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Review Article

Small-Sided Games in Soccer Training: A Bibliometric Analysis

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Abstract

The aim of this study was to examine the overall development of scientific publications on small-sided games (SSGs) in soccer training and to comprehensively reveal research trends in the literature through bibliometric analysis. Within the scope of the study, a total of 1,073 scientific publications indexed in the Web of Science database and published between 2016 and 2026 were analyzed. To visualize the obtained data and clearly identify conceptual network structures, co-authorship, citation, co-citation, and keyword analyses were conducted using VOSviewer software. The findings indicated that the number of publications related to small-sided games demonstrated an overall upward trend throughout the examined ten-year period, reaching its highest level of productivity in 2025. In terms of author productivity, Filipe Manuel Clemente and Bruno Gonçalves were identified as leading contributors who made substantial contributions to the field. Country-based analyses revealed that Spain, Portugal, and England were the most influential countries contributing to the literature. Furthermore, the keyword analysis showed that the terms "soccer," "performance," and "GPS" were among the most prominent concepts, indicating that research has increasingly focused on performance analysis and technological monitoring tools. In conclusion, the literature on small-sided games has attracted growing scholarly interest in recent years, with data-driven and technology-oriented approaches becoming increasingly prominent. By systematically identifying the major trends and developments within the field, this study provides valuable insights for future scientific research and practical applications in soccer training.

Keywords: Soccer, Small-sided games, Bibliometric analysis.

Introduction

Soccer is one of the most popular sports worldwide. Despite its universal appeal and a history spanning more than a century, uncertainties still remain regarding optimal training methodologies and conditioning demands (Aguiar et al., 2012). Among the various training approaches employed in soccer, small-sided games (SSGs) have emerged as one of the most widely utilized methods due to their unique structure and versatility (Folgado et al., 2019). SSGs are generally defined as training activities conducted on a reduced playing area with fewer than 11 players per team compared to a standard soccer match (Bizati, 2016). Similarly, Hill-Haas et al. (2011) described SSGs as skill-based, game-oriented training activities performed in smaller spaces with fewer players and modified rules, distinguishing them from traditional match play.

The primary objective of SSGs is to expose players to specific situations and conditions that enable them to replicate the physical, technical, and tactical demands of competitive match performance (Ometto et al., 2018). Coaches frequently incorporate SSGs

into training programs to simulate the physical, technical, and tactical requirements encountered during official soccer matches (Aktaş, 2013). By closely reproducing the movement patterns and physiological demands characteristic of soccer, SSGs provide athletes with opportunities to perform under conditions of pressure and fatigue while simultaneously offering numerous benefits to players of all ages and performance levels (Gabbett et al., 2008; Halouani et al., 2014; Hill-Haas et al., 2011).

Furthermore, SSGs facilitate the integration of physical conditioning exercises into the overall training process while maintaining the use of the ball and preserving the sport-specific nature of training (Serra-Olivares et al., 2015). This approach transforms conditioning activities into dynamic and game-related exercises that are consistent with the demands of soccer. In addition, SSGs provide players with frequent ball contacts, allowing them to repeatedly experience and solve fundamental tactical problems encountered during gameplay. Increased involvement with the ball has been associated with higher motivation levels and prolonged active participation during training sessions (Bizati, 2016).

The ability of SSGs to simultaneously develop physical performance, technical proficiency, and decision-making skills makes them an effective strategy for optimizing training time without compromising training quality (Reilly & Gilbourne, 2003; Gamble, 2004). Beyond their time-efficient nature, the integration of physical, technical, and tactical elements within a single training format has made SSGs increasingly valuable, particularly for amateur and semi-professional players who often face limited training schedules (Castellano et al., 2013).

Little (2009) identified several advantages of SSGs over traditional training methods, including enhanced motivation, improved movement efficiency, increased tactical awareness, refinement of technical skills, a balanced relationship between training duration and physical load, and a reduced risk of injury. Considering these benefits, coaches frequently employ SSGs to recreate the physical, technical, and tactical demands experienced during competition (Aguiar et al., 2012). Supporting this perspective, Castillo et al. (2020b) investigated the relationship between SSG participation and physical performance across different age groups and reported a particularly strong association among young athletes.

