

Unlocking the Secrets of Successful Sports Training: A Bibliometric Analysis

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ABSTRACT

This paper's bibliometric investigation aims to provide the formula for effective sports training. Finding patterns and trends in the literature is important to help coaches and athletes enhance their training plans. The Scopus database and 4276 articles were used for the analysis. According to the findings, the Journal of Strength and Conditioning Research has the highest H-Index of 50. With 199 documents, the University of Copenhagen in Denmark is the leading affiliate. With a total of 595 times, the term "exercise" is used by the authors the most. Additionally, "dyspnea" has the biggest relative growth, while "exercise training" is a trending issue with the largest absolute increase. The terms "power," "speed," and "strength" all have definitions that are very relevant to coaching athletes. The findings demonstrate that effective sports training necessitates a multidisciplinary strategy that considers each athlete's particular requirements and skills. This study sheds important new light on the literature on exercise training and emphasises the significance of evidence-based training in sports. The findings can be utilised to help create training plans that maximise performance, stop injuries and enhance athlete wellbeing.

Keywords: Sports training, Performance enhancement, Training methods, Coaching strategies.

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OVERVIEW

Athletes' physical, mental, technical and spiritual growth are all part of sports training. The periodization of training, which can improve an athlete's strength and endurance and lower the risk of injury, is one of the main elements that contribute to the effectiveness of sports training.^[1] Additionally, using the right training techniques is necessary for effective sports training. For instance, resistance training can develop muscle strength and endurance, whereas plyometric training can boost athletes' explosive power.^[2] Developing players' physical, mental, technical and spiritual faculties is complicated during sports training. Proper training periodization and appropriate training techniques are essential to enhance athlete performance and lower the risk of injury.

Successful sports training increasingly emphasises mental conditioning, sports psychology and physical training. Training

mental abilities can enhance performance and lower injury risk in athletes.^[3] It also necessitates routine measurement and evaluation, such as kinematic measurements, tactical assessments and physical fitness testing.^[4]

Effective recuperation tactics are also necessary for successful sports training. Techniques like massage, stretching and active recovery are examples of recovery tactics.^[5] Additionally, getting enough sleep is essential for regenerating body cells and tissues, boosting immunity and improving focus and mental clarity.^[6] Additionally, an effective sports training programme requires a proper diet. To meet nutritional requirements and optimum performance, the athlete's meal plan must explicitly consider carbohydrate, protein and fat intake.^[7,8] This can improve athletes' speed, strength and endurance while lowering their risk of injury^[9] and hastening the recovery process following exercise.^[10]

It is also crucial that coaches and athletes communicate effectively with one another. To help athletes reach their full potential, coaches must be able to motivate them and offer the constructive criticism they need.^[11] Family and close friends can also be crucial to a good sports training programme. Athletes who receive social



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support may feel appreciated and supported, motivating them to practise harder and accomplish their objectives.^[12]

Technology has increased the value of sports training. With technology, coaches and players can better monitor performance, identify issues and oversee training plans. A successful combination of these elements is required for effective sports training. This must be understood and applied moving forward by both coaches and athletes. The following are some advantages of technology in sports training: 1) Physical education quality can be raised with technology, a useful scientific management method.^[13] 2) Utilising contemporary technological tools during training can help improve athlete performance and increase training efficacy.^[14]

The study's objective was to utilise bibliometric analysis to discover the most frequently referenced authors, journals, articles and keywords in the literature on sports training to learn the secrets of effective sports training. To help coaches and athletes improve their training plans, this study will look for patterns and trends in the literature.

LITERATURE REVIEW

Successfull of sports training

Several relevant studies are related to the theme of this research. For example,^[15] investigation of the relationship between mental exhaustion and athletic performance highlights a growing interest in objective measurements and intervention options.^[16] Analysis of sports training loads emphasizes how crucial it is to prepare institutions to use training loads and analysis. The study by^[17] on illnesses linked to sports highlights the importance of international research cooperation and focus on underrepresented areas.^[18] Overview highlights the interdisciplinary appeal of sport management research, which American universities dominate. Finally,^[19] analysis of psychology in sports emphasizes how important psychological elements are to players' total success. When taken as a whole, these studies add to a thorough grasp of the situation and potential future paths in sports-related research, educating institutions, practitioners and researchers in this rapidly evolving subject.

A process for successfully improving athletes' performance is successful sports training. A well-planned and structured training schedule is one of the key elements in the effectiveness of sports training. An efficient training regimen includes strength, speed, endurance, coordination and flexibility.^[20] It also stresses the value of routinely reviewing and assessing training initiatives. This will allow the trainer to modify the training regimen and make sure the athlete makes rapid advancements towards attaining the training objectives.

Research revealed in another study that an effective training regimen can boost athletes' performance quickly.^[21] According to this study, athletes' muscle strength, speed and physical endurance

can all be increased by following a planned training regimen with specific goals and objectives. This study also demonstrates how a planned training programme can lower an athlete's risk of injury. Another study by^[22] showed that good nutrition has a significant role in the success of sports training and an organised exercise regimen.

According to a large body of research on effective sports training, a structured and systematic training schedule is the key to enhancing athlete performance. Periodization, block periodization and nonlinear periodization are training techniques that can assist coaches and athletes in achieving peak performance. As a result, trainers and athletes must understand and incorporate these ideas into their training plans.

