

A comprehensive bibliometric analysis of small-sided games in soccer: 20 years (2003–2023) of scientific exploration

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Abstract:

Introduction. Soccer as a sport has undergone thorough examination across various fields of knowledge. Notably, the exploration of small-sided games has emerged as a prominent and captivating subject of study, garnering increased attention in contemporary scientific discourse. **Objective.** The aim of this study was to conduct a bibliometric study on the scientific output pertaining to small-sided games in soccer from 2003 to 2023. This examination was carried out by evaluating the comprehensive dataset available in the Scopus database. **Methodology.** The descriptive bibliometric analysis of scientific production considered various key indicators for each document, encompassing: 1) database source; 2) document type; 3) publication year; 4) author names; 5) knowledge domain; 6) journal names; 7) journal country; 8) publication count; 9) quartile ranking; 10) Index; 11) SCI index; 12) citations; 13) average citations per article; 14) documents per institutional affiliation; 15) documents per country/territory; and 16) document count per language. To perform this comprehensive analysis, MeSH terms such as "Soccer" and "Small sided games" were employed in the search utilizing the query ("Small AND Sided AND Games AND Soccer"). The search yielded a total of 714 documents. Employing the VOSviewer program, co-occurrence maps were generated to visualize keyword relationship and co-authorship-patterns within the dataset. **Results.** The findings indicate that the predominant form of output is research articles (91.0%), followed by review articles (5.7%). Examining the publication timeline revealed a consistent upward trend in scientific output since 2011 peaking in 2022 with 196 documents. Leading contributors to this body of work include Clemente, F.M. (10.084%), Praça, G.M. (5.462%) and Gonçalves, B. (4.902%). In terms of subject areas, the majority of production is concentrated in Medicine (73.94%) and Health Professions (69.88%). Key journals driving publication and impact include the Journal of Strength and Conditioning Research (64 papers, 3374 citations), Journal of Human Kinetics (37 papers, 1066 citations), and the Journal of Sports Sciences (34 papers, 2795 citations). These journals fall within the Q1 quartile in terms of citations. The Centro de Investigação em Desporto, Saúde e Desenvolvimento Humano emerged as the leading institution contributing 10.92% of the research with an impressive 78 papers. Notably, English overwhelmingly dominates the language landscape, encompassing 95.09% of the scientific production. **Conclusions.** Small-Sided Games have become instrumental in exploring diverse adaptations related to the technical–tactical, physical, and physiological demands of soccer, highlighting that the number of studies has been increasing over the years, sports science stands out as a pivotal driver, playing a crucial role in shaping the design and planning processes for sports preparation across various levels and categories in soccer.

Key Words: soccer, sport, sports science, small-sided-games, evaluation.

Introduction

Soccer, like other sports, has evolved according to sport sciences, developing training programs and methods that help technical staff to design planning processes in search of a significant improvement of athletes, always prioritizing situations of specificity and dynamics of the sport being practiced (Davids et al., 2013; Becerra-Patiño, Sarria-Lozano & Prada-Clavijo, 2022; Becerra-Patiño & Escorcía-Clavijo, 2023; Ospina León et al., 2023). This is why, at the end of the 1990s, with the research proposal entitled "Carbohydrate intake and multiple sprint sports: With special reference to football (soccer)" developed by Balsom, Wood, & Ekblom (1999) began to address the issue of "reduced games" in a simple way and without much depth, exposing the energy demands that these involve, showing that in a soccer match with modified times and sizes of the goals, in addition to the dimensions of the field and the size of the field, the energy intake of the players is also modified, in addition to the significantly smaller field dimensions (33 m x 20 m) the players require a high carbohydrate supplementation, due to the amount of intermittent and high intensity actions associated with glycolytic metabolism and other actions characteristic of soccer (sprints, jumps, accelerations, decelerations) (Silva et al. , 2023).

Thus, research began to investigate this topic of small-sided games (SSG) in soccer, and, as a result, the exponential increase of this subject of study in recent years. However, it was not until years later that the term known today as SSG was introduced, implemented by Arnett & Lutz (2003) where they mention that by means of SSG in two different sports (soccer and field hockey) the physical activity levels of the participants went from low to moderate and high during more than 56% of the session time. These measurements were performed by means of a TriTrac R3D (triaxial accelerometer) where the intraclass correlation coefficient (ICC) revealed consistent results (soccer and field hockey, $R = 0.84$) and between the lessons of each sport (soccer, $R = 0.87$; field hockey, $R = 0.85$).

Therefore, research proposals related to SSGs in soccer have two main approaches: i) the incidence of SSGs on physical abilities and physiological adaptations that are generated from the very nature of SSGs and ii) the technical-tactical elements and the benefits in the cognitive, participatory and decisional component due to the conditioning (constraints) of SSGs (Casamichana, Castellano & Castagna, 2012; Casamichana, Bradley & Castellano, 2018; Pinca et al., 2021; Pa'ò, Nagy & Vanderka, 2023). Thus, research proposals show by means of biomarkers such as blood lactate and heart rate (measurement of internal training load) and GPS (measurement of external training load) that SSGs with a duration of 30 seconds are characterized by a higher training intensity and are more physiologically demanding than SSGs with a duration of 45 seconds, and, at the same time evidence an increase in training volume with a decrease in intensity (Kryściak et al., 2023). In another way, there is also the possibility of an integration of other training methods on par with SSG, as shown in the study developed by Nobari et al. (2023) where there is a combination of High-intensity interval training (HIIT) with SSG, also a combination of repeated sprint training (RST) with SSG, resulting in significant improvements in body composition, sprint, COD and vertical jump, improvements that have also been evidenced in other studies (Barba et al., 2020; Da Costa et al., 2023).

