. In this way, training tends to focus on running-based exercises [22], and game-based drills are limited to small playing areas, favoring the use of a smaller number of players [9, 16, 28]. However, these compensatory strategies address primarily the physical aspects of performance and may not fully account for tactical, technical, and psychological factors. Wide-scale tactical principles, technical actions, and the psychological aspects of playing in official matches should be considered [10, 15]. The introduction of friendly matches on MD + 1 has been suggested to be a beneficial strategy that partly replicates the match demands that are not experienced by nonstarters [10, 15]. Nevertheless, before determining the most effective compensatory strategies for nonstarters, it is crucial to first establish what is currently known regarding the differences between starters and nonstarters and identify potential gaps in the literature.

The effects of competition participation time on soccer players' performance factors have been investigated [2, 19, 22]. However, the findings remain fragmented, and the systematic assessment that is possible with a scoping review, complemented with an evidence gap map (EGM) to highlight the most pressing knowledge gaps and suggest future research needs in a user-friendly format, is lacking [29–31]. Therefore, the aims of this systematic scoping review with an evidence gap map were as follows: (i) to provide a synthesis of findings from studies comparing the performance factors of starters and nonstarters; (ii) to identify compensatory strategies for players with reduced playing times and barriers to the implementation of these strategies; and (iii) to develop an evidence gap map to guide future research toward addressing the most relevant gaps in the literature.

2 Methods

We followed the PRISMA 2020 guidelines [32], but the former extension for scoping reviews (PRISMA-ScR) was also considered [33], as well as the Cochrane guidelines [34].

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 [35]. The inclusion criteria followed the PECOS approach [36]: (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 min versus nonstarter < 60 min; other classifications were acceptable); (iv) Outcome(s): any outcomes related to tactical, technical, psychological, and/or physical/physiological factors; and (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 2 external experts (16 experts were contacted by ResearchGate and/or email and one agreed to participate); and (iv) errata/retractions for included studies (in the case of retractions, these studies 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 [37], increasing the likelihood that all appropriate studies could be identified. The main search strategy was as follows:

> [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 (ESM; Supplementary Table S1).

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 reached. When necessary, the primary and corresponding authors were contacted for clarifications before deciding to include or exclude a study. The authors were given 2 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 when a consensus was not achieved. A proprietary Microsoft® Excel datasheet was created to extract all relevant information and is available as supplementary material. In cases 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 2 weeks to provide the requested information. If multiple studies reported data from the same trial, they were treated as a single study. With regard to 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

The information extraction strategy was designed to organize data from included studies into relevant domains systematically. Primary outcomes related to performance factors and programming variables were extracted and categorized as follows: 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). Subcategories were further created within these areas when appropriate. 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 with the aim of generating an evidence gap map).

Additional study information included, but was not limited to, citation details, publication year, country of data collection, participants (i.e., sample size, age, sex, and competitive level), performance factors (i.e., technical, tactical, psychological, and physical), training load metrics (e.g., using GPS/GNSS, Borg/Foster scales), categorization of competitive time (i.e., acute and chronic exposure time), compensatory training (e.g., day of compensatory training and type of exercises), period of analysis, funding sources, and competing interests. To categorize players based on their playing time, we created two categories: 'acute exposure' and 'chronic exposure'. Acute exposure refers to a week-to-week exposure, assessing playing time within a short-term period (e.g., a single match or a week). Chronic exposure refers to the total playing time accumulated throughout a specific competitive period (e.g., percentage of total playing time in the season). 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 [38]. This characterization aimed to standardize the categorization of the competitive level of all studies; therefore, it superseded 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

Risk of bias was assessed independently by two authors (AM and JA). When there were disagreements, the two authors re-analyzed the process; if no consensus was achieved, a third author (JRS) made the final decision. Risk of bias was assessed using a non-randomized studies tool (RoBANS) [39]. Multiple studies corresponding to a single trial were treated as a single study for risk-of-bias assessment. 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, that is, the worst outcome assessment. Assessment of global risk of bias (labeled as unclear, high, or low) was intended to help interpret overall findings and contribute to assessing the strength of the body of evidence [40].

2.8 Synthesis of Results

Evidence gap maps are systematic evidence synthesis products that display the available evidence relevant to a specific research question [23]. An evidence gap map was developed to visually present the evidence and identify research gaps for new primary research and synthesis [30]. Due to the potentially large number of studies and the 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 Fig. 1. An initial search yielded 32,613 results, and 58 studies were eligible for inclusion in our scoping review. The reference lists of all studies were examined to identify additional eligible studies, resulting in one more study being included [41]. Snowball citation

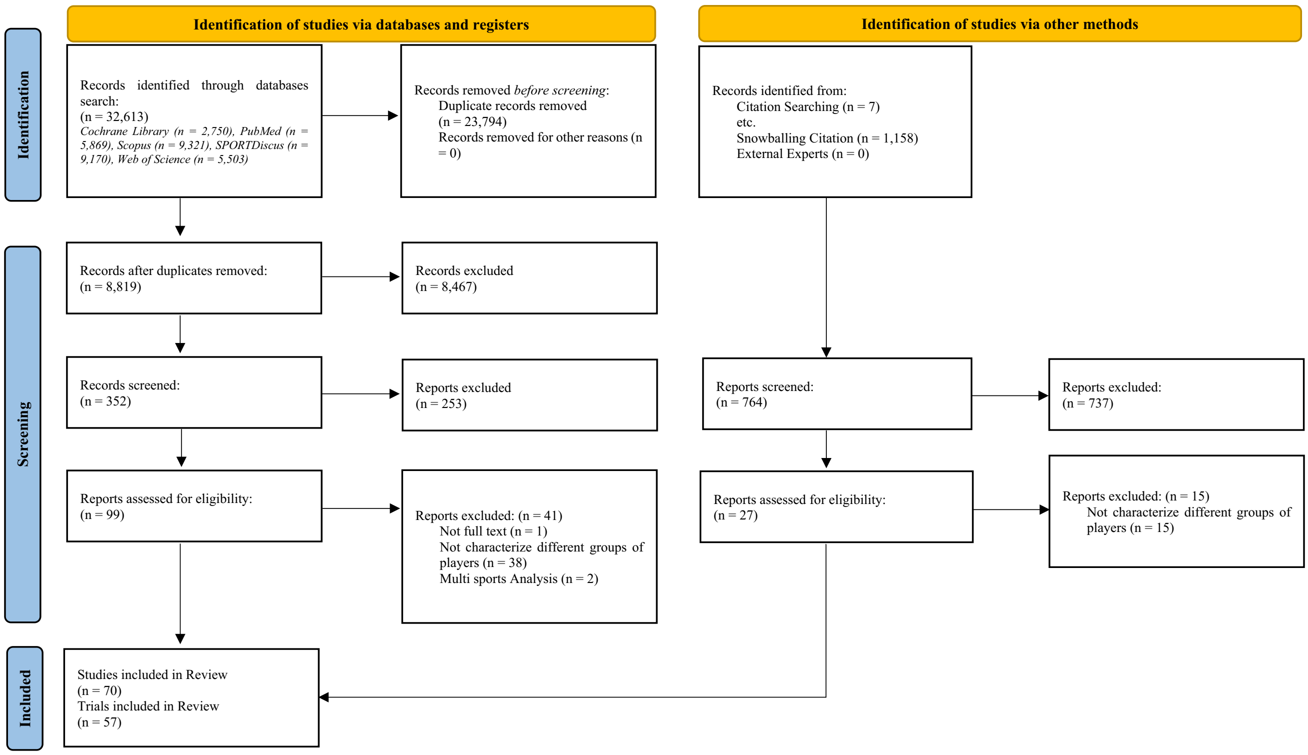

Fig. 1 Process of identifying eligible studies for this scoping review

tracking was performed for the 58 included studies, and 11 were considered eligible for inclusion in our scoping review [42–52]. Twenty studies presented results from the same trial, which were considered a single work [2, 11, 13, 42, 47, 49, 51, 53–65]. Therefore, 57 independent trials corresponding to 70 publications were considered eligible for inclusion in our review [1, 2, 10–14, 18, 19, 41–100]. The complete study search and selection process is presented in the ESM (subsection 1.1).

3.2 Study Characteristics and Context-Related Information

Figure 2 shows the year of publication of included trials comparing performance factors in soccer starters and nonstarters. Most studies ($k = 48$, 68.6%, corresponding to 37 trials) were published in the last 5 years (2019–2023). Figure 3 presents the distribution of the included studies per continent, age group, and sex. Thirty-three trials were conducted in Europe (57.9%), ten in North America (17.5%), six in South America (10.5%), four in Asia (7.0%), and one in Oceania (1.8%), while three trials did not report location information (5.3%). Thirty-nine trials included male adults (68.4%), nine trials included female adults (15.8%), and nine trials included male non-adults (15.8%; < 18 years of age).

The characteristics of the studies are presented in Table 1. The sample size ranged from 11 to 1077 participants per trial, their age ranged from 13.5 to 29.5 years, the mean age was 21.7 ± 2.3, and the mode was 20.0. Twelve trials (21.1%) did not report age, 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 the ESM (subsection 1.2).