Bibliometric Analysis

A strong method for revealing research trends, significant contributors and areas of emphasis within a certain topic is bibliometric analysis. An increasingly crucial technique for assessing and comprehending scientific research is bibliometric analysis. Research impact and distribution and prospective interdisciplinary research prospects can all be evaluated using bibliometric analysis. Bibliometric analysis is used to study the emergence and evolution of research topics and communities,^[23] collaboration patterns and networks^[24] and research performance evaluation. It can also analyse climate change or public health.^[25]

The potential of bibliometric analysis to track the evolution and spread of scientific terms and concepts is highlighted by.^[26] The ethical ramifications of bibliometric analysis, such as the possibility of data bias or unintended effects of employing metrics to evaluate academics or institutions, are stressed.^[27]

By examining individual-level bibliometric data, researchers can learn more about each researcher's productivity, impact and influence. Researchers must make their data and code available for examination and replication by others and provide clear and thorough descriptions of their procedures and data sources. We intend to use bibliometrics in this investigation.

METHODOLOGY

Determination of the title of the paper

The study "Unlocking the Secrets of Successful Sports Training: A Bibliometric Analysis" examines the field of sports coaching using bibliometric research techniques. The impact and influence of research papers, authors, journals and institutions are measured using bibliometrics, a quantitative method of assessing and interpreting scientific literature. By examining previous studies in this area, this study aims to identify important elements and best practices in athletic training. The phrase "unlocking secrets" in the study's title suggests its goal is to reveal previously undiscovered information about sports training that could enhance players' performance and results. As suggested by the title, the study's goal

is to thoroughly analyse the body of research on sports coaching to identify its strengths and potential.

Selection and determination of the database

Scopus is a database that was used for the study. Scopus was chosen because its publications greatly impact the advancement of science across all sectors of knowledge and are of assured high quality. The evaluation process for the papers included in this database was extensive and took a while. The Scopus database offers more thorough and extensive coverage of pertinent studies^[28] and the largest database of abstracts and citations for top academic research papers.^[29,30] This bibliographic database enables data set consolidation and contains details on diverse, high-quality research that has significantly altered the world.^[31] In the past, researchers from all over the world have used this database.^[32,33]

Keyword determination and validation

The Scopus database's data was retrieved on February 15, 2023 and is used in this study. All documents about the research topic are searched for using the keywords "successful," "effective," "efficient," "optimal," "winning," "champion," "elite," "best practice," "evidence-based," "athletic training," "exercise training," "physical conditioning," "sports conditioning," "sport-specific training," "performance training," "strength and conditioning," "training methods in sports," "athletic development," and "training adaptation in sports." To access and assess all of the documents referred to in this research and to get more detailed information, it is crucial to validate keywords for relevant word phrases. The advice of various experts, including KHA (a bibliometric expert), YMS (a sports expert and sports lecturer) and DR (a sports trainer), served as the basis for this keyword validation.

Data collection parameters

To locate and include each of these phrases in the title, abstract and keywords, the TITLE-ABS-KEY selection of these terms was employed in the inquiry. The term is entered into the Scopus search area without applying a search filter, yielding 9,184 document hits. Then, taking into account several factors, we establish several criteria for filtering documents to be retrieved, including:

Removing documents that were submitted or published in 2023. This is done because only a few articles were published in 2023 and documents taken this year certainly will not provide information on the growth and development of publications in 2023;

Determine the last ten years, starting from 2013-2022. This aims to obtain the latest information regarding training methods, nutritional intake, rest periods, recovery and other matters related to uncovering the secrets of athlete success in achieving optimal performance. Therefore, all the years from 1973 to 2012 and 2023 were not taken for analysis.

Only the final publication status of the document is retrieved. We chose the final document because every reader can access published manuscripts either for free (open access) or paid (subscription) access;

Only the type of article document that we take. We assume that this type of document has gone through a rigorous review process that tends to take quite a long time, so we are sure that the manuscripts written will be maintained in quality and the impact factor of the manuscripts that have been published;

English is the preferred language for the three types of documents we take. This reason was because the use of English in published manuscripts is a language that is used globally and everyone tends to be able to understand it, especially researchers around the world;

We chose a scientific source for the type of journal because journals usually carry out a peer-review process. Of course, each author will receive feedback from the reviewers regarding the manuscripts that have been submitted.

After filtering the documents according to the specified criteria, 4,285 document results were obtained. The total number of documents was retrieved through three stages of data collection: 1) 2020-2022=1,497 document results; 2) 2017-2019=1,311 document results; and 3) 2013-2016=1,477 document results.

Data analysis

Scholars all over the world employ a variety of bibliometric software tools to provide readers with information through engaging infographics and graphical representations. Bibliometric tools were the instruments we used in this investigation. ScientoPy, a separate script created by,^[34,35] is the tool we use to analyse this set of research metadata. ScientoPy is also used to examine the bibliography of articles.^[36] The open-source Python program ScientoPy can be used to review scientometrics books. Using bibliographical information, it can automatically organise and report on top themes (by author or index keywords), authors and countries,^[37,38] and Biblioshiny for Bibliometrix,^[39] which is a Java program created by Massimo Aria at Federico University of Naples. With the help of the Shiny package environment, Biblioshiny combines the usability of web applications with the capabilities of the Bibliometrix package.^[40] ScientoPy software is typically used to see publication trends, whereas Biblioshiny explores how the subject area has evolved. After performing an initial analysis using the ScientoPy software, the software automatically detects 9 (0.2%) duplicate papers. As a result, the total number of documents examined was 4,276.

RESULTS

General information

A web-based database (Biblioshiny) and ScientoPy software were used to retrieve and analyze all documents and the results were used

to inform readers and other researchers about how information from 4,276 documents about sports training was distributed. This information is important because the results will summarise the data collected. Figure 1 shows that, between 2013 and 2022, 110 single-author publications accounted for 19,237 authors. Of these collaborative authors, 28.58% were international co-authors. The fact that knowledge has been shared among collaborative authors from different affiliations and countries shows how widely the understanding of sports training has spread worldwide. A total of 1,159 reputable and well-known scientific sources have published 4,276 documents. Figure 1 displays extensive information about the examined metadata.