Because of the above, there are also proposals that relate physical variables in (female) soccer players with their tactical responses, approaching the SSG as a pedagogical tool that helps coaches to solve tactical problems with the specific demands of the game (Trombiero et al., 2023). However, there are questions about how creative soccer players can be, which has allowed them to refer how SSG constraints lead to changes in information from the living environment, consequently, guiding players towards more adaptive and unpredictable movement patterns, likewise, manipulation of constraints (size and time) creates limitations in the exploration of certain action possibilities (movements with and without ball), thus, contributing to consolidate creative components and consequently, the promotion of imagination and resolution of athletes at various ages (Caso & Van der Kamp, 2020; Canton et al., 2021; Santos et al., 2023). On the other hand, SSGs in soccer have also been addressed through systematic reviews (De Dios-Alvarez et al., 2022; Sarmento et al., 2018) and meta-analyses (Clemente et al., 2021; Clemente, Afonso & Sarmento, 2021). There, studies aimed at analyzing the effects of SSGs by quantitative synthesis of high-speed running, very high-speed running, sprinting and associated intra-individual reliability during soccer matches have been developed (Dello-Iacono et al., 2023). In the conditional component, it seems to require a higher physical demand, based on heart rate (HR), the technical-tactical performance indicates that the number of erroneous passes and lost balls tend to be higher, the SSGs suggest that soccer players need to make different tactical decisions to achieve a goal or task, as there are different ways to achieve it.

The use of these different approaches seems to promote alternatives for coaches to develop important skills in planning processes in soccer training (Maia-Junior et al., 2023; Clemente & Sarmento, 2020; Clemente et al., 2020; Dello-Iacono et al., 2023), highlighting useful information on the technical, physical and physiological interactions in SSG and how the manipulation of these types of variables can improve the soccer training process focused on the female gender, suggesting that the topic should be deepened, emphasizing the differences and specific needs that attend women's soccer and SSG (De Dios-Álvarez et al., 2022; Becerra-Patiño, Sarria-Lozano & Palomino, 2023; Becerra-Patiño & Escorcía-Clavijo, 2023b; Becerra-Patiño et al., 2023). The effects of SSG on sand and artificial surfaces have also been studied, evidencing that use of sand can be considered complementary to traditional turf soccer training, exclusively, when the training objective is to stimulate muscular strength of the lower extremities. However, this training is not suggested if maximum speeds are desired (Rago, Pizzuto, & Barreira, 2018). There are even research proposals on the effects of total quality of recovery, well-being (sleep during the previous night, stress, fatigue and delayed onset muscle soreness-DOMS), perceived exertion (RPE) and physical enjoyment during reduced SSG soccer matches, evidencing that indices such as sleep, stress, fatigue and DOMS can be used to give information to coaches and physical trainers about the recovery and well-being of their players. The use of tools such as questionnaires during and after exercise or training sessions represents a useful strategy to detect emotional response and assess a positive feeling state of physical activity in SSGs (Selmia et al., 2018), added to this, research conducted with professional soccer players indicates that the use of SSGs in a standardized and regular way can help the assessment of neuromuscular fatigue (Rowell et al., 2018).

Finally, the SSG are game situations that can be adapted to multiple objectives and tasks desired by the coach, have a variety of sizes, small, medium and large, limiting the amount of square meters for each player, thus ensuring variability in the costs and fluctuation in the environment, allowing emphasis on isolated and global tasks (Castillo-Rodríguez et al., 2023), in fact, the behavior of the coach is determined by his integrative

strategies, methodological and assertive communication skills, in this way, from the motivation generated by the coach can impact on different physical and technical variables helping to achieve maximum strengths of the player, consequently, verbal encouragement is a constructive method to improve the performance of players during the SSG and improve the quality of the training process by allowing better conditional performance in training by allowing better physiological adaptations (Hammami et al., 2023).

Therefore, the aim of the present study was to examine the scientific production of SSGs in soccer in the period from 2003 to 2023, through the consideration of a bibliometric study in the Scopus database.

Methodology

The present bibliometric study is based on a descriptive and mixed-approach analysis of the scientific production on SSGs in soccer in the last twenty years (2003-2023) from the use of bibliometrics as a research technique and with the help of the Scopus databases (Salinas-Ríos & García-López, 2022; Mamani-Jilaja et al., 2023). The following MeSH terms "Soccer", "Small Sided-Games", "sports performance", and the search equations (Soccer AND Small AND Sided AND Games") in the Scopus database were used to search the documents. In addition, filters were applied to the descriptors used related to year of publication, open access documents and document types. A step-by-step process was developed for document selection based on bibliometric criteria that provide valuable information (Mazzardo et al., 2022).

The inclusion criteria took into account: 1) date of publication, between January 1, 2003 and August 20, 2023; 2) English, Spanish, Portuguese, French, German, Croatian and French; 3) that the journal is indexed in Scimago in quartiles Q1, Q2, Q3, Q4; iv) access to the full paper; v) . Papers that did not meet any of the above inclusion criteria were eliminated. Meanwhile, exclusion criteria were: 1) systematic reviews, meta-analyses or reviews of papers; 2) books, book chapters or conference proceedings; 3) undergraduate or doctoral theses; 4) in a database other than Scopus.

To select the documents, an analysis matrix was prepared in Microsoft Excel based on the following categories 1) database; 2) type of document; 3) year of publication; 4) name of authors; 5) area of knowledge; 6) name of journal; 7) country of journal; 8) number of publications; 9) Quartile; 10) H Index; 11) SCI Index; 12) citations; 13) average number of citations per published article; 14) documents by institutional affiliation; 15) documents by country/territory; 16) number of documents by language. The Scopus database yielded 714 documents that were submitted to the metadata regulation process, to eliminate documents for duplicity or for not having access to the complete document. Finally, for statistical analysis, Excel was used to generate tables and figures (frequency/percentage). The VOSviewer program was used to create co-occurrence maps based on keywords and co-authorship (Van Eck & Waltman, 2011; 2014).

Results

Regarding the type of documents, it can be seen in table one that the lowest number of documents are related to the categories: note, errata, editorial and conference review, short survey and session document, while there are 12 book chapter documents (1.7%) and 41 review articles (5.7%). Finally, the largest scientific production is shared in research article format with 650 studies (91.0%).

Table 1. Documents by type

Type	Number of publication	Percentage %
Note	1	0.1%
Erratum	1	0.1%
Editorial	1	0.1%
Conference review	1	0.1%
Short Survey	2	0.3%
Letter	2	0.3%
Conference paper	3	0.3%
Book Chapter	12	1.7%
Review	41	5.7%
Article	650	91.0%
	714	100%

In relation to the bibliometric analysis developed, figure one reveals the behavior of the scientific production of the SSG in soccer in relation to the publication period between 2003 and 2023. In total, 714 studies were collected. Thus, it can be observed that the number of publications remained low between the year of the first referenced study in 2003 until 2010 with a total of 31 studies (4.34%). Then between 2011 the number of studies increased to 17 and continued to increase until 2019. In the end, between 2011 and 2019, a total of 339 studies (47.47%) were collected. Meanwhile, in the last four years the number of studies has been increasing, reaching the maximum peak of publication in 2022 with 196 studies (27.45%).