The implementation of SSGs during training sessions can lead to variations in acute physiological responses (Hill-Haas et al., 2009). Consequently, even when players perform similar tasks, their physiological responses may differ considerably (Clemente, 2016). Moreover, modifying specific SSG variables enables coaches to increase or decrease training intensity according to desired objectives (Little, 2009). Therefore, when designing SSG-based training programs, coaches should consider players' physiological, physical, technical, and tactical requirements. In addition, the dimensions of the playing area should be adjusted according to the intended training outcomes and objectives established by the coaching staff (Kaya & Gürol, 2021).

Given the growing body of research on SSGs, a comprehensive examination of the scientific literature is warranted. Therefore, the purpose of the present study was to investigate academic publications related to small-sided games in soccer training through bibliometric methods, identify major scientific trends in the field, and provide a comprehensive overview of the characteristics of existing research. To achieve this objective, publications indexed in the Web of Science (WoS) database that met the predefined inclusion criteria were analyzed. Specifically, the study sought to address the following research questions:

- What is the quantitative distribution of publications according to publication year and language?
- What are the characteristics of the co-authorship network within the literature?
- What is the structure of the author citation network?
- What are the characteristics of the country-based citation network?
- What are the dominant patterns revealed through keyword co-occurrence analysis?
- What is the structure of the author co-citation network?

Material and Methods

Research Design

This study was conducted within the framework of a qualitative research design based on the document analysis method and employed bibliometric analysis techniques to examine the scientific literature on SSGs in soccer training. The Web of Science (WoS) database served as the sole source of data collection. In accordance with the predefined search criteria, all relevant records published between 2016 and 2026 were retrieved from the WoS database, yielding a total of 1,073 publications.

Following the data collection process, the exported bibliographic records were analyzed using Microsoft Excel and VOSviewer software (version 1.6.20). The analyses were performed to identify publication trends, scientific collaboration patterns, and the intellectual structure of the SSG literature. To achieve these objectives, five principal bibliometric analyses were conducted.

Co-authorship analysis was employed to identify patterns of academic collaboration among researchers. Author and country citation analyses were performed to evaluate the scientific impact and influence of individual authors and countries within the field. Keyword co-occurrence analysis was utilized to determine the dominant thematic areas and emerging research trends. Finally, author co-citation analysis was conducted to explore the theoretical foundations and intellectual structure underpinning the literature on small-sided games in soccer training.

Data Collection

The data collection process was conducted on March 19, 2026, using the “All Fields” search function within the Web of Science (WoS) database. The search strategy was specifically designed to identify scientific publications focusing on SSGs in soccer training through the use of topic-related English keywords. To ensure the inclusion of relevant studies and improve data consistency, a series of predefined filtering criteria were applied.

The search query was formulated as follows: ("soccer" OR "football") AND ("small-sided games" OR "small sided games" OR "SSG").

The initial search yielded a total of 1,485 records published between 1995 and 2026. To enhance the currency and homogeneity of the dataset, the publication period was restricted to the most recent ten-year interval (2016–2026), reducing the number of records to 1,126. Subsequently, the document type was limited exclusively to “articles”, thereby excluding reviews, conference proceedings, book chapters, and other publication formats

from the analysis. Following the application of these inclusion criteria, a final dataset consisting of 1,073 articles was obtained.

For data exportation, the "Export" function available within the WoS interface was utilized, and the "Plain Text" file format was selected. During the export procedure, all identified records were included, and the option "Full Record and Cited References" was chosen under the record content settings. Once the export process was completed, the bibliographic records were downloaded and prepared for subsequent bibliometric analyses.

In the data analysis phase, descriptive statistics were calculated using Microsoft Excel, whereas advanced bibliometric mapping and network visualizations were generated using VOSviewer software (version 1.6.20). To explore the intellectual structure, thematic orientations, publication trends, and international collaboration patterns within the SSG literature, several bibliometric networks were constructed and visualized, including co-authorship networks, author citation networks, country citation networks, keyword co-occurrence networks, and author co-citation networks.