Document growth over the last ten years

Figure 2, which depicts the year-on-year increase in documents, depicts fluctuations in the number of documents produced between 2013 and 2022. The number of documents decreased in subsequent years and peaked at 338 in 2015. This followed an initial spike of 383 in 2013 to 393 in 2014. However, this trend occurred again in 2017 with a slight increase to 370 papers, then a significant jump to 474 documents in 2018. Although there was a small decrease to 465 papers in 2019, there was a consistent increase in subsequent years, reaching a peak of 568 documents in 2021. But again, there was a significant decline to 427 documents in 2022. These fluctuations in the growth of research documents reflect the complex dynamics involved in creating and disseminating scientific literature, which are influenced by variables such as changes in funding, publishing policies and research objectives.

Journals and citations are scattered throughout the Bradford Zone

4,276 scientific articles were published by 1,159 journals, with ten journals producing more than 17 articles on sports training. The top 10 journals are shown in Table 1 in order of H-index, G-index, total amount of citations and publications. The H-Index itself speaks of the quantity of citations derived from papers that have been published. Because they consider each publication's

total number of publications and citations, the H-index and the number of publications do not have a strictly linear connection. The number of publications with at least h citations is the h -index.^[41,42] When a group of articles is arranged in descending order of the number of citations they receive, the G-Index is the highest number such that the top g articles receive (together) at least g^2 citations.^[43]

Bradford's Law outlines the quantifiable connection between journals and the papers they publish. According to Bradford, the first zone is a nuclear zone, which is extremely productive; the second zone is a zone with moderate production and the third zone is a zone with low productivity.^[44] Table 2 breaks down Bradford's Law's application into three zones over 1,159 published journals and publications.

Author Productivity through Lotka's Law

To establish himself as an authority in a particular field and to benefit readers, teachers, sports practitioners, coaches and all other parties involved in the world of sports, each writer will undoubtedly conduct research related to his area of specialisation. Using Lotka's Law, this section shows the authors' production from 2013 through 2022. Lotka's Law states that authors who have only made one contribution make up around 60% of all publications on a specific field.^[45] In addition, according to,^[46,47] the proportion of authors who produce two scientific works is equal to one-fourth of the proportion of authors who produce one work and so on. In other words, the proportion of authors who produce scientific works is equal to one-fourth of those who write a scientific work. The output of writers with one document created up to 22 papers is shown in Table 3.

Most relevant affiliation

Although not all authors are employed by organisations or research institutes, most authors have a place of affiliation where they belong. This is due to the status of free researchers, who are not constrained by any organisation and conduct research solely for their interests and satisfaction or for other reasons



Figure 1: General information of the analysed metadata.

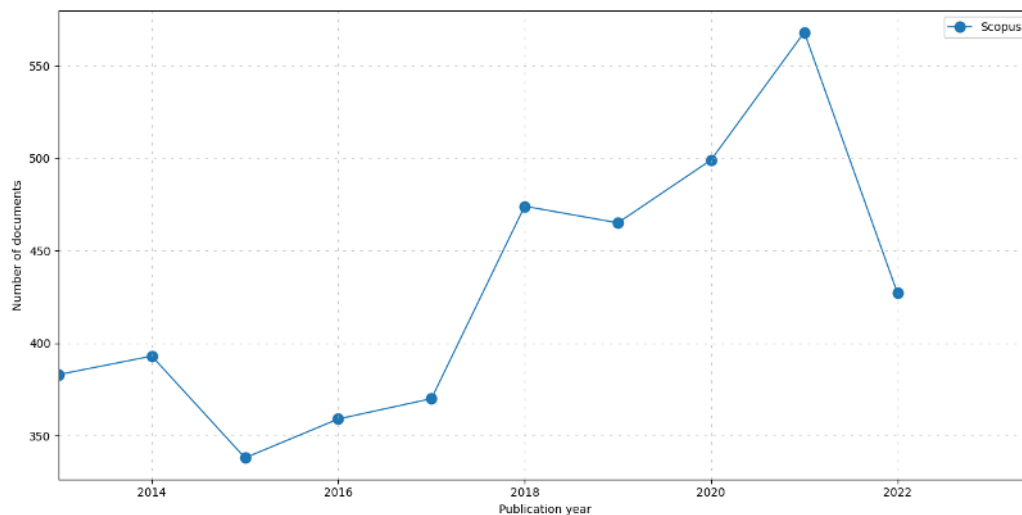


Figure 2: Document growth.

Table 1: The top 10 journals by source local impact according to H-Index, G-Index, Total Citation (TC), Number of Publication (NP), Publication Year (PY).

Rank	Source	h_index	g_index	m_index	TC	NP	PY_start
1	Journal of Strength and Conditioning Research.	50	75	4.545	11069	404	2013
2	International Journal of Sports Physiology and Performance.	30	46	2.727	3145	142	2013
3	Plos ONE.	28	50	2.545	2843	97	2013
4	Medicine and Science in Sports and Exercise.	27	59	2.455	3717	92	2013
5	Journal of Sports Sciences.	21	31	1.909	1315	81	2013
6	British Journal of Sports Medicine.	19	26	1.727	1445	26	2013
7	Scandinavian Journal of Medicine and Science in Sports.	19	51	1.727	2695	53	2013
8	European Journal of Applied Physiology.	18	25	1.636	719	48	2013
9	Journal of Applied Physiology.	18	30	1.636	995	43	2013
10	Frontiers in Physiology.	17	26	1.7	768	46	2014

Table 2: Dissemination of journals and citations in the Bradford Zone.