In relation to the main author, table two shows the authors with the highest number of citations per document, taking into consideration the scientific production of published documents. It is highlighted that the

ten authors with the highest scientific production on SSG are: Clemente, F.M with 72 papers (10.084%), Praça, G.M. with 39 (5.462%), Gonçalves, B. and Krustup, P. with 35 papers each (4.902%), Sampaio, J. with 31 (4.342%), Travassos, B. (4.062%), Dellal, A. with 23 (3.221%), Sarmento, H. with 22 (3.081%), Castellano, J. with 20 (2.801%) and Casamichana, D. with 19 papers respectively (2.661%) (see table 2).

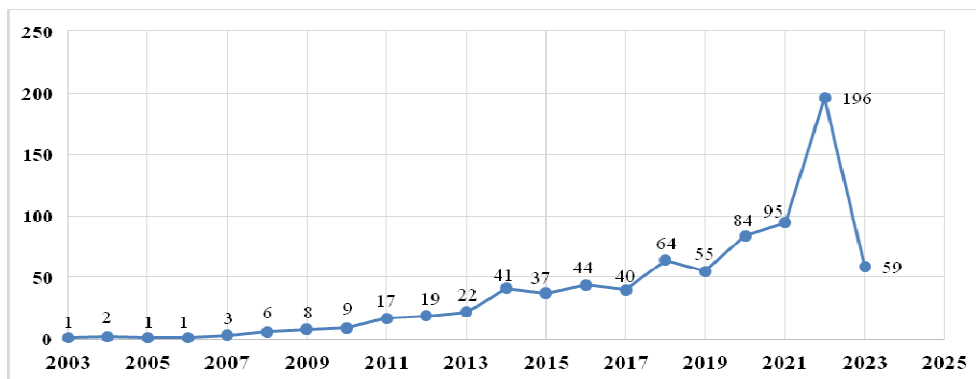


Figure 1. Number of publications per year

Table 2. Documents by author.

Author	Number of publication	Percentage %
Clemente, F.M.	72	10.084
Praça, G.M.	39	5.462
Gonçalves, B.	35	4.902
Krustup, P.	35	4.902
Sampaio, J.	31	4.342
Travassos, B.	29	4.062
Dellal, A.	23	3.221
Sarmento, H.	22	3.081
Castellano, J.	20	2.801
Casamichana, D.	19	2.661
Wong, D.P.	18	2.521
Castaña, C.	17	2.381
Castillo, D.	17	2.381
Chamari, K.	17	2.381
Coutinho, D.	17	2.381
Greco, P.J.	17	2.381
Teoldo, I.	17	2.381
Chagas, M.H.	14	1.961
Nakamura, F.Y.	14	1.961
Knechtle, B.	13	1.821
Ramirez-Campillo, R.	13	1.821
Aquino, R.	12	1.681
Coutts, A.J.	12	1.681
Randers, M.B	12	1.681
Silva, A.F.	11	1.541
Barreira, D.	10	1.401
Davids, K.	10	1.401
Garganta, J.	10	1.401
Mohr, M.	10	1.401
Raya-González, J.	10	1.401
Rosemann, T.	10	1.401
Total	606	84.874%
	31 authors	

Likewise, with regard to the relationship of authors with documents published in Scopus on the SSG in soccer, the VOSviewer program (reference) shows the compilation by citations and documents of authors with more than two citations per scientific article, and, at the same time, the map of nodes is established to recognize the relationship with other authors who have written on the same subject (see Figure 2). As a result, again the authors Clemente, F.M., Praça, G.M. Gonçalves, B. and Krustup, P. have the largest bibliometric size among the 714 documents analyzed in Scopus.

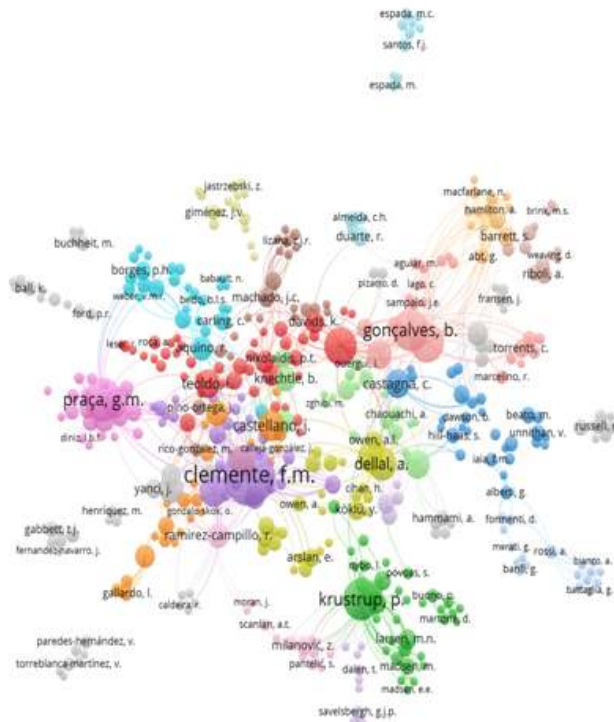


Figure 2. Node map for the relationship between the authors. Source: VOSviewer.

Regarding the thematic area, Figure 3 shows the type and area in which scientific knowledge on the SSG is being produced. Here it is revealed that, when reviewing the 11 main areas, the ones that obtain a higher percentage are medicine (73.94%) and health professional (69.88%), while, the rest of the areas have low numbers of publication.