3.3 Categorization of Playing Time

Table 2 categorizes starters and nonstarters based on match participation time. The inclusion of players in the different categories of match participation time followed two approaches: (i) acute exposure, which refers to a week-to-week exposure, assessing playing time within a short-term period (e.g., a single match or a week) (i.e., starter ≥ 60 min vs nonstarter < 60min); and (ii) chronic exposure, which refers to the total playing time accumulated throughout a specific competitive period (i.e., total playing time; starter ≥ 60% vs nonstarter < 60%). The most adopted categorization was the allocation of players based on match participation ($k = 33$, 57.9%) [1, 2, 12–14, 18, 42, 45–47, 50, 51, 53–58, 60–62, 65, 66, 68, 69, 71, 73, 76, 81, 83, 85, 87, 88, 91–97, 99]. The primary threshold to categorize a starter was having played ≥ 66.7% of the match time, with players having a match volume below

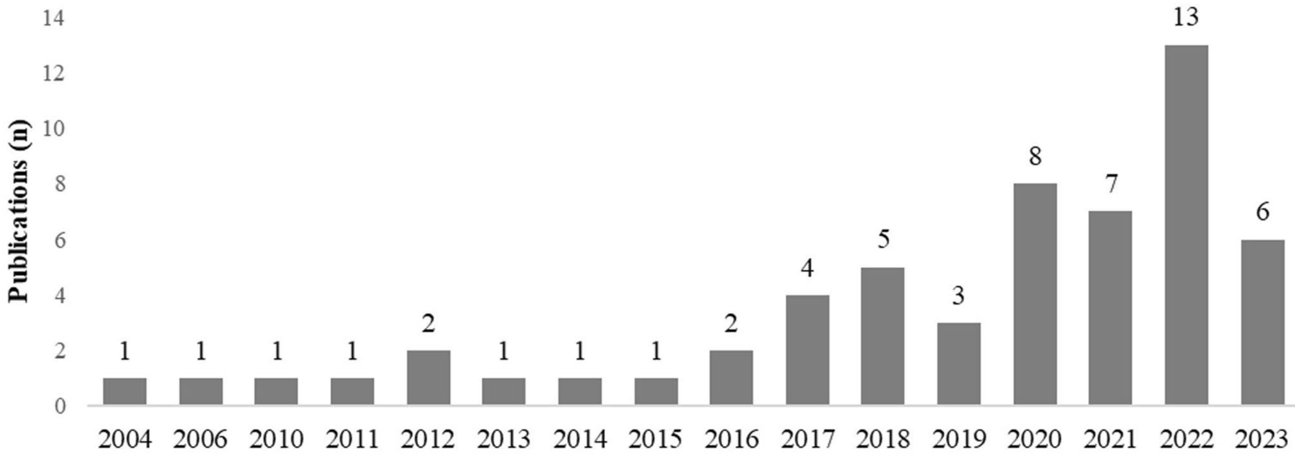

Fig. 2 Years of publication of included trials comparing performance factors in soccer starters and nonstarters

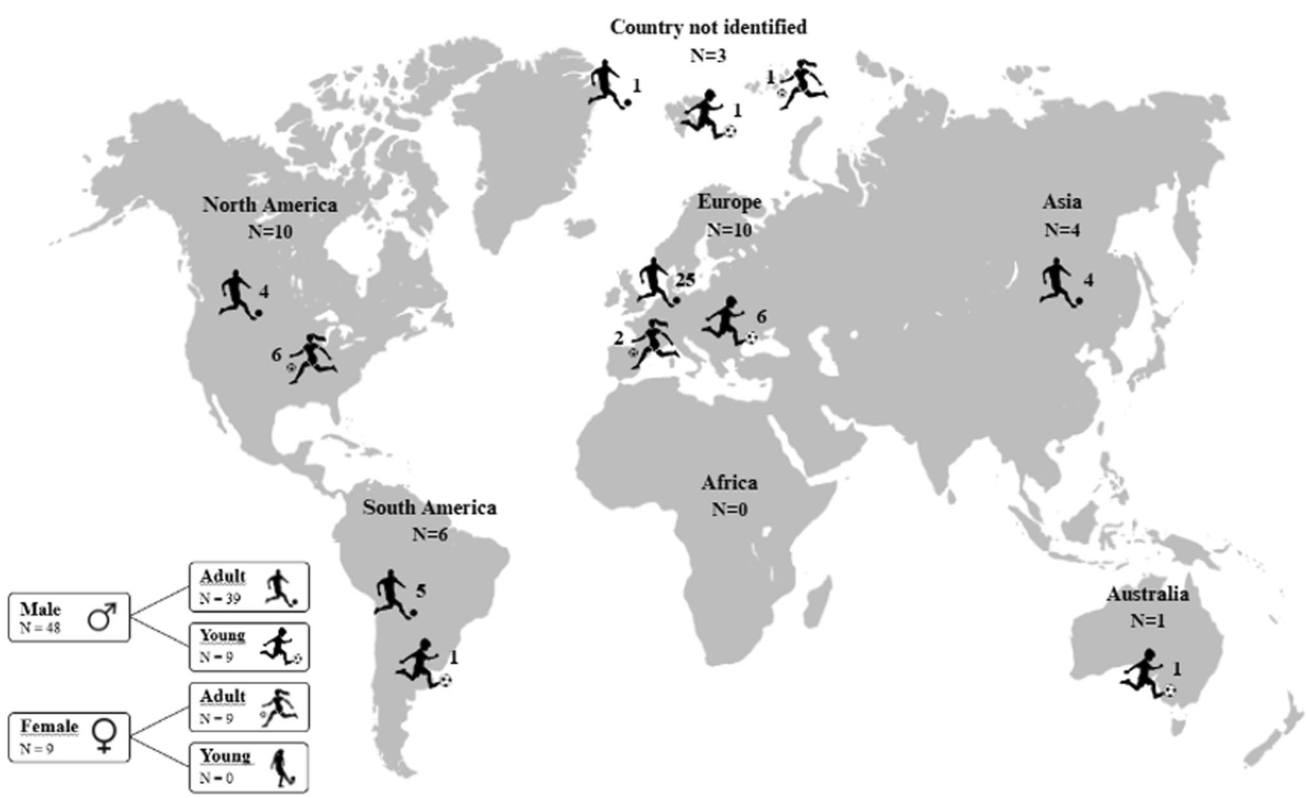

Fig. 3 Distribution of the included studies per continent, age group and sex

this cut-off being considered nonstarters (14.0%) [12, 13, 18, 42, 53–56, 60–62, 73, 87, 88, 93]. Further details on categorization are presented in the 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 versus nonstarters, respectively [1, 2, 12–14, 18, 42, 48, 51, 53–56,

Table 1 Characteristics of included studies

Study	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. [42]	Iran	19	M	28.0 ± 4.6	Tier 4	Acute	Physical	No	43 weeks	No funding source	No conflict of interest
Anderson et al. [10]	England	19	M	25.0 ± 4.0	Tier 4	Chronic	Physical	No	39 weeks	Unreported	Unreported
Los Arcos et al. [47]	Spain	40	M	Unspecified	Tier 3	Acute	Physical	Yes	2 seasons	Unreported	Unreported
Azcárate et al. [57]	Spain	21	M	26.7 ± 3.1	Tier 3	Acute	Physical	Yes	16 weeks	Unreported	No conflict of interest
Azcárate et al. [58]	Spain	17	M	27.1 ± 3.3	Tier 3	Acute	Physical	No	8 weeks	Received external funding	No conflict of interest
Barbosa et al. [66]	Brazil	55	M	24.0 ± 2.4	Tier 4	Acute	Physical	No	Unspecified	Received external funding	Unreported
Barreira et al. [67]	Portugal	35	M	19.7 ± 1.2	Tier 3	Chronic	Physical	No	35 weeks	No funding source	No conflict of interest
Bradley et al. [68]	England	1382	M	Unspecified	Tier 4	Acute	Physical and technical	No	1 season	Unreported	No conflict of interest
Calderón-Pellegrino et al. [69]	Spain	Unspecified	M	Unspecified	Tier 4	Acute	Physical	Yes	3 seasons	No funding source	No conflict of interest
Carling et al. [70]	French	25	M	Unspecified	Tier 4	Acute	Physical	No	Unspecified	No funding source	Unreported
Casamichana et al. [71]	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. [72]	Spain	22	M	26.1 ± 5.7	Tier 3	Acute	Physical	No	7 months (October–April)	Received external funding	No conflict of interest
Curtis et al. [11]	USA	82	M	20.0 ± 2.0	Tier 2	Chronic	Physical	No	4 months (August–November)	Received external funding	No conflict of interest
Curtis et al. [59]	USA	107	M	20.0 ± 2.0	Tier 2	Chronic	Physical	No	4 months (August–November)	Received external funding	No conflict of interest
Dalen and Lorås [14]	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. [73]	Spain	14	F	21.7 ± 1.7	Tier 3	Acute	Physical	Yes	Competitive midseason period	Received external funding	No conflict of interest

Table 1 (continued)