Zones	Number of Journals	Percentage of Journals	Frequency paper
1	17	1.47	1.423
2	163	14.06	1.445
3	979	84.46	1.408
Total	1.159	100	4.276

(such as phenomena in politics, religion, culture, or even sports), among others. However, affiliation is crucial for confirming the author's identity and frequently serves as a source of funding when undertaking research. This connection may be made through academic institutions, legally recognised professional groups or public and commercial research organisations. With 199 documents, the University of Copenhagen in Denmark is the affiliate that helps most authors create and publish academic papers. The University of So Paulo in Brazil came in second with 186 documents and the Australian Catholic University came in third with 102 documents. The ten affiliates listed in Figure 3 are

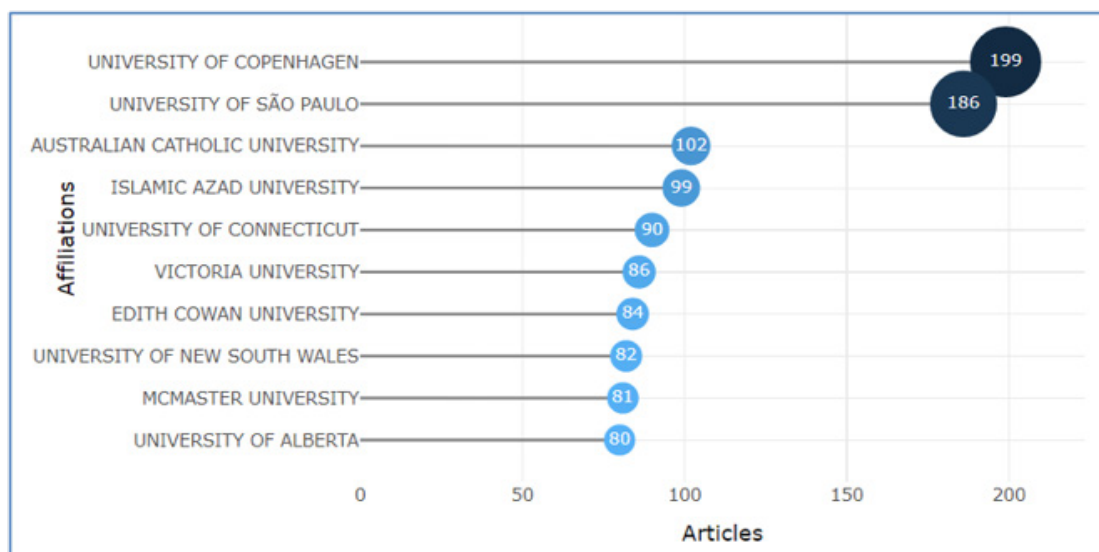
those whose employees (lecturers, professors and researchers) have included the affiliate's name in their publications, letting readers know that the author is affiliated with that organisation.

Distribution of publications by country

The authors researched with financial support from their employers' affiliates or the government. Many things will make a nation famous. The nation will become well-known for its accomplishments in sports thanks to its athletes, organised leagues, well-known coaches, sponsors, fans, sports systems, sports legislation, sports venues and sports specialists. They

Tabel 3: Author Productivity through Lotka's Law.

Documents written	N. of Authors	Proportion of Authors
1	15767	0.820
2	2215	0.115
3	607	0.032
4	281	0.015
5	149	0.008
6	79	0.004
7	47	0.002
8	27	0.001
9	19	0.001
10	7	0.000
11	10	0.001
12	8	0.000
13	4	0.000
14	2	0.000
15	6	0.000
16	1	0.000
17	1	0.000
18	3	0.000
19	1	0.000
20	2	0.000
22	1	0.000
Total	19237	100

**Figure 3:** Most affiliation.

also significantly benefit the nation's growing reputation in terms of researchers. One measure of a nation's standing in the sports (sports science) field, particularly in sports training, is the number of publications produced and receiving citations. With 14,416 citations, the United Kingdom leads all other nations in this category. Australia, with an average of 24.10, has the most

article citations overall. Three of the top 10 nations-China, Iran and Japan-are from the Asian region. The top 10 nations in sports training publications do not include any individuals from the African continent. With 19 papers, 464 citations and an average article citation of 24.40, South Africa represents the African continent in 33rd place. According to Total Documents (TD),

Table 4: Distribution of publication by country.

Country	Articles	SCP	MCP	Freq	MCP_Ratio	TC	AAC
USA	729	617	112	0.17	0.154	14416	19.80
Australia	305	208	97	0.071	0.318	7352	24.10
Brazil	295	212	83	0.069	0.281	3964	13.40
United Kingdom	295	172	123	0.069	0.417	5376	18.20
China	267	211	56	0.062	0.21	3428	12.80
Spain	165	93	72	0.039	0.436	3008	18.20
Canada	151	108	43	0.035	0.285	3216	21.30
Iran	147	129	18	0.034	0.122	1438	9.80
Germany	128	72	56	0.03	0.438	2226	17.40
Japan	124	107	17	0.029	0.137	1433	11.60

MCP: Multiple Countries Publication, SCP: Single Country Publication, AAC: Average Article Citations.

Total Citations (TC) and Average Article Citations (AAC), Table 4 lists the top 10 nations.

Most Globally Cited Document

Undoubtedly, an excellent book can significantly impact the advancement of science. One sign is the positive feedback readers and other writers worldwide have given to the published articles. Even while it's possible that the number of citations cannot be used as a gauge to assess whether or not an article has an influence, the fact that the piece receives a lot of them nonetheless serves as proof. The five articles with the most citations are listed in Table 5. The article written by,^[48] published by the Scandinavian Journal of Medicine and Science in Sports, obtained a Total Citation (TC) of 1533, a Total Citation Per Year (TCPY) of 170.33 and a Normalised Total Citation (NTC) of 47.30.