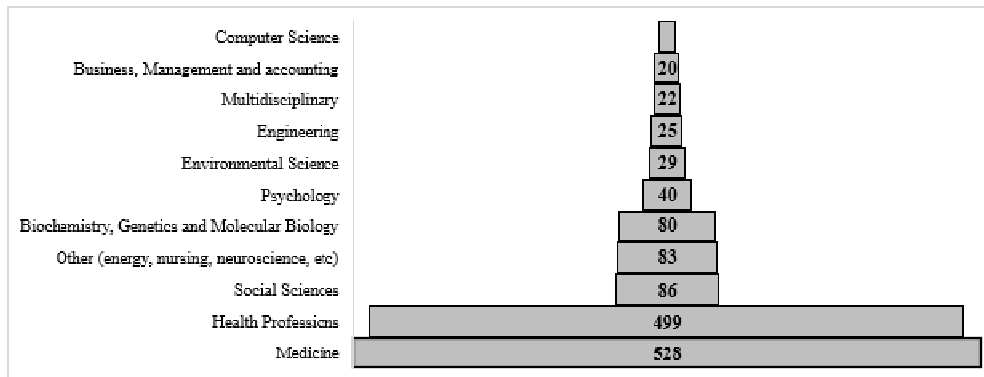


Figure 3. Total number of documents in relation to subject area

In order to establish the relationship between the name of the journals that publish scientific knowledge, the country and quartile of the same, as well as the H index, SCI index for the year 2022, the number of citations per journal and the average number of citations per published article, a table was prepared (see 3). Table 3 compiles the information corresponding to 511 of the 714 eligible documents (71.56%).

It reveals that the countries that generate the greatest scientific production on SSG and at the same time receive citations are the United Kingdom with the journals Journal of Sports Science (4.76%), International Journal of Sports Science and Coaching (3.50%) and Science and Medicine in Football (3.36%), while the second country with the greatest production is the United States with the Journal of Strength and Conditioning Research (8.96%) and International Journal of Sports Physiology and Performance (3.50%).

Among the 12 journals with the highest number of published papers are the United States with 109 (15.26%), Poland with 84 (11.76%), United Kingdom with 83 (11.62%), Switzerland with 25 (3.50%), Italy with

22 (3.08%) and, finally, Romania with 18 papers (2.52%). The journals with the highest number of citations are: Journal of Strength and Conditioning Research (3374 citations), Journal of Sports Sciences (2795 citations), Journal of Human Kinetics (1066 citations) and International Journal of Sports Medicine (1133 citations). The journals with the highest average number of citations per published article are: i) Sports Medicine with 8 papers, 883 total citations and 110.375 average citations per published article; ii) Journal of Science and Medicine in Sport with 8 papers, 846 citations and 105.750 average citations per published article and; iii) International Journal of Sports Medicine with 12 papers, 1133 total citations and 94.417 average citations per published article.

Of the 28 journals consulted, the journals with low levels of publication and average number of citations per published article are Spain with 23 documents and 187 citations, Brazil with 21 documents and 166 citations and Romania with 18 documents and 182 citations. Thus, of the 16644 citations of the 28 journals, quartile one has 12898 (77.49%), quartile two 2624 (15.76%), quartile three 930 (5.58%) and, finally, quartile four with 192 citations (1.15%).

Table 3. Total number of publications, article citations and average number of citations per published article from the first 28 journals

Journal	Country	Number of publication	Quartil	H-Index	SJR 2022	Citas	Average number of citations per published article
Journal of Strength and Conditioning Research	United States	64	Q1	151	1.3	3374	52.719
Journal of Human Kinetics	Poland	37	Q2	51	0.73	1066	28.811
Journal of Sports Sciences	United Kingdom	34	Q1	153	1.14	2795	82.206
Biology of Sport	Poland	28	Q1	38	1.48	401	14.321
International Journal of Sports Physiology and Performance	United States	25	Q1	85	1.33	951	38.040
International Journal of Environmental Research and Public Health	Switzerland	25	Q2	167	0.83	160	6.400
International Journal of Sports Science and Coaching	United Kingdom	25	Q2	38	0.63	269	10.760
Science and Medicine in Football	United Kingdom	24	Q1	22	1.23	208	8.667
Journal of Sports Medicine and Physical Fitness	Italy	22	Q3	74	0.50	381	17.318
Plos One	United States	20	Q1	404	0.89	645	32.250
Human Movement	Poland	19	Q3	21	0.37	180	9.474
Journal of Physical Education and Sport	Romania	18	Q3	32	0.31	182	10.111
Sports	Switzerland	15	Q1	33	0.88	167	11.133
International Journal of Performance Analysis in Sport	United Kingdom	15	Q1	41	0.83	392	26.133
Retos	Spain	14	Q3	24	0.34	53	3,786
Human Movement Science	Netherlands	14	Q2	100	0.64	888	63.429
International Journal of Sports Medicine	Germany	12	Q1	118	0.97	1133	94.417
Revista Brasileira de Cineantropometria E Desempenho Humano	Brazil	12	Q4	25	0.22	128	10.667
Research in Sports Medicine	United Kingdom	10	Q1	44	0.95	327	32.700
Kinesiology	Croatia	10	Q2	29	0.37	98	9.800
RICYDE: Revista Internacional de Ciencias del Deporte	Spain	9	Q3	22	0.35	134	14.889
Proceedings of the							

Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology	United Kingdom	9	Q4	23	0.31	26	2.889
Motriz. Revista de Educacao Fisica	Brazil	9	Q4	19	0.22	38	4.222
Frontiers in Psychology	Switzerland	9	Q2	157	0.89	143	15.889
Sports Medicine	Switzerland	8	Q1	213	3.29	883	110.375
Scandinavian Journal of Medicine and Science in Sports	Denmark	8	Q1	132	1.13	189	23.625
Journal of Science and Medicine in Sport	Netherlands	8	Q1	117	1.32	846	105.750
European Journal of Sport Science	United Kingdom	8	Q1	73	1.09	587	73.375
Total	28 Journal	511	Q1 14	Q2 6	Q3 5	Q4 3	16644

In reference to institutional affiliation and the relationship between institution, number of publication and percentage it is found in Figure 4 that those with the highest scientific production on SSG in soccer are: Centro de Investigação em Desporto, Saúde e Desenvolvimento Humano with 78 papers (10.92%), Instituto Politécnico de Viana do Castelo with 72 papers (10.08%), Instituto de Telecomunicações with 58 (8.12%), Universidade Federal de Minas Gerais with 51 (7.14%), Universidade do Pais Vasco with 45 (6.30%), Universidade da Beira Interior with 36 (5.04%), Universidade do Porto with 35 (4.90%), University of Trás-os-Montes and Alto Douro with 34 (4.76%), Universidade de Coimbra with 30 (4.20%) and Universidade Federal de Vicosa with 29 papers (4.06%).