Study	Country	Sample size	Sex	Age (mean ± SD)	Competitive level	Categorization of competitive time	Performance factors	Compensatory training	Period of observation	Funding sources	Competing interests
Eskandarifard et al. [43]	England	24	M	15.6 ± 0.2	Tier 2	Chronic	Physical	No	8 months (August–March)	Received external funding	No conflict of interest
Fernandes et al. [44]	Portugal	19	F	24.1 ± 2.7	Tier 3	Acute	Physical	No	10 weeks	Received external funding	No conflict of interest
Filho et al. [74]	Brazil	112	M	18.6 ± 1.1	Tier 3	Chronic	Psychological	No	Unspecified	Unreported	Unreported
Furtado Mesa et al. [75]	USA	19	F	20.0 ± 1.61	Tier 2	Chronic	Physical	No	4 months (August–November)	No funding source	No conflict of interest
Gai et al. [76]	China	9507	M	Unspecified	Tier 4	Acute	Physical and technical	No	1 season	Received external funding	No conflict of interest
Garcia et al. [45]	Brazil	29	M	26.0 ± 4.0	Tier 3	Acute	Physical	No	21 weeks	Received external funding	No conflict of interest
García-Aliaga et al. [46]	Spain	1007	M	Unspecified	Tier 3	Acute	Physical	No	Unspecified	No funding source	No conflict of interest
Gholizadeh et al. [60]	Iran	19	M	28.0 ± 4.6	Tier 4	Acute	Physical	No	43 weeks	Received external funding	No conflict of interest
Giménez et al. [1]	Spain	14	M	23.2 ± 2.7	Tier 4	Acute	Physical	No	2 weeks	No funding source	Unreported
Gualtieri et al. [77]	Italy	20	M	28.4 ± 4.3	Tier 4	Chronic	Physical	Yes	42 days	Unreported	No conflict of interest
Hernández et al. [78]	Spain	18	M	26.2 ± 3.9	Tier 3	Acute	Physical	Yes	7 weeks	Unreported	No conflict of interest
Hoppe et al. [79]	Germany	92	M	17.7 ± 0.2	Tier 2	Chronic	Physical	No	7 seasons	Received external funding	No conflict of interest
Jagim et al. [80]	USA	22	F	Unspecified	Tier 2	Chronic	Physical	No	1 season	No funding source	No conflict of interest
Jajtner et al. [81]	USA	28	F	20.5 ± 1.2	Tier 2	Acute	Physical	No	12 weeks	Unreported	Unreported
Kraemer et al. [82]	USA	25	M	19.3 ± 0.9	Tier 2	Chronic	Physical	No	11 weeks	Unreported	Unreported
Kubayi [83]	Unspecified	252	M	Unspecified	Tier 4	Acute	Physical and technical	No	UEFA Euro Tournament	No funding source	No conflict of interest
López et al. [84]	Spain	20	M	27.2 ± 13.2	Tier 4	Chronic	Physical	Yes	10 months (August–May)	Unreported	Unreported
Lorenzo-Martinez et al. [85]	Germany	431	M	Unspecified	Tier 4	Acute	Physical and technical	No	1 season	Unreported	Unreported
Los Arcos et al. [2]	Spain	40	M	Unspecified	Tier 3	Acute	Physical	Yes	9 weeks	Unreported	No conflict of interest

Table 1 (continued)

Study	Country	Sample size	Sex	Age (mean ± SD)	Competitive level	Categorization of competitive time	Performance factors	Compensatory training	Period of observation	Funding sources	Competing interests
Los Arcos et al. [47]	Spain	24	M	20.3 ± 2.0	Tier 3	Acute	Physical	Yes	30 weeks	Unreported	Unreported
Magrini et al. [86]	USA	18	F	19.5 ± 1.2	Tier 2	Chronic	Physical	No	Spring off-season	Unreported	Unreported
Manning et al. [87]	Unspecified	556	F	27.1 ± 4.0	Tier 5	Acute	Physical and technical	No	Women's FIFA World Cup	No funding source	Conflict of interest
Marqués-Jiménez et al. [48]	Unspecified	35	M	14.3 ± 0.9	Tier 2	Acute	Physical	No	2 seasons	Unreported	No conflict of interest
Martin-Garcia et al. [12]	Spain	24	M	20.0 ± 2.0	Tier 4	Acute	Physical	Yes	42 weeks	No funding source	No conflict of interest
Martins et al. [88]	Portugal	11	M	16.2 ± 0.3	Tier 3	Acute	Physical	No	50 weeks	Received external funding	No conflict of interest
McLean et al. [89]	USA	16	F	19.9 ± 1.2	Tier 2	Chronic	Physical	No	16 weeks	No funding source	No conflict of interest
Morgans et al. [18]	England	15	M	25.8 ± 4.1	Tier 4	Acute	Physical	Yes	Unspecified	Unreported	Unreported
Nobari et al. [13]	Iran	21	M	28.3 ± 3.8	Tier 4	Acute	Physical	No	48 weeks	Received external funding	No conflict of interest
Nobari et al. [54]	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. [53]	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	No funding source	No conflict of interest
Nobari et al. [90]	Iran	20	M	29.4 ± 4.4	Tier 4	Acute	Physical	No	20 weeks	Received external funding	Conflict of interest
Nobari et al. [61]	Iran	21	M	28.3 ± 3.8	Tier 4	Acute	Physical	No	48 weeks	Received external funding	No conflict of interest
Nobari et al. [62]	Iran	21	M	28.3 ± 3.8	Tier 4	Acute	Physical	No	48 weeks	Received external funding	No conflict of interest
Nobari et al. [49]	Iran	19	M	27.5 ± 4.7	Tier 4	Acute	Physical	No	43 weeks	Funding	No conflict of interest
Oliveira et al. [64]	Portugal	17	M	25.4 ± 4.0	Tier 4	Acute	Physical	No	41 weeks	Received external funding	No conflict of interest
Oliveira et al. [64]	Portugal	17	M	25.4 ± 4.0	Tier 4	Acute	Physical	No	40 weeks	Received external funding	No conflict of interest

Table 1 (continued)

Study	Country	Sample size	Sex	Age (mean ± SD)	Competitive level	Categorization of competitive time	Performance factors	Compensatory training	Period of observation	Funding sources	Competing interests
Padrón-Cabo et al. [91]	Spain		M	Unspecified	Tier 4	Acute	Physical	No	10 months (August–May)	Received external funding	No conflict of interest
Palmer and Akehi [92]	USA	24	F	19.7 ± 1.3	Tier 2	Acute	Physical	No	Pre-season	Received external funding	Unreported
Papadakis et al. [93]	Greek	21	M	23.6 ± 4.2	Tier 4	Acute	Physical	Yes	11 months (July–May)	Unreported	Unreported
Paraskevas and Hadjicharalambous [94]	Cyprus	17	M	29.5 ± 4.0	Tier 3	Acute	Physical	No	17 weeks	Unreported	Unreported
Rago et al. [50]	Unspecified	453	M	Unspecified	Tier 5	Acute	Physical and Technical	No	Men´s FIFA World Cup	Unreported	Unreported
Raya-Gonzalez and Castillo [65]	Spain	19	M	18.5 ± 0.5	Tier 3	Acute	Physical	Yes	30 weeks	Unreported	No conflict of interest
Raya-González et al. [51]	Spain	19	M	18.0 ± 0.6	Tier 3	Acute	Physical	No	9 months (September–May)	No funding source	No conflict of interest
Reche-Soto et al. [95]	Spain	22	M	22.6 ± 4.8	Tier 3	Acute	Physical	No	1 season	No funding source	No conflict of interest
Sams et al. [52]	USA	30	M	18.0 to 23.0	Tier 2	Chronic	Physical	Yes	14 weeks	Received external funding	No conflict of interest
Silvestre et al. [96]	USA	25	M	19.9 ± 1.3	Tier 2	Acute	Physical	Yes	16 weeks	Unreported	Unreported
Sporis et al. [19]	Croatia	64	M	18.2 ± 0.6	Tier 3	Chronic	Physical	Yes	260 days	Unreported	Unreported
Sydney et al. [97]	Australia	21	M	15.6 ± 0.7	Tier 2	Acute	Physical	No	13 months	Unreported	No conflict of interest
Teixeira et al. [98]	Portugal	60	M	15.2 ± 1.8	Tier 2	Chronic	Physical	Yes	6 weeks	Received external funding	No conflict of interest
Titton [99]	Brazil	17	M	18.5 ± 0.7	Tier 3	Acute	Physical and psychological	No	20 days	Unreported	No conflict of interest
Vilamitjana et al. [41]	Argentina	22	M	23.4 ± 2.4	Tier 4	Chronic	Physical	No	10 weeks	Unreported	Unreported
Zanetti et al. [100]	Brazil	21	M	13.5 ± 0.7	Tier 2	Chronic	Physical	No	5 days	Received external funding	Unreported

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

Table 2 Categorization of playing time

Study	Acute: chronic categorization	Categories of analyses, n	Categorization of playing time (original)	Starter (%)	Replaced (%)	Substitute more play time (%)	Substitute less play time (%)	Nonstarter (%)	Nonselected (%)
Alijanpour et al. [42]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Anderson et al. [10]	Chronic	3	Players' starting status; ≥ 60%; 30–60%; < 30%	≥ 60.0	30.0–60.0			< 30.0	
Los Arcos et al. [47]	Acute	4	Accumulated minutes; > 70 min; 45–70 min; 20–45 min; < 20 min	≥ 77.8	50.0–77.8	22.2–50.0	< 22.2		
Azcárate et al. [57]	Acute	3	Accumulated minutes; 90 min; 70–90 min; < 70 min	100.0	77.8–100.0	< 77.8			
Azcárate et al. [58]	Acute	3	Accumulated minutes; ≥ 45 min; < 45 min; 0 min	≥ 50.0				< 50.0	0.0
Barbosa et al. [66]	Acute	2	Accumulated minutes; 90 min; < 90 min	100.0				< 100.0	
Barreira et al. [67]	Chronic	3	Players' starting status; ≥ 55%; 30–54%; < 30%	≥ 55.0	30.0–54.9			< 29.9	
Bradley et al. [68]	Acute	3	Accumulated minutes; 90 min; 75–90 min; 15–75 min	100.0	16.7–83.3	< 16.7			
Calderón-Pellegrino et al. [69]	Acute	4	Accumulated minutes; ≥ 45 min; 30–45 min; 15–30 min; 5–15 min	≥ 50.0	33.3–50	17.7–33.3	5.6–17.7		
Carling et al. [70]	Acute	2	Specific categorization; ≥ 10 min	≥ 100.0				≥ 11.1	
Casamichana et al. [71]	Acute	4	Accumulated minutes; 90 min; > 60 min; < 60 min; 0 min	100.0	≥ 66.7			< 66.7	0.0
Castillo-Rodríguez et al. [72]	Acute	2	Specific categorization; ≥ 15 min					≥ 17.7	
Curtis et al. [11]	Chronic	2	Total play time and players' starting status; ≥ 60%; < 60%	> 60.0				< 60.0	
Curtis et al. [59]	Chronic	2	Total play time and players' starting status; ≥ 60%; < 60%	> 60.0				< 60.0	
Dalen and Lorås [14]	Acute	2	Accumulated minutes; 60–80 min; Category 2: 0–30 min	75.0–100.0				0.0–37.5	
Díaz-Serradilla et al. [73]	Acute	2	Accumulated minutes; Category 1: ≥ 60 min; < 60 min	≥ 66.7				< 66.7	