Three-Field Plot between scientific sources, authors and author keywords

In-depth information about the distribution and focus of research can be found by examining the connections between scientific sources, authors and author keywords. In the discipline of sports training, Figure 4 depicts a three-field plot illustrating the relationship between scientific sources (on the left), writers (in the centre) and authors' keywords (on the right). The three stories were selected because it is a given that every publication is the product of a researcher from a nation and these three plots represent the productivity and contribution of a nation with an education and management system that can produce trustworthy writers. It is also a given that the authors will submit their papers to reputable scientific journals in the hopes that they will be accepted, published and be able to provide real value to readers.

Of course, the major objective for authors is to have their works published in respected scientific journals (indexed by Scopus). Even reputable scientific sources will critique authors according to the journal editor's policy guidelines.

Of course, the authors play a significant role in the publications. Through the extensive research they conduct and the literature they produce, writers build a new civilisation in advancing science. Scholars and readers can provide value to the writers by acknowledging their expertise. In the meantime, the authors' keywords are employed about the themes and research areas they have studied to communicate their thoughts and conclusions to readers. This allows them to present fresh ideas and new research using these keywords and other keywords that can result in high-quality research. New and powerful.

Authors' keywords and trending topics

A word cloud relating to the author's keywords in this research field is produced using the Biblioshiny web-based application from R version <http://127.0.0.1:4959/>. This word cloud was created using the graphic parameter we used to analyse the author's keyword. The author picked the keyword because it provides more detailed information on themes relating to sports training. Based on the program's recommendations, we select 50 keywords for analysis and generate a circular output of a list of authors' keywords (note: the analysis should also include a thesaurus file to mix synonyms and singular and plural terms). The frequency of word occurrences, Triangle-forward image, Tahoma font, Random Dark text colours, 0.6 font sizes, 0.65 ellipticity, 0.65 padding and 0.65 rotation are some of the factors that are used to create the author's keyword word cloud output. Figure 5 provides a visual representation of the 50 keywords that frequently appear with the word "exercise." These 50 keywords include words like "exercise training" (304 occurrences), "physical activity," and other words with very small word sizes.

The trend themes of the sports training theme, which were examined using ScientoPy software, are also explained in Figure 6. ScientoPy can identify popular subjects using author keyword trends by looking at the top author keywords with the highest AGR (as indicated in the "Topic Growth Indicators" section). An overview of the evolution of the most popular sports training

Table 5: Most global cited document.

Authors	Year	Title	Source	TC	TCPY	NTC
Pedersen and Saltin	2015	Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases	Scandinavian Journal of Medicine and Science in Sports.	1533	170.33	47.30
Arends <i>et al.</i>	2017	ESPEN expert group recommendations for action against cancer-related malnutrition	Clinical Nutrition	1454	207.71	61.77
Petersen <i>et al.</i>	2018	Practice guideline update summary: Mild cognitive impairment: Report of the Guideline Development, Dissemination and Implementation Subcommittee of the American Academy of Neurology	Neurology	822	137.00	42.08
Campbell <i>et al.</i>	2019	Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable	Medicine and Science in Sports and Exercise	788	157.60	48.62
Special Communications	2016	Nutrition and Athletic Performance	Medicine and Science in Sports and Exercise	683	85.38	23.08
Morton <i>et al.</i>	2018	A systematic review, meta-analysis and meta-regression of the effect of protein supplementation on resistance training-induced gains in muscle mass and strength in healthy adults	British Journal of Sports Medicine	488	81.33	24.98
Wang and Chen	2014		Bioresource Technology	431	43.10	13.18
Fragala <i>et al.</i>	2019	Resistance Training for Older Adults: Position Statement from the National Strength and Conditioning Association	The Journal of Strength and Conditioning Research	394	78.80	24.31
Evans <i>et al.</i>	2014	Attention to Local Health Burden and the Global Disparity of Health Research	Plos ONE	390	39.00	11.93
Barberan-Garcia <i>et al.</i>	2018	Personalised Prehabilitation in High-risk Patients Undergoing Elective Major Abdominal Surgery: A Randomized Blinded Controlled Trial	Annals of Surgery	390	65.00	19.96