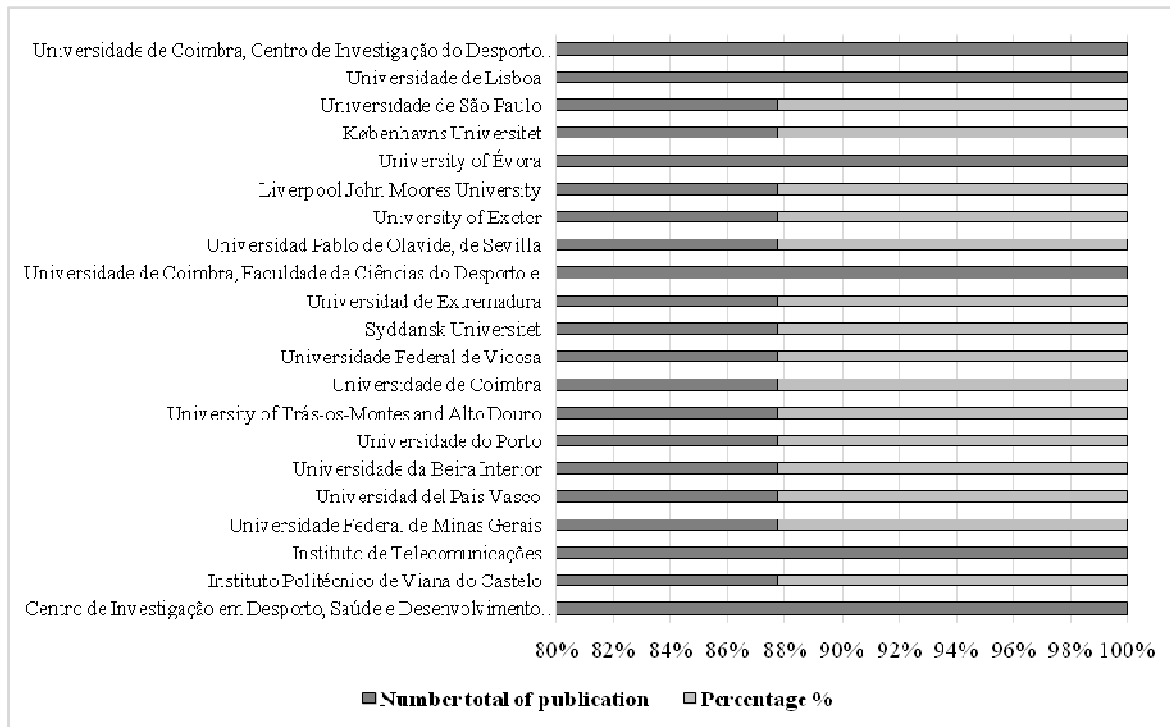


Figure 4. Documents by affiliation. Comparison of the document count in the first 21 affiliations

In reference to the country or territory, Figure 5 shows that the countries that report the greatest amount of production are Portugal (189), Spain (183), United Kingdom (128), Brazil (124), Australia (72), Italy (67), France (51) and Tunisia (43).

Similarly, the analysis by country/territory in figure three reveals the research trends, in which it is determined that of the top eight countries/territories, there are five for the European continent and one each for the North American, South American, African, Asian and Oceanian continents.

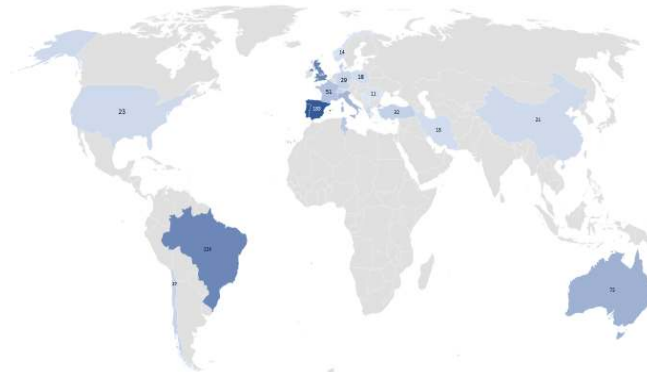


Figure 5. Number of documents per country/territory. Source: Bing.

Table 4 shows the number of documents by language, highlighting that the largest production is in English (95.09%), followed by Spanish (3.64%). Thus, of the 714 studies analyzed, only 35 documents do not correspond to the English language. This indicates that the specialized literature on the study of SSG in soccer has a preference for English, which leads to centralizing research and concentrating all efforts to continue publishing in that language.

Table 4. Number of documents per language

Language	Number of publication	Percentage %
English	679	95.09%
Spanish	26	3.64%
Portuguese	5	0.70%
French	2	0.28%
German	1	0.14%
Croatian	1	0.14%
Total	714	100%

Finally, for the analysis of the node map for the co-occurrence relationship between the different keywords related to SSGs and soccer, the minimum number of occurrences of a keyword was taken to be three. Thus, of the 2959 keywords, 686 met the threshold by analysis in the VOSviewer program (Van Eck & Waltman, 2020). Against the most important analysis for the study of SSGs in soccer were: soccer, physiology, male, heart rate, adult, human experiment, team sports, physical fitness and performance. In sum, many of the most commonly used keywords are related to the physical and performance characteristics associated with the game and, in turn, are related to other concepts used such as oxygen consumption, acceleration, physical conditioning human, physical exertion, velocity and fatigue.