Data Analysis

The data analysis process was carried out in two stages to organize descriptive statistics and map advanced bibliometric relationships within the literature. In the first stage, descriptive analyses of the retrieved publications were conducted using Microsoft Excel. Frequency and percentage calculations were performed to determine the distribution of publications by year and publication language. In the second stage, VOSviewer software (version 1.6.20) was employed to perform bibliometric network analyses and generate visual representations of the scientific literature. Bibliographic records exported from the WoS database in "Plain Text" format with the "Full Record and Cited References" option selected were imported into VOSviewer for further analysis. The bibliometric mapping procedure followed several sequential steps within the VOSviewer interface. First, the "Create" option was selected from the main menu, followed by the command "Create a map based on bibliographic data." Subsequently, Web of Science was specified as the data source, and the downloaded bibliographic files were uploaded to the software. To enhance analytical accuracy and reduce data inconsistencies, a thesaurus file was incorporated during the network construction process. This procedure enabled the consolidation of synonymous terms and alternative spellings (e.g., "SSG" and "Small-Sided Games"), thereby minimizing conceptual ambiguity and improving the reliability of the generated networks. All analyses were conducted using the Full Counting method, which assigns equal weight to each occurrence and directly reflects the contribution of individual units within the network. Threshold values for inclusion in the analyses were applied according to the minimum and maximum criteria automatically determined by VOSviewer. Consistent with the objectives of the study, a series of bibliometric analyses were performed to investigate the intellectual structure, thematic orientations, publication trends, and international collaboration patterns within the small-sided games literature. Specifically, co-authorship analysis, author citation analysis, country citation analysis, keyword co-occurrence analysis, and author co-citation analysis were conducted, and the resulting scientific network maps were visualized and interpreted.

Results

To provide an overview of the general characteristics of the dataset, descriptive statistical analyses were conducted. The chronological distribution of publications, illustrating the development of the literature over time, is presented in Figure 1, while the

distribution of publication languages and their relative proportions are reported in Table 1. In addition to the descriptive findings, several bibliometric network analyses were performed to explore the scientific structure of the SSGs literature. The co-authorship analysis, which identifies patterns of collaboration among researchers, is presented in Figure 2. The author citation analysis, conducted to evaluate the scientific influence and impact of individual authors within the field, is illustrated in Figure 3. The country citation analysis, aimed at identifying the geographical distribution of scientific contributions and the most influential countries, is shown in Figure 4. The keyword co-occurrence analysis, which reveals the major thematic areas and emerging research trends, is presented in Figure 5. Finally, the author co-citation analysis, conducted to examine the intellectual foundations and theoretical structure of the field by identifying the most influential scholars, is visualized in Figure 6.