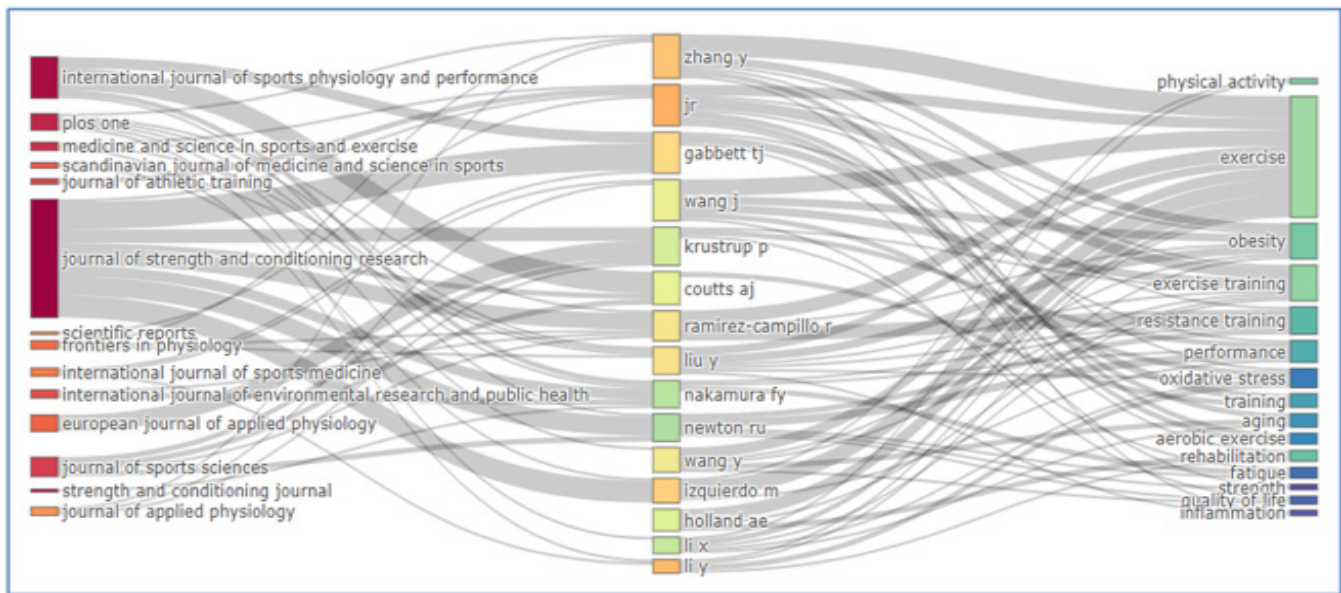


Figure 4: Three field plots between 15 scientific sources, authors and author keywords.



Figure 5: Wordcloud from a spread of 50 author keywords.

themes is shown in Figure 5. The number of documents is represented using a logarithmic scale against the year of release on the left side of this progression map. This means that the first row on the X-axis represents the year the research of the topic was started and the last row on the Y-axis shows the total number of documents published for each topic. The Y-axis on the right represents PDLY, while the X-axis represents each topic's AGR during 2020-2021. The highest AGR and PDLY subjects can be found using this graph. As a result, "exercise training" and "dyspnea" are trending issues with the biggest absolute rise and relative growth, respectively.

Conceptual Structure Map

A conceptual structure map or contextual structure map of each word that frequently appears in research publications on sports training difficulties is presented in this study after dividing the data based on mapping the relationships between terms using regional mapping. Each word is positioned by the values of Dim 1 and Dim 2 to construct a mapping between words whose values are not considerably different. Each variable in the red and blue sections, which represent the two halves of the area separated in this data, is related to one another.

The variables above were chosen for factorial analysis: Keyword author is a field, there are 50 terms in total, multiple correspondence

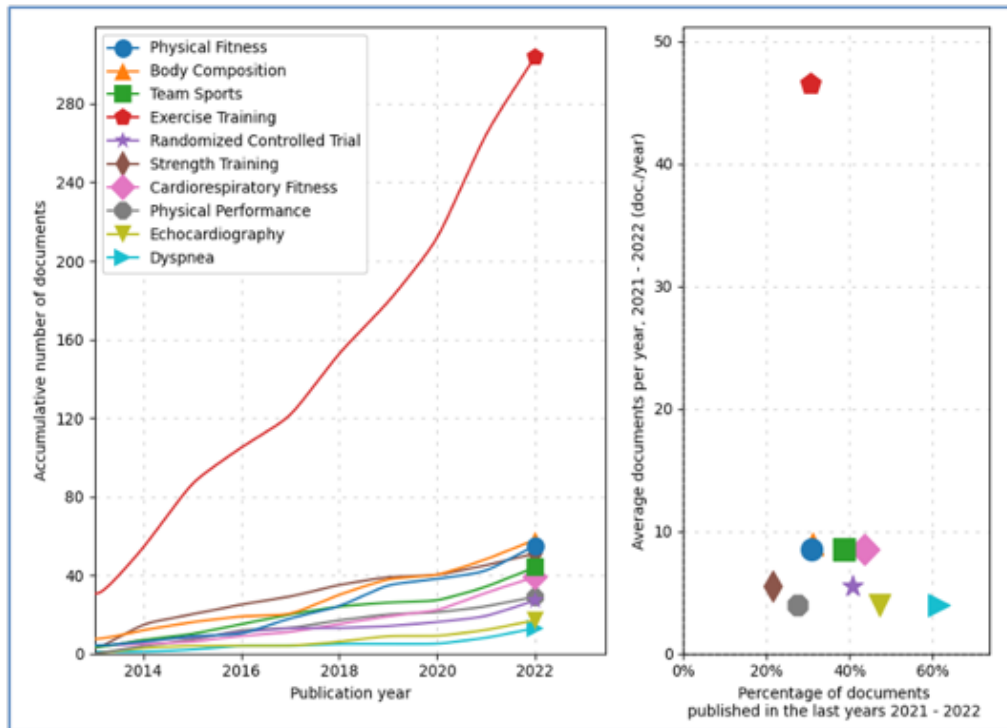


Figure 6: Displays the top 10 trending topics subjects based on the author's keyword.