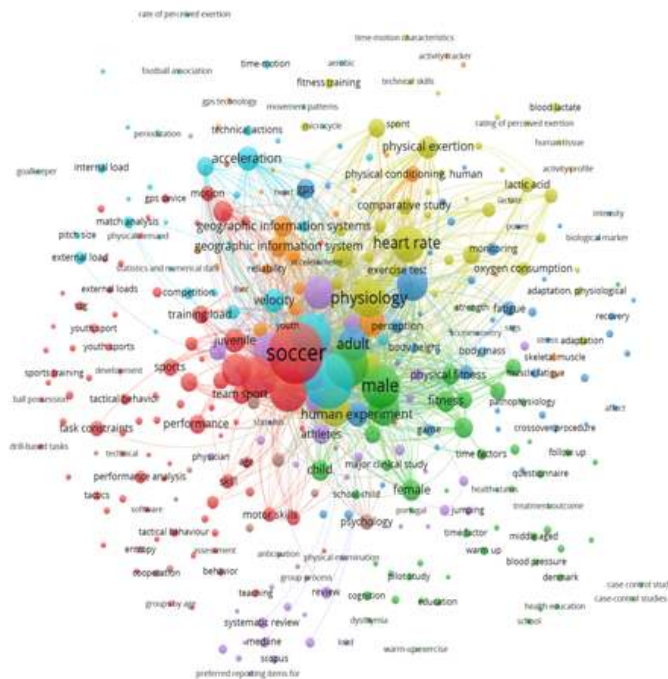


Figure 6. Node map for the co-occurrence relationship between the different keywords. Source: VOSviewer

Conclusions

Initially, the scientific production related to SSG and soccer reveal that there is a considerable increase in scientific production in the 20 years that were analyzed, revealing that the year 2022 is the most productive with 196 investigations. As a consequence of this research interest, knowledge is produced that allows understanding the needs of soccer as an object of study. Each of the scientific advances has provided quality information, and, with it, seeks to favor the processes of general and specific sports preparation, related to the improvement of sports performance.

This bibliometric study examined the global trends in scientific production on SSG in soccer between 2003-2023. The analysis revealed a gradual increase in the number of studies per year, authors researching the topic and types of papers until 2013 with 22 papers, then there is an increase in the year 2014 there is an increase of 93.18, an increase of 95.45% in the year 2020 and an increase of more than 100% in the year 2022 with 196 published papers. All this, indicates that there is a growing interest in SSG research in soccer in all its categories and levels. Journals associated with the countries of the United States, United Kingdom, Poland, Switzerland, Spain, Italy, Holland and Romania are the most prominent in the production of knowledge on SSG and soccer, being the journals *Journal of Strength and Conditioning Research*, *Journal of Human Kinetics*, *Journal of Sports Sciences*, *Biology of Sport*, *International Journal of Sports Physiology and Performance* and *International Journal of Environmental Research and Public Health* the ones that played a prominent role in scientific production and, all these journals are ranked within the Q1 and Q2 quartiles. Key authors such as Clemente, F.M., Praça, G.M., Gonçalves, B., Krstrup, P., Sampaio, J. & Travassos, B. contributed significantly to the study of the subject.

The results of this bibliometric study show a high scientific production in the last 20 years and, after analyzing the 21 main institutions, it is detailed that the three institutions with the highest production are the Centro de Investigação em Desporto, Saúde e Desenvolvimento Humano, Instituto Politécnico de Viana do Castelo and Instituto de Telecomunicações, where all these institutions are located in Portugal. The analysis by country/territory of the institutions reveals that the continents that produce the most knowledge are Europe, South America, Oceania and Africa.

Within the areas of knowledge that study the SSG and their relationship with soccer, it reveals that, of the 11 main areas, most of the studies are focused on medicine and health professionals, with very few studies framed within the multidisciplinary, which would indicate the need to continue researching this type of topics from the integration of multiple knowledge related to soccer such as physiotherapy, psychology, nutrition, among others. The results of this study highlight the universal and international scope of knowledge production and, at the same time, reveal the research interest to continue understanding processes related to physical capacities, morphological characteristics, adaptive processes and technical-tactical variables associated with decision making. In relation to the analysis carried out with the VOSviewer program, in which the publications were compiled by keyword matching, the most used words in the study of SSG in soccer are associated with physical characteristics, sports performance and training.

The present study has shown that there is a high number of papers that have studied the relationship between plyometrics and sport, including research and/or popular science articles, review articles and book chapters, according to the analysis of the Scopus database. This may help researchers to recognize areas where research on plyometrics and sport is needed. Finally, this research is a valuable contribution to recognize the importance of plyometrics in sport, highlighting the need to continue researching and analyzing the different effects produced by its development in the different sport and athlete specific capacities.

Limitations

The main limitations of the study are focused on not recognizing the totality of authors, institutions and thematic areas related to the SSG and soccer. This is due to the research group's criterion of prioritizing the generality of the findings and highlighting those who have developed the most research. For future studies related to bibliometric analysis, a qualitative analysis could be explored that relates the key words of the titles, objectives and main conclusions of each study.

With the conclusions of the present study, it becomes evident the need to conduct research that reveals the effects of SSG in other collective sports and seeking to impact other capabilities and characteristics not only related to the area of medicine. There, it is necessary to study the other effects produced by SSG interventions at different ages and in longitudinal studies that help to understand the changes that the player goes through when learning to play.

The main limitation of the present study is associated with not recognizing important variables of the studies on SSG, such as the intervention times of the training programs, the dependent and independent variables, the dimension of the space, the game times, among other characteristics associated with the proposals of each study. Likewise, the results found allow the researchers to recognize the research possibilities of the SSG in relation to soccer and, in the same way, to seek to decentralize the research in search of other contexts, countries, institutions, sports, population samples and capacities to be related.

Future perspectives and practical applications

Given the future prospects of studies focused on evaluating, identifying and recognizing the effects of SSG in soccer, there is a need to conduct a greater number of experimental studies in women's soccer and infant-juvenile soccer, in which the different psychological, emotional and psychosocial characteristics of individuals are related, as well as the motor skills and abilities to establish relationships between the developments achieved by these same skills and abilities in response to the stages of training in soccer. Likewise, it is necessary to recognize that male soccer and at the elite level is where most studies are focused, and this same phenomenon would be interesting if it were replicated in studies that evaluate male and female athletes in the same research that respond to the same context. This opens the possibility of broadening academic interests, to respond to the needs of sport sciences by recognizing other capacities inherent to the development and use of SSG in soccer, in relation to interest in practice, variation in decision-making, creativity and imagination, processes necessary for the development of the game.

Finally, the academic community is invited to continue developing this type of studies focused on recognizing the effect of the SSG in soccer, seeking to relate it to other nutritional, psychosocial, psychological and hormonal characteristics of the population samples and the needs evidenced by each context.