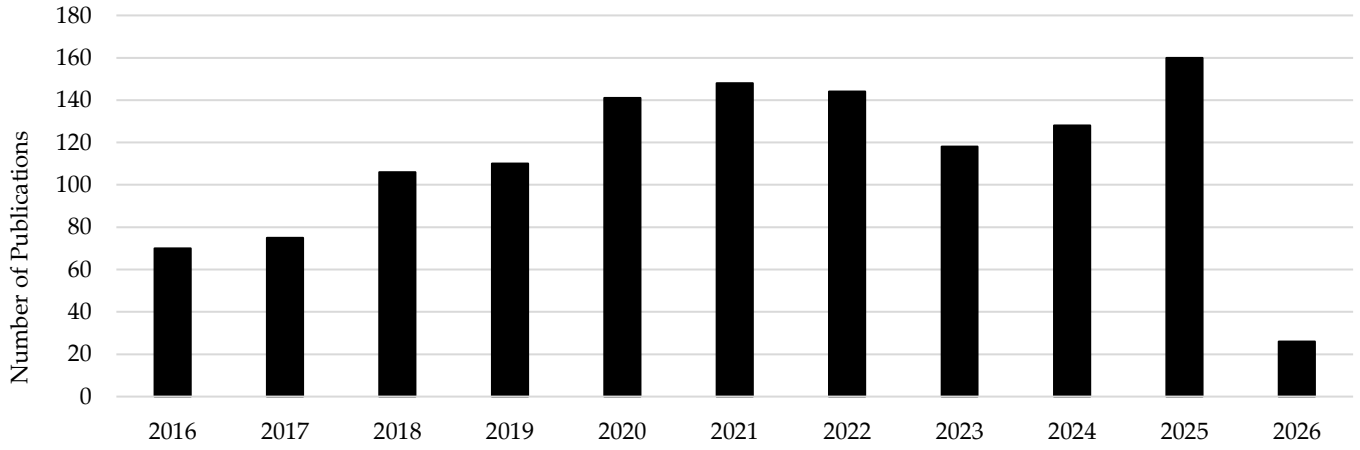

Figure 1. Distribution of publications by year

An examination of the publication distribution between 2016 and 2026 reveals fluctuations in the annual number of publications throughout the study period. Publication output was relatively low in 2016 and 2017, whereas a noticeable increase emerged beginning in 2018. The number of publications remained particularly high during the period from 2020 to 2022, indicating a substantial growth in scientific interest in small-sided games within soccer training. A decline was observed in 2023; however, publication output increased again in 2024 and continued to rise in 2025, which recorded the highest number of publications during the analyzed period. It should be noted that the data for 2026 represent only the publications indexed up to March 2026, the date on which the database search was conducted.

Table 1. Distribution of publications by language.

Publication Language	Number of Publications (n)	Percentage (%)
English	1004	93.57
Spanish	51	4.75
Portuguese	13	1.21
German	5	0.47
Total	1073	100.00

As presented in Table 2, English was the predominant publication language, accounting for 1,004 publications (93.57%) of the studies included in the analysis. English-language publications were followed by Spanish with 51 publications (4.75%), Portuguese

with 13 publications (1.21%), and German with 5 publications (0.47%). These findings demonstrate the overwhelming dominance of English as the primary language of scientific communication within the literature on small-sided games in soccer training.

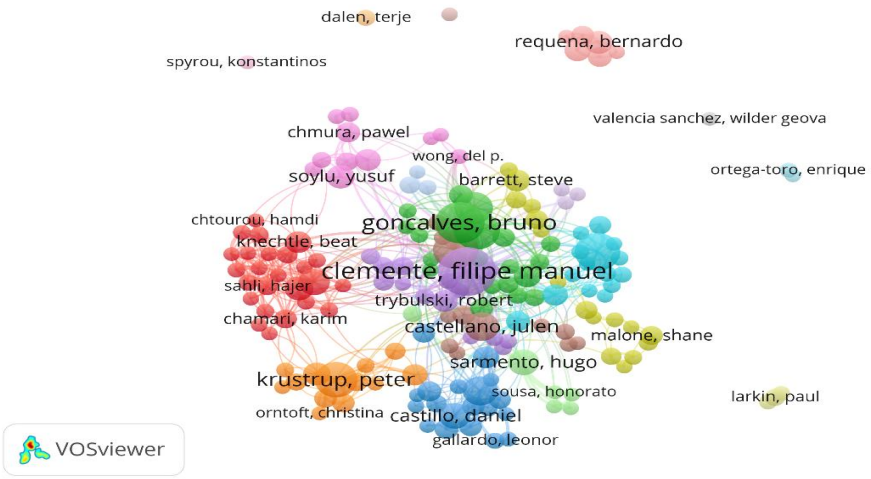

Figure 2. Co-authorship network map.

Figure 2 presents the co-authorship network within the SSGs literature, revealing the social structure of the field and highlighting prominent research groups. Filipe Manuel Clemente, Bruno Gonçalves, and Peter Krustrup, represented by the largest nodes on the map, emerge as the most central actors, establishing collaboration bridges within the literature through their extensive network connections. An examination of the network structure reveals several distinct groups characterized by close collaborative relationships surrounding these central authors. In this context, researchers such as Julen Castellano, Hugo Sarmento, Daniel Castillo, and Yusuf Soylu, who maintain close connections with Clemente and Gonçalves, form an integrated structure at the center of the network. On the other hand, scholars such as Karim Chamari, Hamdi Chtourou, Beat Knechtle, and Hajer Sahli represent another prominent collaboration cluster characterized by strong co-authorship ties among themselves. Peter Krustrup, meanwhile, occupies a position on the other side of the network, forming a distinct research group of his own.