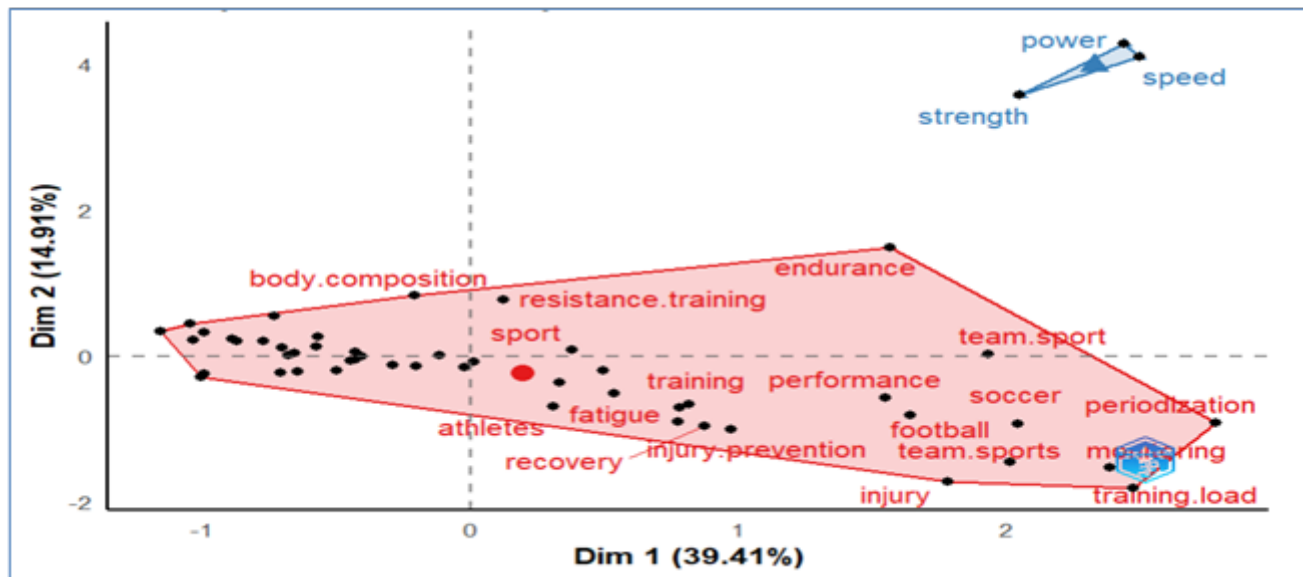


Figure 7: Conceptual Structure Map.

analysis is the approach and the number of clusters is determined automatically based on system recommendations. More and more study publications are connecting the words since the red area in the image above has more and more terms. The words "power," "speed," and "strength" are divided into smaller groups and given blue regions, respectively. Because these three aspects of physical fitness serve as the cornerstone for enhancing an athlete's performance during training and competition, the blue area indicates that the author's three keywords include criteria

specifically relevant to sports training. A conceptual structural map can be shown in Figure 7.

DISCUSSION

The ScientoPy and Biblioshiny apps were used in this study's bibliometric analysis of journal articles on sports training that have been added to the Scopus database. According to the study's findings, a web database (Biblioshiny) and ScientoPy software were used to evaluate 4,276 papers about sports training. A

summary of the distribution of the information in these documents can be given using the information resulting from this analysis. This study reveals that 19,237 authors contributed to 110 articles between 2013 and 2022, including document authors and one author. International cooperation authors make up 28.58% of author collaborations. Because of the knowledge exchange between the collaborating authors from different affiliations and nations, it can be shown that knowledge about sports training has expanded far over the world. Based on the study's findings, international collaboration among authors from diverse nations has resulted in extensive knowledge exchange on sports training.

Additionally, this study offers crucial details on patterns and areas of interest for future research in sports training from 2013 to 2022. This study may be a starting point for more investigation into the same subject, in agreement with the results of various earlier studies on international cooperation. It is widely acknowledged that research collaboration, especially international cooperation, raises research standards, increases the quantity of scientific production (publications) and has a high impact (citations).^[49] It also benefits the participating organisations and the researchers themselves. While bringing value and offering fresh insights,^[26] international collaboration can address regional or global concerns.^[50] The report emphasises how international cooperation significantly impacts the sports training industry. This is consistent with previous research emphasising the benefits of international collaboration on research impact, productivity and standards. The information in this study supports the idea that different viewpoints and international cooperation lead to a broad expansion of knowledge in the sector.

The "Journal of Strength and Conditioning Research" has the most scholarly papers published, with 404, the highest H-Index at 50, the highest G-Index at 75 and the most citations overall, with 11069 (as of the time this article was written). The research paper that received the most citations from other academics, with a total of 1,533, was "Exercise as Medicine: Evidence for Prescribing Exercise as Therapy in 26 Different Chronic Diseases" by Pederson (2015), which was published in the Scandinavian Journal of Medicine and Science in Sports. The recommendations made in this paper suggest that health systems create the necessary framework so that guided exercise can be prescribed as medicine. However, it is still necessary to establish the ideal exercise form and intensity and determine whether single-leg training, high-intensity interval training, or other novel exercise modalities will be appropriate for a given diagnosis. According to the findings, the Journal of Strength and Conditioning Research is the leading journal for research on exercise training and greatly influences the spread of knowledge. The scientific article also received the highest contributions from the third Bradford zone. These results aid readers and scholars in locating materials on the subject of sports training and in understanding how knowledge has grown in the area.

Through Lotka's Law, the study's findings depict the pattern of sports writers' production. Table 3 shows 82% of writers produced just one document between 2013 and 2022. Only 11% of authors produced more than two documents, while the number of authors who produced more than two documents shrank. Even among authors who produce ten or more documents, the percentage is negligibly small, sometimes even falling below 0%. This production pattern is consistent with Lotka's Law, which states that only a small percentage of writers are productive, whereas most writers only produce one piece. Authors must retain their productivity and commitment to self-development to continue producing high-quality work and contributing to the sports field. This study can give academics and professionals in the sports industry a broad perspective of the productivity patterns of authors in that industry. The findings of this study can also be used as a guide for authors who want to keep up their output and advance their sporting careers.

The findings of this study suggest that most writers are connected to the organisation with which they are associated or with which they work. This is crucial to support the author's identity and is typically done as a donation when doing research. These findings can help readers learn more about the author's affiliation and the place of origin of the research institutions that fund their scholarly work. In this situation, a scientific work's trustworthiness and credibility may be significantly influenced by the existence of an affiliation. This demonstrates how the quantity of research publications can serve as a proxy for a nation's standing in sports and sports science. With a total of 14,416 citations, the United States is the nation with the most citations. The findings of this study might give a broad perspective of how the state contributes to the creation of sports periodicals. Additionally, these findings aid researchers in selecting the nations or establishments that would benefit most from financial backing for their work. Additionally, the government can use these findings to develop sports-related laws and plans. There may be publications from other nations that are inaccessible to that database. Still, this research has limitations, such as the fact that the data was only collected using a few databases.