Table 2 (continued)

Study	Acute: chronic categorization	Categories of analyses, n	Categorization of playing time (original)	Starter (%)	Replaced (%)	Substitute more play time (%)	Substitute less play time (%)	Nonstarter (%)	Nonselected (%)
Eskandarifard et al. [43]	Chronic	2	Total play time; ≥ 50%; < 50%	≥ 50.0				< 50.0	
Fernandes et al. [44]	Acute	2	Specific categorization; ≥ 60 min (3 consecutive matches); < 60 min (3 consecutive matches)	≥ 180.0				< 180.0	
Filho et al. [74]	Chronic	3	Total play time; ≥ 75%; > 25% to < 75%; ≤ 25%	≥ 75.0	> 25.0 to < 75.0	≤ 25.0			
Furtado Mesa et al. [75]	Chronic	2	Total play time; ≥ 50% (78 ± 13.7 min); < 50% (36 ± 13.9 min)	≥ 50.0				< 50.0	
Gai et al. [76]	Acute	2	Accumulated minutes; 90 min; < 90 min	100.0				< 100.0	
Garcia et al. [45]	Acute	3	Accumulated minutes; ≥ 60 min; < 60 min; 0 min	≥ 66.7				< 66.7	0.0
García-Aliaga et al. [46]	Acute	4	Accumulated minutes; 90 min; ≥ 76 min; 61–75 min; 46–60 min	100.0	≥ 84.4	67.8–83.3	50.0–67.7		
Gholizadeh et al. [60]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Giménez et al. [1]	Acute	2	Accumulated minutes; > 65 min; < 65 min	≥ 72.2				< 72.2	
Gualtieri et al. [77]	Chronic	2	Specific categorization; median-split approach for defining starter and non-starter in each mesocycle						
Hernández et al. [78]	Acute	2	Specific categorization; starting the match; substituted, replaced or nonselected						
Hoppe et al. [79]	Chronic	4	Specific categorization; > 50% of all matches; > 50% of playing time in each match; > 50% in the starting eleven; other players						
Jagim et al. [80]	Chronic	2	Total play time; ≥ 50%; < 50%	≥ 50.0				< 50.0	
Jajtner et al. [81]	Acute	2	Accumulated minutes; ≥ 40 min; ≤ 40 min	≥ 44.4				< 44.4	
Kraemer et al. [82]	Chronic	2	Total play time; 83.06%; 16.95%	83.1				17.0	

Table 2 (continued)

Study	Acute: chronic categorization	Categories of analyses, n	Categorization of playing time (original)	Starter (%)	Replaced (%)	Substitute more play time (%)	Substitute less play time (%)	Nonstarter (%)	Nonselected (%)
Kubayi [83]	Acute	3	Accumulated minutes; entire match; replaced; substitute						
López et al. [84]	Chronic	2	Total play time; > 50%; < 50%	≥ 50.0				< 50.0	
Lorenzo-Martinez et al. [85]	Acute	3	Accumulated minutes; entire match; replaced; substitute						
Lorenzo-Martinez et al. [85]	Acute	4	Accumulated minutes; > 70 min; 45–70 min; 20–45 min; < 20 min	≥ 77.8	50.0–77.8	22.2–50.0	< 22.2		
Los Arcos et al. [2]	Acute	2	Accumulated minutes; > 45 min; < 45 min	≥ 50.0				< 50.0	
Los Arcos et al. [47]	Chronic	2	Accumulated playing time and players' starting status (M ± SD, respectively); 1633.8 ± 478.2; 158.2 ± 269.3	1633.8 ± 478.2[a]				158.2 ± 269.3[a]	
Magrini et al. [86]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Manning et al. [87]	Acute	2	Specific categorization; starting the match; substitute						
Marqués-Jiménez et al. [48]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Martin-Garcia et al. [12]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Martins et al. [88]	Chronic	2	Players' starting status; > 80%; < 50%	> 80.0				< 50.0	
McLean et al. [89]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Morgans et al. [18]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Nobari et al. [13]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Nobari et al. [54]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Nobari et al. [55]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Nobari et al. [53]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	

Table 2 (continued)

Study	Acute: chronic categorization	Categories of analyses, n	Categorization of playing time (original)	Starter (%)	Replaced (%)	Substitute more play time (%)	Substitute less play time (%)	Nonstarter (%)	Nonselected (%)
Nobari et al. [56]	Acute	2	Specific categorization; ≥ 60 min (3 consecutive matches); < 60 min (3 consecutive matches)	≥ 180.0				< 180.0	
Nobari et al. [90]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Nobari et al. [61]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Nobari et al. [62]	Acute	2	Specific categorization; ≥ 60 min (3 consecutive matches); < 60 min (3 consecutive matches)	≥ 180.0				< 180.0	
Nobari et al. [49]	Acute	2	Specific categorization; ≥ 60 min (3 consecutive matches); 60 min (3 consecutive matches)	≥ 180.0				180.0	
Oliveira et al. [64]	Acute	2	Specific categorization; ≥ 60 min (3 consecutive matches); < 60 min (3 consecutive matches)	≥ 180.0				< 180.0	
Oliveira et al. [64]	Acute	2	Specific categorization; ≥ 60 min (3 consecutive matches); < 60 min (3 consecutive matches)	≥ 180.0				< 180.0	
Padrón-Cabo et al. [91]	Acute	3	Accumulated minutes; entire match; replaced; substitute						
Palmer and Akehi [92]	Acute	2	Accumulated minutes; ≥ 40 min; < 40 min	≥ 44.4				< 44.4	
Papadakis et al. [93]	Acute	2	Accumulated minutes; ≥ 60 min; < 60 min	≥ 66.7				< 66.7	
Paraskevas and Hadjicharalambous [94]	Acute	2	Accumulated minutes; ≥ 60 min; ≤ 40 min	≥ 66.7				< 44.4	
Rago et al. [50]	Acute	3	Accumulated minutes; ≥ 75 min; 30–75 min; < 30 min	≥ 62.5		< 62.5	< 30.0		
Raya-Gonzalez and Castillo [65]	Acute	2	Accumulated minutes; ≥ 45 min; ≤ 45 min	≥ 50.0				< 50.0	
Raya-González et al. [51]	Acute	2	Accumulated minutes; ≥ 45 min; ≤ 45 min	≥ 50.0				< 50.0	

Table 2 (continued)

Study	Acute: chronic categorization	Categories of analyses, n	Categorization of playing time (original)	Starter (%)	Replaced (%)	Substitute more play time (%)	Substitute less play time (%)	Nonstarter (%)	Nonselected (%)
Reche-Soto et al. [95]	Acute	2	Accumulated minutes; ≥ 90 min starting-up players; ≥ 45 min played in the second half of the match	≥ 100.0				< 50.0	
Sams et al. [52]	Chronic	3	Total play time; ≥ 60 min; < 60 min; 0 min	≥ 66.7				< 66.7	0.0
Silvestre et al. [96]	Acute	2	Accumulated minutes; 90 min; ≤ 90 min	≥ 100.0				< 100.0	
Sporis et al. [19]	Chronic	2	Specific categorization; ≥ 1000 min of total play time; < 1000 min of total play time						
Sydney et al. [97]	Acute	3	Accumulated minutes; entire match; replaced; substitute						
Teixeira et al. [98]	Chronic	2	Players' starting status (M ± SD, respectively); ≥ 55% (73.82 ± 12.08 min); < 55% (24.06 ± 9.67 min)	≥ 55.0				< 55.0	
Titton [99]	Acute	3	Accumulated minutes; entire match; replaced; substitute						
Vilamitjana et al. [41]	Chronic	2	Accumulated playing time and players' starting status (*M* ± SD, respectively); 531.6 ± 118.1; 31.5 ± 42.8 min						
Zanetti et al. [100]	Chronic	2	Specific categorization; ≥ 75% of participation and total match time; other players	≥ 75.0				< 75.0	

M mean, *min* minutes, *SD* standard deviation

[a]Absolute values of total match time

60–62, 65, 66, 73, 76, 81, 87, 88, 92–96]. Nine trials (15.8%) categorized players into three groups (e.g., ≥ 50% vs < 50% vs 0%) for starters versus replaced/fringe versus substitutes/nonstarters, respectively [45, 50, 57, 58, 68, 83, 85, 91, 97, 99], and four trials (8.8%) had four distinct profiles (100% vs ≥ 66.7% vs < 66.7% vs 0%) for starters versus replaced versus substitute versus nonstarters, respectively [46, 47, 69, 71]. Six trials (10.5%) analyzed player groups but did not report individual playing times [48, 83, 85, 91, 97, 99].