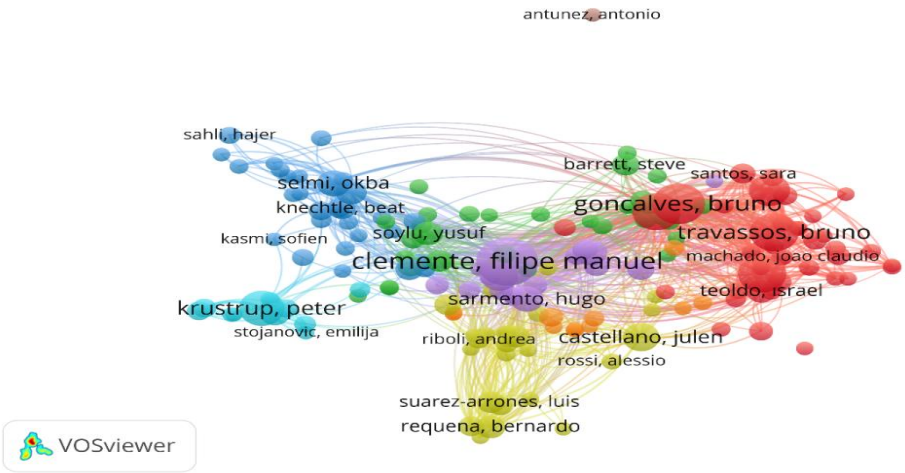

Figure 3. Author citation network map.

Figure 3 presents the author citation network within the SSGs literature, illustrating the extent of authors' scientific contributions. Filipe Manuel Clemente, Bruno Gonçalves, and Bruno Travassos, represented by the largest nodes on the map, stand out as the most central and influential actors in the literature due to their high citation counts and well-established connections. An examination of the structural characteristics of the network reveals strong research groups that are highly interconnected and frequently cited around the centrally positioned Clemente. In this context, researchers such as Hugo Sarmento, Yusuf Soylu, Julen Castellano, and Alessio Rossi form an integrated structure in the central and lower sections of the network, reinforcing one another through extensive citation relationships. On the other hand, scholars such as João Cláudio Machado and Israel Teoldo, positioned on the right side of the network together with Gonçalves and Travassos, represent another prominent reference cluster with a high level of scientific influence within the literature. Meanwhile, authors including Okba Selmi, Beat Knechtle, Hajer Sahli, and Peter Krustrup, located on the left side of the network, represent other distinct academic groups characterized by strong citation relationships among themselves.

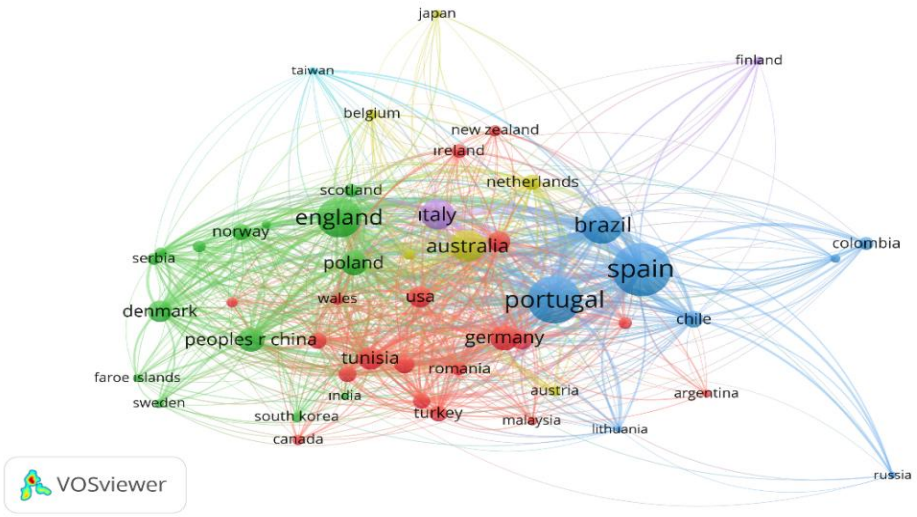

Figure 4. Country citation network map.