The papers^[48] in the Scandinavian Journal of Medicine and Science in Sports received the most citations. In total, 1533 people have referenced the article, giving it a Citation Total Per Year (TCPY) of 170.33 and a Normalised Total Citation (NTC) of 47.30. The number of citations can sometimes be a good predictor of how influential a piece is, but it can show how widely readers and other authors are reading and responding to it. As a result, the most popular papers can advance science in a given sector. This can inspire scientific papers that can significantly impact science and guide other researchers as they create their studies.

The three field images depicting the relationship between authors, authors' keywords and scientific sources in sports training can give detailed information about the distribution and focus of the

study. The majority of the authors of the publications examined, according to the study's findings, were from the United States, the United Kingdom and Australia. This demonstrates that these nations have effective management and education systems that produce dependable and effective writers in sports training. It was also discovered that the writers' most popular journals were Plos ONE, the International Journal of Sports Physiology and Performance and the Journal of Strength and Conditioning Research. This demonstrates that the authors have great faith in these publications to publish their research findings. The most often used keywords among authors were "exercise," "exercise training," and "physical activity." This demonstrates that enhancing athlete performance through training and muscle development is a major focus of research in sports training. The findings of this study can help readers and researchers better understand the distribution and focus of research in sports training. Additionally, this knowledge can help authors choose the best publication to publish their research findings and the best keywords to draw readers in and boost the effect of their work.

An examination of the author's keywords and popular subjects in the field of sports training was done. The web-based Biblioshiny tool employs 50 keywords to create a "word cloud" that displays the phrases commonly used with the word "practice" to examine the author's keywords. The word "exercise" is the largest in the word cloud, followed by the terms "exercise" and "physical activity". Using the ScentoPy programme, a trend analysis of sports training subjects was also completed. Topic growth metrics are employed in this analysis to pinpoint trending subjects. The topic "exercise training" is the most explored and has a significant absolute rise, as shown in the resulting graph. The subject of "dyspnea" experienced the biggest relative growth in contrast. The findings of this study give a general overview of frequently used terms and popular subjects in sports training. This might help readers and researchers decide what to read or research to find out the most recent information regarding sports training.

This study presents a conceptual or contextual structure map of each word frequently appearing in research articles on sports training concerns. It also describes the findings of mapping the relationship between words using regional mapping. Each word is given a value of Dim 1 and Dim 2 to establish a mapping between words whose values are not noticeably different. Each variable in the red and blue sections, which represent the two halves of the area separated in this data, is related to one another. The following criteria were picked for factorial analysis: The technique is multiple correspondence analysis, the field is keyword author, the number of words is 50 and the number of clusters is determined automatically based on system recommendations. The red area in the image above has an increasing number of terms, indicating

that the words there are linked to an increasing number of research publications. However, "power", "speed" and "strength" are divided into smaller groups with blue squares. Because these three aspects of physical fitness are the cornerstone for enhancing an athlete's performance during training and competition, the blue area demonstrates that the author's three keywords contain specific criteria for sports training. A conceptual structural map can be shown in Figure 6. The findings of this study suggest that topic trends and word cloud analysis can give a broad overview of the main terms and research areas that frequently appear in research articles in the area of sports training. While this happens, conceptual structure mapping can offer additional specific details about the connections between concepts in the study environment. These findings can be used as a guide for academics and practitioners in sports to do additional research and gain a deeper understanding of issues frequently arising in research articles about athletes' training.

All amateur or professional athletes should include training in their daily schedules because it is crucial to their performance. Training is important because it enables the body to acquire various skills and talents, such as improving the physical fitness components (strength, speed, agility, flexibility, endurance, power and stamina). Regular practice can enhance both individual and playing abilities. Additionally, it can improve an athlete's psychological traits like motivation, mindset, self-confidence, self-esteem and collaboration before, during and after training and competition. Regular exercise can also speed up the body's recovery from physical exertion, which improves the body's ability to adapt to training demands and boosts resilience to disease and injury.

CONCLUSION

Several inferences can be derived from the findings of the bibliometric research that has been conducted. First, there has been an upsurge in studies on exercise training over time, particularly around 2020-2021. Second, the top three countries for producing research in sports training are the US, Australia and Brazil. Third, physical activity, exercise and exercise training are the subjects that appear most frequently in sports training research. Strength, quickness and endurance are the three most crucial fundamental principles of sports training. Researchers and practitioners in sports training might benefit from this bibliometric study's findings by better understanding current trends and research themes. Designing a successful sports training strategy can also be aided by key fundamental ideas like strength, speed and endurance. The results may not contain all pertinent research in exercise training; nevertheless, it should be noted that these results only include research indexed in Scopus and using specific keywords.

Several potential future study avenues in sports training can be investigated in light of the above bibliometric research findings. The use of technology in sports training, the impacts of physical activity on mental health and the impact of sport on quality of life are a few of the issues that stand out. There is still opportunity for more research in this area, as evidenced by the fact that physical activity and exercise are the most popular themes in bibliometric studies on sports training. To better contribute to advancing sports training, researchers can employ bibliometric analysis to help uncover trends and subjects currently evolving in the discipline. Finally, bibliometric analysis offers a helpful summary of current research trends and directions in sports training. The effectiveness of sports training and athlete performance can be enhanced using these strategies to identify knowledge gaps and possibilities for more research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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