Six trials (10.5%) applied varying definitions of acute exposure, referring to playing time assessed within a short-term period (e.g., a single match or a week), for starters versus nonstarters. These included (i) a starter had to complete a minimum of 60 min in each of three consecutive matches; players who did not achieve this duration were considered nonstarters [44, 49, 63, 64, 90]; (ii) starters were the players who began the match (starting eleven), while nonstarters were those who either participated later in the match or did not play any minutes [78]; and (iii) players were considered nonstarters when playing a minimum of 10 min per match [70] and 15 min per match [72].

3.3.2 Chronic Trials

Concerning chronic exposure, 14 trials (24.6%) assigned different participation categories based on observation periods [10, 11, 41, 43, 52, 59, 67, 74, 75, 80, 82, 84, 86, 89, 98]. 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) [11, 41, 59, 86]. Five trials (8.8%) categorized players solely by total playing time (e.g., ≥ 50% vs < 50%, respectively) [43, 75, 80, 82, 84] and two trials (3.5%) by the percentage of matches started (e.g., ≥ 80% vs ≤ 50%, respectively) [89, 98], for starters and nonstarters, respectively. Four trials categorized players into three cut-offs. Two trials (3.5%) grouped players by the amount of total playing time (e.g., ≥ 66.7% vs < 66.7% vs 0%, respectively) [52, 74], while two trials (3.5%) showed players' starting status cut-offs (e.g., ≥ 60% vs 30–60% vs < 30%, respectively) [10, 67], for starters, substitutes, and nonstarters, respectively.

Four trials (7.0%) used other chronic definitions to differentiate starters versus nonstarters, such as i) a starter had to play ≥ 95% of all official matches and nonstarters ≥ 95% of all friendly matches during a season [19]; ii) according to the playing time during each mesocycle (two blocks of 21 days) using a median-split approach [77]; iii) starters had to participate in all matches and completed a minimum of 75% of the total time of the match, and the remainder were considered nonstarters [100]; or iv) starters if they played > 50% of all matches, > 50% of playing time in each match, and > 50% in the starting eleven [79].

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%) completed a compensatory training session after the official match [2, 47, 58]. Six of the 16 trials (37.5%) performed supplementary work on MD + 1 [12, 69, 71, 73, 78, 93], and one of the 16 trials (6.3%) carried out complementary training on MD + 2 [52]. Two of the 16 trials (12.5%) performed additional training on match day and throughout the week (MD + 1 and MD + 2) [65, 77]. Five of the 16 trials (31.3%) did not provide information on which day the compensatory training was performed for nonstarters [18, 19, 84, 96, 98]. The different strategies used to increase the weekly load of nonstarters were mainly based on small-sided games (56.3%) [12, 52, 58, 71, 73, 77, 84, 93, 96] and running-based drills (25.0%) [18, 52, 73, 93]. One of the 16 trials (6.3%) played friendly matches to attempt to reproduce competitive loads [19]. Five of the 16 trials (31.3%) did not provide information on which strategies were used for nonstarters [2, 47, 65, 69, 98].

3.5 Performance Factors

Regarding performance factors, 49 trials (85.9%) presented data exclusively on the physical element [1, 2, 10–14, 18, 19, 41–49, 51–67, 69–73, 75, 77–82, 84, 86, 88–98, 100] and one trial (1.8%) on the psychological factor [74]. Several trials used integrated approaches: six trials (10.5%) investigated technical and physical factors [50, 68, 76, 83, 85, 87], and one trial (1.8%) investigated psychological and physical variables [99]. The performance factors were presented in separate sub-sections for the physical, technical, and psychological factors, and a separate section was dedicated to analyzing studies that included two factors in an integrated manner. No study examined the tactical factor. Regarding the outcomes of the investigations, 245 variables for each performance factor were extracted from the studies (Supplementary Table S2, see ESM). All details regarding the outcomes of the analysis of playing time in relation to different performance factors are presented in the ESM (subsection 1.4).

3.5.1 Physical Factors

Fifty-six trials (98.3%) analyzed 211 different physical variables (external absolute intensity [EAI] and internal absolute intensity [IAI], physiological determinants, exercise performance measurements, and anthropometric measurements) [1, 2, 10–14, 18, 19, 41–73, 75–100].

Table 3 Information related to compensatory trainings

Study	Days of compensatory training	Integrated (physical and tactical/technical)	Technical/tactical factors	Technical factors	Physical factors	Specific training	Categorization of compensatory training
Los Arcos et al. [47]	MD					Individual physical practice	Details were not provided
Azcárate et al. [57]	MD		Small-sided game		Continuous running		Details were not provided
Calderón-Pellegrino et al. [69]	MD + 1					Unspecified	Details were not provided
Casamichana et al. [71]	MD + 1		Small-sided game and small-positional game	Technical circuit			TC followed by a SPG and a SSG with GK within an assigned area (30–60 m^2 per player)
Díaz-Serradilla et al. [73]	MD + 1	Small-positional game with running-based-drills	Small-sided game		Running-based drills		RBD: 2 × 6 × 20 s all-out sprints with 90 s of active recovery, had 5 min of recovery, and then performed a repeated sprint drill consisting of 2 × 5 × 25-m sprints followed by shooting at goal with 25 s of passive recovery. SSG: 4 × 4 (62.5 m^2 per player) of 3 bouts of 4 min separated by 90 s of passive recovery. RBD + SSG: (i) 2 × 5 × 25 m with 25 s of recovery between repetitions and 5 min between sets; ii) after 5 min of recovery, 4 × 4 (62.5 m^2 per player) of 3 bouts of 4 min separated by 90 s of passive recovery
Gualtieri et al. [77]	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)		Details were not provided

Table 3 (continued)

Study	Days of compensatory training	Integrated (physical and tactical/technical)	Technical/tactical factors	Technical factors	Physical factors	Specific training	Categorization of compensatory training
Hernandez et al. [78]	MD + 1				Specific circuits with high neuromuscular demand		Details were not provided
Lopez et al. [84]	Unspecified		Ball possession and small-sided game	Completions	Explosive strength and aerobic capacity		Activation: 3 min of general movements, followed by 20 min of explosive strength in the gym, 2 min of mobility, 8 min of coordination, proprioception, and change of direction, and 2 min of passing drills. Main: 14 min of explosive strength and 3 SSG: (i) 7 min of 6 × 6 with 2 floaters (10 m × 18 m), ii) 12 min of 3 × 3 (30 m × 25 m), and iii) 5 × 5 with the dimensions of 2 penalty areas. Recovery, 10 min of abdominal and eccentric exercises and 8 min of stretching
Los Arcos et al. [47]	MD					Individual physical practice	Details were not provided
Los Arcos et al. [2]	MD					Unspecified	Details were not provided
Martin-Garcia et al. [12]	MD + 1		Small-sided game and small-positional game	Technical circuit			TC followed by a SPG and a SSG with GK (30–60 m^2 per player)
Morgans et al. [18]	Unspecified				High-intensity running		Details were not provided

Table 3 (continued)

Study	Days of compensatory training	Integrated (physical and tactical/technical)	Technical/tactical factors	Technical factors	Physical factors	Specific training	Categorization of compensatory training
Papadakis et al. [93]	MD + 1	Combination of small-sided games and high-intensity aerobic runs	Small-sided games (3 vs 3–7 vs 7)				The session had a duration of 20–40 min and included SSG ranging from 3 × 3 to 7 × 7 or a combination of SSGs and high-intensity aerobic runs, with the goal of accumulating time in the high intensity aerobic zone
Raya-Gonzalez and Castillo [65]	MD + 1 or MD + 2					Unspecified	Details were not provided
Sams et al. [52]	MD + 2		Small-sided game		High-speed running		The session had a duration of 45–60 min and included SSGs and high-speed running and sprinting
Silvestre et al. [96]	Unspecified		Small-sided game				Details were not provided
Sporis et al. [19]	Unspecified					Friendly matches	Details were not provided
Teixeira et al. [98]	Unspecified					Unspecified	Details were not provided

GK goalkeepers, *m* meters, *MD* match day, *MD + 1* one day after the match, *MD + 2* two days after the match, *RBD* running-based drills, *SPG* small positional game, *SSG* small-sided game, *TC* technical circuit

3.5.1.1 External Absolute Intensity Indicators Sixty-three EAI variables (e.g., total distance, sprint distance, and accelerations) were observed in 35 trials (61.4%) [1, 10–14, 18, 42, 44–46, 49, 50, 53–56, 59–62, 64, 67–73, 75–78, 80, 83, 85, 87, 90, 91, 95, 97–100]. Nonstarters presented higher EAI in total distance, in speed distances at 3.3–7 m/s^{-2}, accelerations, decelerations, and high metabolic load distance during friendly soccer matches [1] and in the sessions after the match (MD + 1) [12, 78]. Two trials demonstrated no significant differences in EAI for total distance, very high-intensity running, accelerations, and decelerations between starters and nonstarters [64, 100]. Thirteen trials showed that substitute players covered greater total distance, distance in a range of speed zones (1.7–7 m/s^{-2}), accelerations, and player load™ (a metric that quantifies the sum of accelerations in all axes of the internal tri-axial accelerometer during movement) relative to playing time than the players who were replaced or completed the entire match [46, 50, 68, 69, 72, 75, 76, 83, 85, 91, 95, 97, 99, 101, 102]. Sixteen trials observed that starters accumulated higher EAI compared with nonstarters (total distance, distance in a range of speed zones [2–7 m/s^{-2}], number of accelerations and decelerations, player load) in a weekly microcycle and over the season [10, 11, 13, 14, 18, 42, 45, 49, 53–56, 59–62, 67, 71–73, 75, 77, 80, 90, 95].