Figure 4 presents the country-based citation network within the SSGs literature, illustrating the geographical distribution of scientific influence and international citation relationships. The largest nodes in the network belong to Spain, Portugal, England, and Brazil, indicating that these countries have the highest citation impact and occupy central positions in the field. Spain and Portugal appear as the most prominent countries in the network, with large node sizes and dense connections to several other countries. This finding suggests that these countries play a leading role in the development and dissemination of research on small-sided games in soccer training. England also represents a major contributor, forming strong citation links with European countries such as Norway, Denmark, Scotland, Poland, and Belgium. Brazil, positioned close to Spain and Portugal, reflects another influential research hub, particularly within the international citation structure. The network map also shows that countries such as Italy, Australia, Germany, Turkey, Tunisia, and the United States occupy notable positions, contributing to the broader citation network through multiple intercountry connections. In addition, countries including China, the Netherlands, Ireland, Chile, Argentina, and Colombia demonstrate varying levels of citation linkage, indicating the global expansion of SSG-related research. Overall, the country citation network reveals that the literature on small-sided games is strongly

shaped by European countries, particularly Spain, Portugal, and England, while contributions from South America, Asia, and other regions demonstrate the increasingly international character of this research field.

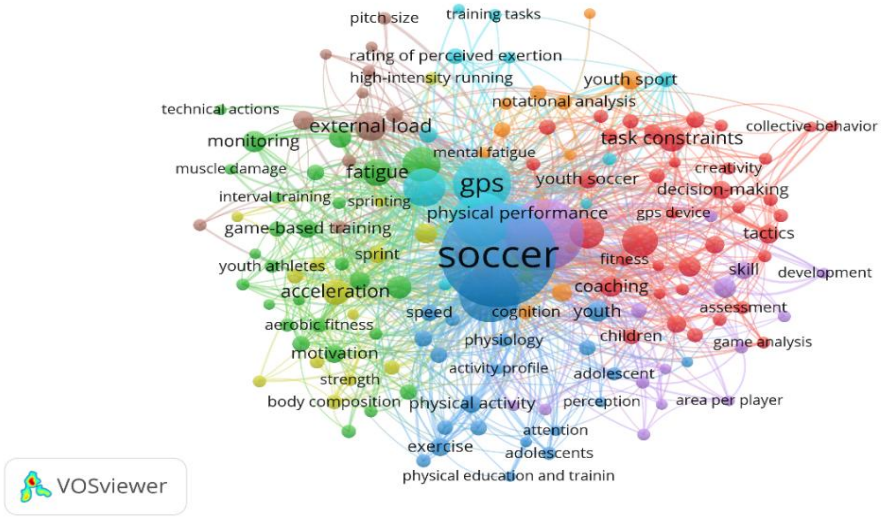

Figure 5. Keyword co-occurrence network map.

Figure 5 presents the keyword co-occurrence network within the SSGs literature, illustrating the thematic focus, conceptual structure, and current research trends of the field. The concept of "soccer," represented by the largest node and occupying the most central position in the network, emerges as the primary integrative element of the literature, connecting all major research themes through its extensive links with surrounding keywords. The upper and left sections of the network are dominated by terms such as "GPS," "physical performance," "fatigue," "external load," "acceleration," and "rating of perceived exertion," reflecting a strong research focus on the monitoring of small-sided games through technological tracking systems, the objective and subjective assessment of training loads, and the fatigue responses experienced by athletes. On the other hand, terms such as "task constraints," "tactics," "decision-making," and "skill development," which are concentrated on the right side of the network, highlight the strategic importance of constraints-based approaches, tactical awareness, and decision-making processes in game-based training environments. Keywords located in the lower section of the network, including "youth," "children," "physiology," and "cognition," indicate multidisciplinary research interests related to the developmental effects of small-sided games across different age groups, as well as their influence on cognitive processes and physiological adaptations.