Conflicts of interest

The authors have no conflict of interest

References

- Arnett, M., & Lutz, R. (2003). Measurement of moderate to vigorous physical activity of middle school girls, using TriTrac activity monitors during small-sided, game-based lessons. *Measurement in Physical Education and Exercise Science*, 7(3), 149-159 https://doi.org/10.1207/S15327841MPEE0703_02
- Balsom, P., Wood, K., & Ekblom, B. (1999). Carbohydrate intake and multiple sprint sports: with special reference to football (soccer). *Int J Sports Med*, 20(1), 48-52 <https://doi.org/10.1055/s-2007-971091>
- Barba, F., Iturriaga, F. M., Borges-Hernández, P. J., Ruiz-Lara, E., & Perdomo, A. (2020). Effect of training in SSG on the ability to repeat sprints in young football players. *Journal of Physical Education and Sport*, 20(4), 1783-1790 <https://doi.org/10.7752/jpes.2020.04242>
- Becerra Patiño, B. A., Sarria Lozano, J. C., & Prada Clavijo, J. F. (2022). Morphofunctional characteristics by position in U-15 female soccer players from Bogota. *Retos*, 45, 381-389. <https://doi.org/10.47197/retos.v45i0.91167>
- Becerra-Patiño, B., Sarria-Lozano, J., & Palomino, F. (2023). Characterization of variables associated with sports performance: interdisciplinarity in women's soccer in Colombia. *Journal of Physical Education and Sport*, 23(1), 76-85. doi:10.7752/jpes.2023.01009
- Becerra Patiño, B. A., & Escorcía-Clavijo, J. B. (2023a). The transfer and dissemination of knowledge in sports training: a scoping review. *Retos*, 50, 79-90. <https://doi.org/10.47197/retos.v50.99163>.
- Becerra-Patiño, B., & Escorcía-Clavijo, J. (2023b). Effect of relative age in the FIFA Women's World Cup U-20 and senior elite categories: differences in playing positions and obtained results. *Journal of Physical Education and Sport*, 23(3), 613-621. doi:10.7752/jpes.2023.03076
- Becerra-Patiño, B., Paucar-Urbe, J., Martínez-Benítez, C., Ávila-Martínez, J., & Sarria-Lozano, J. (2023). Analysis of physical variables as an indicator of performance in a sample of Colombian women's soccer players: influence of being a starter and a non-starter. *Journal of Physical Education and Sport*, 23 (6), 1481 - 1487. doi:10.7752/jpes.2023.06181
- Canton, A., Torrents, C., Ric, A., Guerrero, I., Hileno, R., & Hristovski, R. (2021). Exploratory behavior and the temporal structure of soccer small-sided games to evaluate creativity in children. *Creativity Research Journal*, 33(1), 16-25. <https://doi.org/10.1080/10400419.2020.1836878>
- Caso, S., & Van der Kamp, J. (2020). Variability and creativity in small-sided conditioned games among elite soccer players. *Psychology of Sport and Exercise*, 48. <https://doi.org/10.1016/j.psychsport.2019.101645>
- Casamichana, D., Castellano, J., & Castagna, C. (2012). Comparing the physical demands of friendly matches and small-sided games in semiprofessional soccer players. *J Strength Cond Res*, 26(3), 837-43. doi: 10.1519/JSC.0b013e31822a61cf.
- Casamichana, D., Bradley, P., & Castellano, J. (2018). Influence of the varied pitch shape on soccer players physiological responses and time-motion characteristics during Small-Sided Games. *J Hum Kinet*, 64, 171-180. doi: 10.1515/hukin-2017-0192.
- Castillo-Rodríguez, A., Durán-Salas, A., Giménez, J. V., Onetti-Onetti, W., & Suárez-Arrones, L. (2023). The Influence of Pitch Dimensions during Small-Sided Games to Reach Match Physical and Physiological Demands on the Youth Soccer Players. *Sensors*, 23(3), 1299, <http://dx.doi.org/10.3390/s23031299>
- Clemente, F. M., & Sarmiento, H. (2020). The effects of small-sided soccer games on technical actions and skills: a systematic review. *Hum Mov*, 21(3), 100-119 <https://doi.org/10.5114/hm.2020.93014>
- Clemente, F. M., Afonso, J., Castillo, D., Arcos, A. L., Silva, A. F., & Sarmiento, H. (2020). The effects of small-sided soccer games on tactical behavior and collective dynamics: A systematic review. *Chaos, Solitons and Fractals*, 134, <https://doi.org/10.1016/j.chaos.2020.109710>