3.5.1.2 Internal (Subjective and Objective) Absolute Intensity Indicators The IAI metrics' categorization was divided into two distinct dimensions: subjective IAI (e.g., muscular and respiratory perceived effort) and objective IAI (e.g., cardiac indices). Concerning subjective IAI, 16 variables were examined in 22 trials (38.6%), using the Borg rating of perceived exertion (RPE) 6–20 scale, RPE CR10-point scale, adapted by Foster, Hooper Index, Total Quality of Recovery (TQR), visual analog scales (VASs) and a perceptual fatigue questionnaire [1, 2, 43–45, 47, 48, 51, 52, 57–59, 63–65, 73, 77, 80, 81, 88–90, 97–99]. Regarding objective IAI, 24 variables (e.g., Akubat's, Banister's and Edward's TRIMP) were analyzed in six trials (10.5%) [11, 14, 59, 66, 75, 80, 98].

Regarding objective IAI, two trials presented higher accumulated TRIMP during training sessions for nonstarters [11, 14], 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 [59]. One trial showed an increase in mean time spent in higher intensity zones (Zone 4: 90–95% maximal heart rate [HR_{max}] and Zone 5: 95–100% HR_{max}) and a decrease in mean time spent in lower intensity zones (Zone 1: < 70% HR_{max} and Zone 2: 70–85%HR_{max}) after player substitutions [66]. Three trials showed starters accumulated higher heart rate-based measures (70–100% HR_{max}) than nonstarters during a weekly microcycle and over the season [11, 14, 80].

Regarding subjective IAI indicators, three trials demonstrated that respiratory perceived effort was higher in starters, while muscular effort was greater in nonstarters [47, 97]. Starters reported higher perceived effort than the nonstarters after the match [99]. Nonstarters reported significantly higher value in training sessions 48 h after the match [88]. 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, 45, 51, 52, 58, 59, 63, 77, 89, 99]. In addition, levels of alertness appear to decrease from preseason to postseason more in starters than in nonstarters [81].

3.5.1.3 Anthropometric Measurements Twenty-one anthropometric variables (e.g., body composition, maturation factors, and somatic maturation) were examined in 10 trials (17.5%) [41, 43, 79, 82, 84, 87, 92, 93, 96, 100]. One trial showed that young male players' fat-free and body mass was higher in starters than in nonstarters [79]. On the other hand, in collegiate female soccer, starters weighed less [92]. Two trials observed that nonstarters significantly increased body fat compared with starters [82, 93]. One trial found that stature did not impact the duration of match-playing time or performance in an elite Women's World Cup soccer team [87].

3.5.1.4 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 (maximum rate of oxygen consumption [$\dot{V}O_{2max}$], submaximal measures such as velocity at fixed blood lactate concentrations). Regarding neuromuscular physiological determinants, 18 variables (e.g., muscle thickness and testosterone concentrations) were examined in five trials (8.8%) [41, 43, 81, 82, 100]. Regarding neuromuscular performance measures, 54 variables (e.g., linear sprint, sit and reach, and slalom test) were analyzed in 12 trials (21.1%) [18, 19, 43, 79, 81, 82, 86, 89, 92, 93, 96, 100]. With regard to endurance physiological determinants, 15 variables (e.g., maximum oxygen uptake and velocity at 4 mM of blood lactate) were examined in nine trials (15.8%) [19, 41, 43, 79, 81, 93, 94, 96, 100].

Concerning neuromuscular physiological determinants, starters reported a greater change in muscle architecture (e.g., pennation angle and muscle thickness) and insulin-like growth factor concentration [43, 81]. No difference was observed between starters and nonstarters for biomarkers (e.g., creatine kinase and indices of testosterone/cortisol) [41].

In relation to neuromuscular performance measures, starters demonstrated significant increases compared with nonstarters in different physical tests: flexibility (sit and reach test) [19, 43, 81, 86, 92], strength (isometric knee extension), acceleration (0–20 m) and maximal speed phase of sprinting (e.g., 30 m), agility (sprint with 90º turns) and power (countermovement jump and squat jump). One trial showed significant improvements in both starters and nonstarters in upper- and lower-body reactions to visual stimuli [81]. However, both groups showed significant reductions in knee extension isokinetic peak torque (1.05 rad s^{-1}), as well as in performance on vertical jump and linear sprint tests (18.3 m and 36.7 m, respectively) [82]. In addition, nonstarters experienced a slight decrement in power performances assessed by countermovement jump and continuous jumps with legs straight [19]. In contrast, starters experienced significant reductions in maximal power output during the second half of a collegiate soccer season [89].

Concerning endurance physiological determinants, one trial observed greater $\dot{V}O_{2max}$ in starters than nonstarters [43]. Starters and nonstarters showed statistically significant improvements in velocity at 4 mM of blood lactate [94] and decreases in aerobic capacity measured by $\dot{V}O_{2max}$ of 0.4% and 2.7%, respectively [19].

3.5.2 Technical Factors

Six trials (10.5%) analyzed 22 technical variables obtained from match-play (e.g., successful passes, number of shots, and successful dribbles) [50, 68, 76, 83, 85]. There were no differences in pass-completion rates in nonstarters compared with starters [68]. Nonstarters in the Chinese Super League completed more technical actions than starters but with a lower efficacy [76]. One study showed that nonstarters made more accurate passes than starters [83]. Moreover, differences in technical performance indices between starters and nonstarters were observed to vary according to the playing positions [85]. Nonstarters in the position of central defender had less involvement with the ball but higher defensive performance, while the nonstarters in the positions of central midfielder, wide midfielder, and attackers had more possession, touches, and shots than starters [85]. Differences in starting status during the FIFA World Cup were not associated with differences in technical actions [50].

3.5.3 Psychological Factors

Psychological factors were analyzed in two trials (3.5%), using the Sport Motivation Scale (SMS) [74] and the Brunel Mood Scale (BRUMS) [99]. One trial showed that starters obtained higher self-determination indexes, proving to be more intrinsically motivated for soccer practice than nonstarters [74]. No significant differences were observed in mood states for vigor and fatigue in relation to match play time [99].

3.5.4 Integrated Factors

Two trials (3.5%) performed an integrated analysis involving both technical and physical factors during exercise performance measures [19] and competition performance measures (high-intensity running when the team is in possession of the ball [68]. Starters revealed superior performance during the slalom test with the ball, the sprint with 90º turns with the ball, and lower high-intensity running with the ball, relative to playing time, than nonstarters [19, 68].

3.6 Risk of Bias in Individual Studies

Table 4 presents the risk of bias in the 70 studies included. In summary, (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; and (v) risk of bias in measurement of exposure and selective outcome reporting was not reported as high; however, this was unclear in 12 trials (21%) due to the lack of information on important assessment methods and the data obtained being from unreliable sources (i.e., details regarding the GPS procedure protocol), and in 49 trials (86%) due to the absence of a pre-registered protocol. All details regarding the risk of bias in the studies included are presented in the ESM (subsection 1.5).

3.7 Synthesis of Evidence

An EGM (Fig. 4) was developed to synthesize the relevant available evidence to provide a visual presentation of the evidence. The EGM summarizes the findings and provides a brief overview of the evidence and research gaps [103–105]. Figure 4 presents an example of 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 ($k = 39$,

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. [42]	19	Low	Low	Low	Low	Low	Low
Anderson et al. [10]	19	Low	Low	Low	Low	Unclear	Unclear
Los Arcos et al. [47]	40	High	High	Low	High	Unclear	Unclear
Azcarate et al. [57]	21	Low	Low	Low	High	Low	Unclear
Azcarate et al. [58]	17	Low	Low	Low	High	High	Unclear
Barbosa et al. [66]	55	Low	Low	Unclear	Low	Unclear	Low
Barreira et al. [67]	35	High	Low	Low	Low	Unclear	Unclear
Bradley et al. [68]	1382	High	High	Unclear	Low	Unclear	Unclear
Calderon et al. [69]	1047	High	High	Low	Low	Unclear	Unclear
Carling et al. [70]	25	High	Low	Unclear	Low	High	Unclear
Casamichana et al. [71]	24	Low	Low	Low	Low	Low	Unclear
Castillo-Rodríguez et al. [72]	22	Low	Low	Low	Low	Low	Unclear
Curtis et al. [11]	82	High	High	Low	Low	High	Unclear
Curtis et al. [59]	107	High	High	Low	High	Unclear	Unclear
Dalen et al. [14]	18	Low	Low	Unclear	Low	Low	Unclear
Díaz-Serradilla et al. [73]	14	Low	Low	Low	High	Unclear	Unclear
Eskandarifard et al. [43]	24	Low	Low	Low	High	Low	Unclear
Fernandes et al. [44]	19	Low	Low	Low	High	Low	Unclear
Filho et al. [74]	112	High	High	Unclear	High	Unclear	Unclear
Furtado Mesa et al. [75]	19	Low	Low	Low	Low	Low	Unclear
Gai et al. [76]	9507	High	High	Unclear	Low	Unclear	Unclear
Garcia et al. [45]	29	High	Low	Low	High	Low	Low
García-Aliaga et al. [46]	1077	High	High	Unclear	Low	High	Unclear
Gholizadeh et al. [60]	19	Low	Low	Low	Low	Low	Unclear
Giménez et al. [1]	14	Low	Low	Low	High	Unclear	Unclear
Gualtieri et al. [77]	20	Low	Low	Low	High	Low	Unclear
Hernández et al. [78]	18	Low	Low	Low	Low	Low	Unclear
Hoppe et al. [79]	92	High	High	Low	High	Unclear	Unclear
Jagim et al. [80]	22	Low	Low	Low	Low	Low	Unclear
Jajtner et al. [81]	28	High	Low	Low	High	Low	Unclear
Kraemer et al. [82]	25	Low	Low	Low	High	Low	Unclear
Kubayi et al. [83]	252	High	High	Unclear	Low	Unclear	Unclear
López et al. [84]	20	Unclear	Low	Unclear	High	Low	Unclear
Lorenzo-Martinez et al. [85]	431	High	High	Low	Low	Unclear	Unclear
Los Arcos et al. [2]	40	High	High	Low	High	Unclear	Unclear