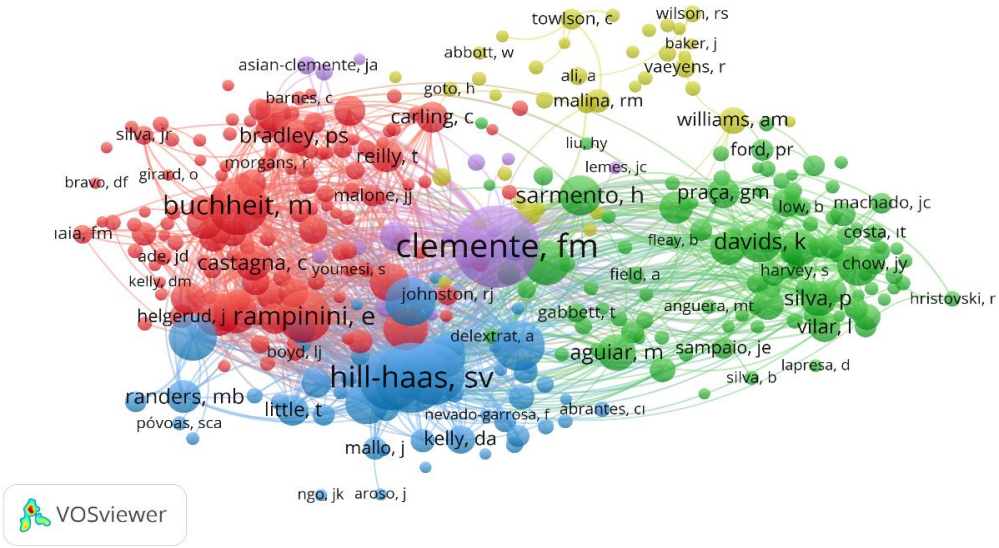

Figure 6. Author co-citation network map.

Figure 6 presents the author co-citation network within the SSGs literature, revealing the theoretical structure of the field and its principal reference sources. Filipe Manuel Clemente, Stefan V. Hill-Haas, Martin Buchheit, and Ermanno Rampinini, represented by the largest nodes at the center of the map, emerge as key bridging nodes within the network due to their numerous connections and high centrality values. An examination of the structural distribution of the network highlights several prominent author groups organized around these central researchers. In this context, authors such as Castagna, Reilly, and Bradley, clustered on the left side of the map together with Buchheit and Rampinini, form a strong reference cluster characterized by close interconnections. On the right side of the network, researchers including Sarmento, Praça, Silva, and Vilar, grouped around Keith Davids, represent another prominent author cluster distinguished by dense internal connections. Meanwhile, the authors concentrated in the lower-central region of the network under the influence of Hill-Haas exhibit a more compact structure while maintaining strong connections with the central core of the network.

Discussion

The present study aimed to comprehensively examine the trends and structural characteristics of the academic literature on SSGs, a training approach that occupies a prominent position in modern soccer training, through the application of bibliometric analysis techniques. The findings revealed a substantial increase in the number of publications related to SSGs over the past decade. This upward trend is consistent with the results reported by Martínez-Benítez et al. (2024) and suggests that SSGs have become increasingly central to contemporary training methodologies. This growth may reflect the broader transition in modern soccer from traditional, isolated, and running-based training approaches toward game-based training models designed to simultaneously develop physical, tactical, and cognitive capacities.

The predominance of English-language publications indicates that research on SSGs is largely produced and disseminated within a global scientific framework. At the same time, the presence of a considerable number of Spanish- and Portuguese-language publications supports the findings of Martínez-Benítez et al. (2024) and points to the existence

of regional concentrations of scientific activity. Consistent with this observation, the country citation analysis identified Spain and Portugal as two of the most influential countries in the field. This prominence may be attributed to the strong academic and applied traditions of soccer training science within these countries. In particular, the widespread adoption of game-based training approaches such as Tactical Periodization may have contributed to the extensive scientific output observed in these regions. Furthermore, the integration of performance-monitoring technologies, including GPS systems, into elite soccer environments has likely strengthened the relationship between practical applications and academic research.

The co-authorship network provides further insights into the developmental structure of the literature. The findings suggest that the field exhibits characteristics of a center–periphery model, in which a limited number of highly productive researchers occupy central positions while other scholars are connected around these core actors. The central roles of Filipe Manuel Clemente, Bruno Gonçalves, and Peter Krustrup indicate that the field has evolved around specific academic hubs rather than through a highly fragmented structure. While such a configuration may contribute to methodological standardization and the accumulation of scientific knowledge, it may also limit the emergence of independent research streams and alternative perspectives. Clemente (2023) emphasized the need for additional experimental studies and investigations focusing on chronic adaptations to improve the understanding of SSGs. The findings of the present study similarly suggest that although the literature has experienced rapid quantitative growth, future research may benefit from the development of more diverse and independent collaboration networks.