- Clemente, F., Ramirez-Campillo, R., Sarmiento, H., Praça, G.M., Afonso, J., Silva, A., Rosemann, T., Knechtle, B. (2021). Effect of small-sided game interventions on the technical execution and tactical behaviors of young and youth team sports players: a systematic review and meta-analysis. *Front Psychol*, 12. <https://doi.org/10.3389/fpsyg.2021.667041>
- Clemente, F.M., Afonso, J., & Sarmiento, H. (2021). Small-sided games: An umbrella review of systematic reviews and meta-analyses. *PLoS One*, 16(2):e0247067. doi: 10.1371/journal.pone.0247067
- Daivs, K., Araújo, D., Correia, V., & Vilar, L. (2013). How Small-Sided and Conditioned Games Enhance Acquisition of Movement and Decision-Making Skills. *Exerc. Sport Sci. Rev*, 41(3), 154-161 <https://doi.org/10.1097/JES.0b013e318292f3ec>
- Da Costa, J. C., Borges, P. H., Ramos-Silva, L. F., Weber, V. M., Moreira, A., & Ronque, E. R. (2023). Body size, maturation and motor performance in young soccer players: relationship of technical actions in small-sided games. *Biology of Sport*, 40(1), 51-61 <https://doi.org/10.5114/biolSport.2023.110749>
- Dello Iacono, A., McLaren, S. J., Macpherson, T. W., Beato, M., Weston, M., Unnithan, V. B., & Shushan, T. (2023). Quantifying Exposure and Intra Individual Reliability of High Speed and Sprint Running During Sided Games Training in Soccer Players: A Systematic Review and Meta analysis. *Sports Medicine*, 53(2), 371-413 <https://doi.org/10.1007/s40279-022-01773-1>
- De Dios-Álvarez, V., Lorenzo-Martínez, M., Padrón-Cabo, A., & Rey, E. (2022). Small-sided games in female soccer players: a systematic review. *Journal of Sports Medicine and Physical Fitness*, 62(11), 1474-1480 <https://doi.org/10.23736/S0022-4707.21.12888-9>
- Hammami, M. A., Guerchi, M., Selmi, O., Sehli, F., Ghouili, H., Stângaciu, O. A., Marinău M. A., Galeru, O., & Alexe, D. I. (2023). Effect of Verbal Encouragement on Physical Fitness, Technical Skill and Physiological Response during Small-Sided Soccer Games. *Sustainability*, 15(4), 3624, <http://dx.doi.org/10.3390/su15043624>
- Kryściak, J., Podgórski, T., Chmura, P., Konefał, M., Chmura, J., Brazaitis, M., Modric, T., & Andrzejewski, M. (2023). Effects of short bout small sided game training on acid base balance markers in youth male soccer. *Scientific Reports*, 13(1), 3510, <https://doi.org/10.1038/s41598-023-30646-4>
- Maia Junior, J. M., de Mello, D. B., Rosa, G., dos Santos, L. A., Nunes, R. A., & de Souza Vale, R. G. (2023). Effects of scoring method on the physical, technical, and tactical performances during football smallsided games (SSGs): A systematic review. *Retos*, 49, 961-969 <https://doi.org/10.47197/retos.v49.98459>
- Mamani-Jilaja, D., Huayanca-Medina, P. C. ., Casa-Coila, M. D. ., Vilca-Apaza, H.-M., & Romero-Carazas, R. (2023). Bibliometric analysis of scientific production in collective sports. *Retos*, 49, 853-861. <https://doi.org/10.47197/retos.v49.99002>
- Mazzardo, T., Campos, L., Pérez, J., & Greco, P. (2022). Pedagogical intervention in team sports: a systematic review. *Journal Phys. Education*, 33, 1-21. <https://www.scielo.br/j/jpe/a/jJGHjMW7NGXcPbZXgCfjrSf/#>
- Nobari, H., Silva, A., Vali, N., & Clemente, F. (2023). Comparing the physical effects of combining small-sided games with short high-intensity interval training or repeated sprint training in youth soccer players: A parallel-study design. *International Journal of Sports Science & Coaching*, 18(4), 1142-1154 <https://doi.org/10.1177/17479541221101842>
- Ospina León, M. Ángel, Cárdenas Castiblanco, J. A., López Mosquera, Y. D., Macías Quecán, J. D., & Becerra Patiño, B. A. (2023). Effects of plyometric training in Colombian soccer players (17-18 years old) according to their position in the field of play. *Retos*, 47, 512-522. <https://doi.org/10.47197/retos.v47.94871>
- Paľo, K., Nagy, N., & Vanderka, M. (2023). External and internal loads on soccer players in various organisational forms of small-sided-games. *Journal of Physical Education and Sport*, 23(3), 682-690. doi:10.7752/jpes.2023.03084.
- Pinca, T., Machado, G., Moniz, F., Fontes, A., & Teoldo, I. (2021). Comparison of soccer players' tactical behaviour in small-sided games according to match status. *Journal of Physical Education and Sport*, 21(1), 12.20. doi:10.7752/jpes.2021.01002
- Rago, V. R., Pizzuto, F., & Barreira, D. (2018). Small-sided soccer games on sand are more physically demanding but less technically specific compared to games on artificial turf. *The Journal of Sports Medicine and Physical Fitness*, 58(4), 385-91 <https://doi.org/10.23736/S0022-4707.16.06708-6>
- Rowell, A. E., Aughey, R. J., Clubb, J., & Cormack, S. J. (2018). A standardized small sided game can be used to monitor neuromuscular fatigue in professional A-league football players. *Front Physiol*, 9, 1011 <https://doi.org/10.3389/fphys.2018.01011>
- Salinas-Ríos, K., & García-López, A. (2022). Bibliometrics, a useful tool within the field of research. *Journal of Basic and Applied Psychology Research*, 3(6), 10-17. <https://doi.org/10.29057/jbaprv.v3i6.6829>
- Santos, S., Couthino, D., Gonçalves, B., & Sampaio, J. (2023). How many creatives are enough? Exploring how manipulating the number of creative players in the opposing team impacts footballers' performance during small-sided games. *Human Movement Science*, 87, 103043 <https://doi.org/10.1016/j.humov.2022.103043>
- Sarmiento, H., Clemente, F., Harper, L., Teoldo, I., Owen, A., & Figueiredo, A. (2018). Small sided games in soccer – a systematic review. *International Journal of Performance Analysis in Sport*, 18(5), 693-749. <https://doi.org/10.1080/24748668.2018.1517288>

- Selmia, O., Gonçalves, B., Ouerguia, I., Sampaio, J., & Bouassida, A. (2018). Influence of well-being variables and recovery state in physical enjoyment of professional soccer players during small-sided. *Research in Sports Medicine*, 26(2), 199-210 <https://doi.org/10.1080/15438627.2018.1431540>
- Silva, H., Nakamura, F. Y., Beato, M., & Marcelino, R. (2023). Acceleration and deceleration demands during training sessions in football: a systematic review. *Science and Medicine in Football*, 7(3), 198-213 <https://doi.org/10.1080/24733938.2022.2090600>
- Trombiero, D. S., Praça, G. M., Borges, E. d., de Lira, C. A., Leonardi, T. J., Laporta, L., et al. (2023). Analysis of Physiological, Physical, and Tactical Responses in Small-Sided Games in Women's Soccer: The Effect of Numerical Superiority. *Applied Sciences*, 13(14), 8380 <http://dx.doi.org/10.3390/app13148380>
- Van Eck, N.J., & Waltman, L. (2011). *Text mining and visualization using VOSviewer*. arXiv preprint arXiv:1109.2058.
- Van Eck, N.J., & Waltman, L. (2014). *Visualizing bibliometric networks*. En Ding, Ying; Ronald Rousseau y Dietmar Wolfram, eds. *Measuring scholarly impact: Methods and practice*. Springer, 285–320.
- Van Eck, N.J., & Waltman, L. (2020). *Manual de VOSviewer* (Manual para VOSviewer versión 1.6.15 ed.). Universiteit Leiden. <https://pdfcoffee.com/manual-vosviewer-1615en-es-pdf-free.html>