Table 4 (continued)

Los Arcos et al. [47]	24	Low	Low	Low	High	Low	Unclear
Magrini et al. [86]	18	Unclear	Low	Low	High	Low	Unclear
Manning et al. [88]	556	High	High	Unclear	High	Unclear	Unclear
Marqués-Jiménez et al. [48]	35	High	High	Low	High	Unclear	Unclear
Martin-Garcia et al. [12]	24	Low	Low	Low	Low	Low	Unclear
Martins et al. [88]	11	Low	Low	Low	High	High	Unclear
McLean et al. [89]	16	Low	Low	Low	High	High	Unclear
Morgans et al. [18]	15	High	Low	Low	High	Unclear	Unclear
Nobari et al. [13]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [54]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [55]	21	Unclear	High	Low	Low	Low	Unclear
Nobari et al. [53]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [56]	21	Low	Low	Low	Low	Low	Unclear
Nobari et al. [90]	20	Low	Low	Low	High	Low	Unclear
Nobari et al. [61]	21	Unclear	High	Low	Low	Low	Unclear
Nobari et al. [62]	21	Unclear	High	Low	Low	Low	Unclear
Nobari et al. [49]	19	Low	Low	Low	Low	Low	Unclear
Oliveira et al. [64]	17	Low	Low	Low	High	Low	Unclear
Oliveira et al. [64]	17	Low	Low	Low	High	Low	Unclear
Padrón-Cabo et al. [90]	943	High	High	Unclear	Low	Unclear	Unclear
Palmer et al. [92]	24	Low	Low	Low	Low	Low	Unclear
Papadakis et al. [93]	21	Low	Low	Low	Low	High	Low
Paraskevas et al. [94]	17	Low	Low	Low	Low	High	Low
Rago et al. [50]	453	High	High	Unclear	Low	Unclear	Unclear
Raya-Gonzalez et al. [65]	19	Low	Low	Low	High	Low	Unclear
Raya-González et al. [51]	19	Low	Low	Low	High	Low	Unclear
Reche-Soto et al. [85]	22	Low	Low	Low	Low	Low	Low
Sams et al. [52]	30	Low	Low	Low	High	Low	Unclear
Silvestre et al. [96]	25	High	Low	Low	High	Low	Unclear
Sporis et al. [19]	64	High	High	Low	High	Unclear	Unclear
Sydney et al. [98]	21	Unclear	High	Low	High	Low	Unclear
Teixeira et al. [98]	60	High	High	Low	High	Unclear	Low
Titton et al. [99]	17	Unclear	High	Low	High	Unclear	Low
Vilamitjana et al. [41]	22	Low	Low	Low	Low	Low	Unclear
Zanetti et al. [100]	21	Unclear	Low	Low	High	Low	Unclear

Green: low risk-of-bias; Yellow: unclear risk-of-bias; Red: high risk-of-bias

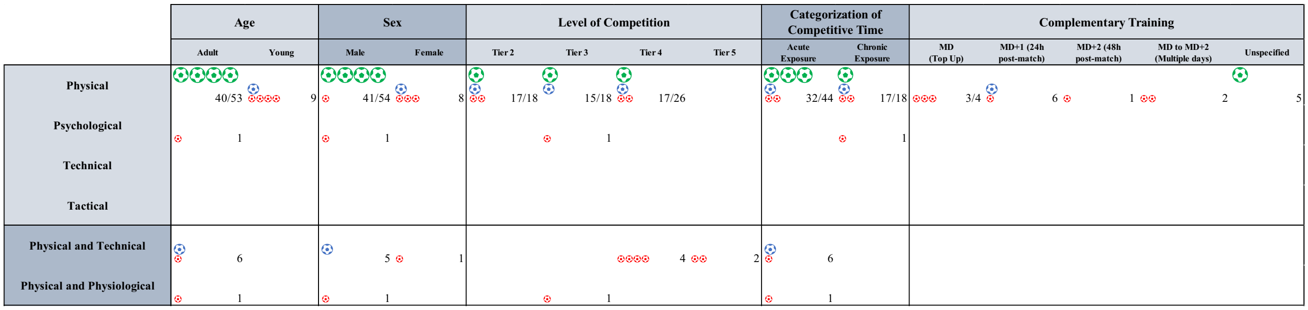

Fig. 4 Evidence gap map of the interaction between performance factors and main outcomes. ⚽ = Represents 10 trials; ⚽ = Represents 5 trials; ⚽ = Represents 1 trial. *Tier 2*: trained/developmental; *Tier 3*: highly trained/national level; *Tier 4*: elite/international level; *Tier 5*: world class. *Acute Exposure*: Players allocated according to match participation (i.e., starter ≥ 60 min vs nonstarter < 60 min); *Chronic Exposure*: players allocated according to playing time accumulated during a specific period of competition (i.e., total play time; starter ≥ 60% vs nonstarter < 60%)

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 (≥ 66.7% vs < 66.7%) for starters versus nonstarters, respectively. Notably, the most frequent day to perform compensatory training was 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 was not addressed in any study. The main methods used to assess training load metrics include GPS ($k = 22$; 38.5%), multiple-camera tracking ($k = 10$, 10.5%), RPE ($k = 14$, 24.6%), using Foster ($k = 11$, 19.3%) and Borg ($k = 3$, 5.3%) scales, and heart rate monitors ($k = 8$; 14.0%).

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 conducted few investigations, and the African continent did not present any studies. Additionally, there is limited 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 fewer analyses. Sixteen out of 57 trials (28.1%) implemented compensatory training for nonstarters.

4 Discussion

The objective of this scoping review with EGM was to provide an EGM that guides future research toward addressing the most relevant gaps in the literature. Comparative analyses were performed regarding the different performance factors between starters and nonstarters. These analyses were also conducted to identify compensatory strategies for players with reduced playing times. Physical performance factors have been extensively studied concerning 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 have analyzed technical and psychological performance factors, while tactical factors have not been addressed in any study. In absolute terms, starters have higher EAI and IAI values during matches, in weekly microcycles, and throughout the season than nonstarters do. In exercise performance measurements, starters presented better results at specific points in time [79, 86, 92] and throughout the season [19, 82, 93, 96]. However, in relative terms, nonstarters have higher EAI and IAI values during matches than starters do. The day most used for compensatory training was MD + 1, and several strategies to reproduce competitive loads were used, such as small-sided games, small-positional games, tactical-technical drills, friendly matches, high-speed running, and strength training. Notably, 16 out of 57 trials (28.1%) reported that compensatory training was provided for nonstarters [2, 12, 18, 19, 47, 52, 58, 65, 69, 71, 73, 77, 78, 84, 93, 96, 98].

4.1 Performance Factors

Performance factors may influence soccer playing status, as coaches most likely select players on the basis of their performance level, with the best players being chosen to start matches [92, 93]. Such selection may also depend on physical performance, psychological readiness, technical skills, tactical beliefs, or strategies specific to a match or in-season period [10, 92]. In a competitive week, for players who complete a certain amount of playing time (usually starters), the match typically represents the highest EAI and IAI value of the microcycle [2, 10, 18, 19, 57–59, 63, 67, 69, 71, 73, 77, 79, 80, 86, 88, 89, 93, 94]. Given that only 11 players can start in an official match, a significant portion of players per team are not or are only partly exposed to the match [2]. As a result, studies analyzing competitive phases ranging from 3 to 10 months support the observation that substantial differences in physical and physiological demands can be observed between nonstarters and starters on the same team, primarily due to disparities in match time rather than training time [10, 11, 14, 75]. This suggests that competition constitutes an important stimulus for improving a player's ability to perform high-intensity movements, such as those involving acceleration (5 m), sprints (20–30 m), jumps, and change of direction, and increasing their maximal aerobic capacity ($\dot{V}O_{2max}$) [19, 94]. A key variable that may influence the level of preparation is playing time, as during competitive periods, some players may accumulate more playing time than others do for technical or tactical reasons [93].