The author citation analysis offers valuable insights into the distribution of scientific influence and the theoretical foundations of the field. The prominent positions occupied by Filipe Manuel Clemente, Bruno Gonçalves, and Bruno Travassos are unlikely to be coincidental. These scholars have played a fundamental role in establishing methodological standards, experimental protocols, and conceptual frameworks for the design and implementation of SSGs. Consequently, researchers conducting empirical studies in this area frequently rely on their work as key reference sources. The concentration of citations around these influential authors suggests that the literature has achieved a considerable degree of academic standardization rather than developing as a fragmented collection of independent studies.

The keyword co-occurrence analysis revealed that terms such as soccer, GPS, physical performance, fatigue, and external load frequently appear together, indicating a growing emphasis on technology-driven performance monitoring within soccer science. These findings suggest that SSGs are increasingly viewed not only as game-based training methods but also as measurable interventions evaluated through objective performance outcomes. The widespread adoption of technological tracking systems has enabled researchers to investigate the physiological and workload responses associated with different SSG formats in greater detail, thereby supporting more systematic approaches to training design and load management. At the same time, the prominence of terms such as decision-making and tactics highlights the recognition of SSGs as tools for developing tactical awareness and cognitive performance in addition to physical fitness.

The author co-citation analysis further demonstrates that the methodological framework and training standards within the SSG literature have been shaped by a relatively small group of foundational scholars. The frequent co-occurrence of the same key

references across numerous studies indicates that issues such as pitch dimensions, player numbers, task constraints, and training design are generally examined within a shared conceptual framework. This finding suggests that the literature has developed around a globally recognized body of knowledge concerning training planning, load monitoring, and tactical applications rather than through disconnected lines of inquiry. Consequently, the co-citation findings support the interpretation that the field possesses a high degree of theoretical coherence and intellectual integration.

Despite its contributions, this study has several limitations that should be acknowledged. First, the search strategy was constructed exclusively using English-language keywords, which may have limited the inclusion of relevant studies published in other languages. Second, the dataset was derived solely from the Web of Science database, potentially excluding relevant publications indexed in other databases. Third, only article-type publications were included in the analysis, while reviews, conference proceedings, book chapters, and other document types were excluded. Finally, the study was restricted to publications published between 2016 and 2026. Future bibliometric investigations could provide a more comprehensive understanding of the field by incorporating multiple databases, multilingual search strategies, additional publication types, and broader temporal coverage.

Conclusions

This study examined the literature on SSGs in soccer through the analysis of 1,073 publications and revealed the scientific development and structural integrity of the field. The findings indicate that, unlike traditional and one-dimensional conditioning methods, SSGs constitute a multidimensional and dynamic training approach that simultaneously develops technical skills, tactical abilities, physical performance, and decision-making processes. Network analyses demonstrated that scientific production is concentrated around specific European countries and leading groups of researchers, highlighting the need for more balanced and multi-centered international collaborations within the field. From a practical perspective, the findings emphasize that SSG designs should be considered not only as a means of physical conditioning but also as a strategic training model that enhances players' in-game decision-making, cognitive load management, and tactical adaptability. In conclusion, this study systematically examines the developmental trajectory and current trends of the SSG literature, thereby clarifying the existing body of knowledge and providing a guiding framework for future research by identifying themes that warrant further investigation.

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Informed Consent Statement: This study did not involve human participants requiring informed consent.

Conflict of Interest: The authors declare no conflict of interest related to this study.

Data Availability Statement: The data analyzed in this study were obtained from the Web of Science database. The raw data can be accessed through the relevant database.

Artificial Intelligence (AI) Usage Disclosure: During the preparation of this manuscript, the author(s) used the Google Gemini (Google) artificial intelligence tool to resolve technical issues encountered during the use of the VOSviewer software and for language editing and proofreading purposes. Artificial intelligence was not used for scientific content generation, data analysis, interpretation of results, or the production of original academic insights. All scientific content and academic contributions presented in this manuscript are entirely the work of the authors.

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