Although most soccer training sessions during a training week are designed to improve players' tactical and technical competence and prepare for upcoming matches [58, 93], there is limited information on technical, psychological, and especially tactical factors regarding nonstarters. Until recently, there have been few detailed scientific investigations of team tactics, one reason being the lack of available and relevant data [106]. Several studies have addressed the associated technical and psychological factors [50, 68, 74, 76, 83, 85, 87, 107]. Various trials focusing on technical performance have demonstrated that the total number of short passes, successful passes, and involvements with the ball decrease between the first and second halves of soccer matches, probably as a consequence of player fatigue [3, 76, 83, 85]. In this context, substitutions appear to be a crucial strategy to counteract this decrease in technical performance since substitute players were shown to have more possession, touches, shots, and defense actions per minute in comparison with players who were replaced and those who played the entire match [76, 83, 85]. Research literature has shown that variables such as ball possession, pass accuracy, and shots can reliably distinguish between successful and unsuccessful teams [76, 108, 109]. Specifically, indications such as the number of shots, the number of shots on target (shot success), ball possession, the number of passes, and pass completion rates (pass success) are positively correlated with team success [5, 76, 109]. This may be important for substitution strategies aiming to maintain team performance in the later stages of a match, where the effects of fatigue start being observed in terms of the players' physical (e.g., fewer high-intensity actions) and technical performance (lower pass accuracy). Psychological factors, such as motivation, confidence, anxiety control, mental preparation, team emphasis, concentration, and cognition, play a significant role in improving the performance of soccer players [107]. Filho et al. [74] reported that starters showed greater intrinsic motivation for soccer, demonstrated through a greater personal drive to engage in the sport, than nonstarters did. Specifically, in soccer, motivation has been correlated with several psychological constructs such as commitment, mental resistance, burnout, and perfectionism, as well as with tactical and technical performance-related variables [74, 107, 110, 111]. Although psychological factors play a significant role in players' performance, these factors alone cannot determine performance in a match [107]. Considering this deduction, all performance factors seem to have a certain level of importance in terms of player performance. Given that starters and nonstarters have different needs to reach comparable performance levels, it is paramount for coaches to implement exposure to training stimuli focused on achieving the desired balance [43]. Differences between starters and nonstarters could lead to differences in key components of soccer-specific fitness. This may become problematic when nonstarters have to play in a full or near-full match [10]. Furthermore, differences 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 individuals who manage player workloads [11, 15]. Therefore, coaches and support staff may need to adopt specific strategies to ensure that players are ready to cope with match demands [2, 10, 18, 43, 45, 60, 67, 69, 71, 73, 75, 77, 78, 80, 97, 98, 107].

4.2 Categorization of Playing Time and Compensatory Training

Several trials organized compensatory strategies for players who did not participate in the match or played less than a predefined cutoff value (usually < 60 min) to compensate for the missing match demands [45]. In this context, playing time is typically the primary criterion for deciding who should participate in a compensatory training session [47]. Different categorizations are made on the basis of playing time, player starting status, or the total number of matches during a competitive season, dividing players into two or more playing-time groups [10, 44, 52, 71]. Nevertheless, the literature regarding the optimal categorization of player groups to replicate the workload for nonstarters appears inconclusive. Furthermore, diverse strategies have been employed to create compensatory training sessions with respect to the training day and type of drill [12, 18, 19, 47, 52, 58, 71, 73, 77, 78, 84, 93, 96]. Several trials examined in this investigation introduced compensatory training strategies capable of sustaining or surpassing the weekly workload of starters [64, 65, 73, 77, 98]. Díaz-Serradilla et al. [73] reported that for nonstarter female players (those who played < 60 min), the session incorporated running-based drills and small-sided games to replicate the intensity, movement patterns, and specific actions (i.e., accelerations and decelerations) that occur during a match. Gualtieri et al. [77] reported that starting professional male soccer players had greater total exposure (training and match time) and total distance values. However, nonsignificant differences between groups were found for very high-intensity running and sprint distances. The training strategy for nonstarters (using a median-split approach in each mesocycle) involved performing low-volume high-intensity aerobic training after a match. Subsequently, on MD + 1, these nonstarters played small-sided games on the soccer field and undertook strength training in the gym. On MD + 2, following the first part of the session, nonstarters continued their compensatory training program with low-intensity tactical-technical drills [77]. The training strategies implemented may have mitigated the differences in high-speed running, sprint distances, and acceleration between groups during the microcycle [73, 77].

However, the training intensity and volume of compensatory sessions may not be enough to compensate for low or nonexistent match demands [2, 47, 58, 69, 71]. 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 other factors [67, 88]. Moreover, some studies have reported organizational and conventional training challenges [10, 11, 46]. In the English Premier League, players are restricted to a maximum of 15 min of postmatch training on the pitch where the match is played and are not allowed to perform change of direction drills to preserve the integrity of the playing surface [10]. Additionally, it is often common practice for the entire playing squad to be given 1–2 days of recovery after each game [10]. In American collegiate soccer, the congested schedule presents limited time for additional training for nonstarters between matches [11]. Garcia et al. [45] reported that on days following away matches, coaches could not compensate for the missing match load, mainly due to travel and/or the logistics of the training (e.g., space, the number of players available to train). Concerning compensatory training strategies, Martin-Garcia et al. [12] demonstrated that MD + 1, for players without match time, exceeds 50% of the match play values (the total distance covered, the number of accelerations and decelerations). However, these strategies did not contribute to developing players' high-speed running and sprinting skills [12, 71]. Alternatively, the study by Stevens et al. [16] revealed that nonstarters who received compensatory training had significantly lower values (e.g., lower total distance, time spent above 90%HR_{max}, and fewer accelerations and decelerations) than starters. These sessions involved fewer players (~ 9 vs ~ 18 in regular training) and increased ball touches, dribbles, and duels but lower physical demands [112]. Training strategies for nonstarters, typically implemented postmatch or during the first or second training sessions in a week, are insufficient to compensate for the demands of weekly EAI and IAI, suggesting the need for coaching staff to incorporate compensatory training strategies distributed across multiple days (distributed practice) [10, 58, 65, 113].

Therefore, managing playing time throughout a season presents significant challenges for coaches, particularly when balancing starters' workloads while ensuring that nonstarters are exposed to adequate and consistent training stimuli. To ensure that all players are prepared to start a match at any point during the season, it is crucial that they maintain the physical adaptations, psychological factors, and tactical-technical skills required to optimize their performance throughout the season. This review emphasizes the need for further research on the technical, tactical, and psychological factors to better understand the demands on nonstarters and improve the tailoring of training programs. More precise time intervals would allow for greater individualization of complementary trainings, ensuring exposure to appropriate stimuli for each player. Furthermore, incorporating technical-tactical components into compensatory sessions distributed throughout a week could help mitigate performance differences between starters and nonstarters, ensuring that all athletes are prepared to compete at the highest level.

4.3 Limitations

The included studies had several limitations. The main limitation is common to studies in sports sciences—the small sample size and the specificity of the team (age, sex, and competition), which may limit the generalizability of the results to other scenarios. This limitation is common to longitudinal studies of professional teams in a competitive season, so replication studies with different samples are warranted. To address this, future studies could aim to pool data from multiple teams or leagues through collaborations or meta-analyses, which might increase the generalizability of findings while respecting the contextual nuances of soccer performance research. With respect to monitoring EAI, the simultaneous use of different data collection instruments (i.e., GPS and multiple-camera player tracking systems) may have implications for data compatibility and lead to overestimation or underestimation of the results. This may introduce bias in the measurement of EAI during trainings and matches. With respect to IAI, the use of preseason values to establish the maximum heart rate may not account for fluctuations in cardiovascular capacity throughout the season, and improperly scheduling physical tests (i.e., starting a battery of tests with maximal aerobic effort) can influence test outcomes. With respect to performance measurements, using only two to three physical test evaluations during a competition season may introduce bias, as the absence of continuous monitoring fails to capture ongoing changes in performance.

Additionally, the effective differences in play time within the same groups (e.g., > 60 min; 61 min vs 89 min) or the impact of match data with reduced times (e.g., 5 min) were not considered. We used the cutoff values and conclusions made available from the studies collected in this review. However, this approach introduces some limitations in precision. Future studies could explore additional cutoffs or refined time classifications within nonstarter groups to provide a more nuanced analysis. Although the present findings may have some inherent biases due to these different cutoffs, the conclusions are still relevant and offer valuable insights into the general trends within the population studied. Moreover, we would like to highlight that using the terms 'starter' and 'nonstarter' may be overly simplistic, as they do not truly reflect the match stimulus experienced by each individual player. This may contribute to potentially overlooking each player's individualized training needs and adaptations. Despite the strong influence of playing time on total EAI and IAI values, a player with 45–50 min of match time may have the same or greater exposure to specific parameters as a player with 60–65 min of match time. Nevertheless, in practice, the primary concern is the accumulated volume and intensity over a week.

5 Conclusion

The present scoping review provides an EGM to guide future research on the effect of competition time on soccer players. Physical performance factors have been widely studied with respect to the differences between starters and nonstarters. However, tactical, technical, and psychological performance factors require further investigation to better understand potential group differences. Compared with nonstarters, starters had greater absolute EAI and IAI values across matches, weekly microcycles, and the season and showed improvements in exercise performance measurements. Nonstarters, however, presented higher relative EAI and IAI values per match. While coaches implement postmatch training to compensate for missing match demands for players with less play time, these strategies appear insufficient to fully mitigate the effects of a lack of match participation. To optimize training for nonstarters, technical staff should implement compensatory training sessions across multiple days, particularly within a 48-h window. In addition, the literature regarding the strategies employed in compensatory training sessions (the training day and type of drill) and categorizing player groups to reproduce the competitive match demands for nonstarters seems inconclusive. Potential avenues for future research include (i) investigating the effects of compensatory training on nonstarters' weekly loads when distributed across multiple days; (ii) investigating additional cutoffs or more refined time classifications for nonstarters; and (iii) directing more studies toward female soccer players.

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Declarations

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Consent to Participate Not applicable.

Consent for Publication Not applicable.

Code Availability Not applicable.

Author Contributions We followed ICJME guidelines. Therefore, all authors have provided substantial contributions for the conceptualization and design of the study, acquisition, analysis, and interpretation of data, as well as drafting and revising the manuscript critically. AM developed the original idea for the manuscript. IB, HS, FMC, JRS, and JA helped to conceptualize the work and were actively involved in all stages of the manuscript, including the establishment of the preregistered protocol. FYN was actively involved in the data analysis and writing of the manuscript. All authors have read and agreed to the published version of the manuscript. Furthermore, all authors agree to be accountable for all aspects of the work.

Registration 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.

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