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# In-Depth Analysis of Exercise and Impact to Basketball Athletes Performance from A Bibliometric Perspective

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DOI: https://doi.org/10.38021asbid.1196899 **REVIEW RESEARCH**

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**Abstract**

The frequency, intensity, duration, and typse of exercise are all included in the exercise concept. Practice is the most relevant factor in improving the performance of basketball players in any competition. This study analysed the expansion of basketball player training publications and trends worldwide. The analysis was based on 422 articles retrieved from the Scopus database. In order to achieve the primary research objective, four essential characteristics as follow were scrutinised further: (1) distribution of publications, (2) country distribution, (3) the most prolific writer, and (4) keywords. The most significant finding reveals that 2010 marked the beginning of the growth and evolution of publications. Consequently, it is vital to publish extensively in this field of study. This study showed that Scanlan A.T. became the most prolific author with 11 documents, 169 citations, and ten link strengths. The terms "maturation", "athletic performance", "training load", "physical fitness", and "adolescent" were widely used concerning the training of basketball players subsequently 2020. According to the interpretation of this information, training for basketball players is directly related to maturity and training load, which had an enormous impact on the performance of basketball players. In a nutshell, studying current research trends using the bibliometric paradigm will provide academics and researchers with critical principles to improve basketball players' training and advance the sports industry.

***Keyword:*** Exercise, Basketball Players, Scopus, Bibliometric

# Egzersizin Derinlemesine Analizi ve Basketbol Sporcu Performansına Etkisi Bibliometrik Bir Bakış Açısından

**Özet**

Egzersizin sıklığı, yoğunluğu, süresi ve türü egzersiz kavramına dahildir. Antrenman, herhangi bir müsabakada basketbol oyuncularının performansını artırmada en alakalı faktördür. Bu çalışma, dünya çapındaki basketbolcu eğitimi yayınlarının ve trendlerinin genişlemesini analiz etti. Analiz, Scopus veri tabanından alınan 422 makaleye dayanmaktadır. Birincil araştırma amacına ulaşmak için dört temel özellik daha ayrıntılı olarak incelenmiştir: (1) yayınların dağılımı, (2) ülke dağılımı, (3) en üretken yazar ve (4) anahtar kelimeler. En önemli bulgu, 2010 yılının yayınların büyüme ve evriminin başlangıcı olduğunu ortaya koymaktadır. Sonuç olarak, bu çalışma alanında kapsamlı bir şekilde yayın yapmak hayati önem taşımaktadır. Bu çalışma, Scanlan A.T. 11 belge, 169 alıntı ve on bağlantı gücü ile en üretken yazar oldu. 2020 sonrasında basketbolcuların antrenmanları ile ilgili olarak "olgunlaşma", "atletik performans", "antrenman yükü", "fiziksel uygunluk" ve "ergenlik" terimleri yaygın olarak kullanılmaya başlandı. Bu bilgilerin yorumlanmasına göre, basketbolcular için antrenman basketbol oyuncularının performansı üzerinde muazzam bir etkiye sahip olan olgunluk ve antrenman yükü ile doğrudan ilgilidir. Özetle, bibliyometrik paradigmayı kullanarak güncel araştırma trendlerini incelemek, akademisyenlere ve araştırmacılara basketbol oyuncularının antrenmanlarını iyileştirmek ve spor endüstrisini ilerletmek için kritik ilkeler sağlayacaktır.

***Anahtar kelime: E***gzersiz, Basketbolcular, Scopus, Bibliyometrik

## Introduction

Despite the assumption that sports are merely enjoyable pursuits, the lessons we learn via participation in sports serve an essential purpose. The sport of basketball, for example, is possibly an excellent social activity and pushes us to be team players. Basketball is a highly competitive team sport that requires a different set of movement patterns concerning the technical and tactical elements of the game (Petway et al., 2020), (Petway et al., 2020). It demands mastery of a wide range of physical and motor skills (such as speed, strength, and endurance) to succeed technically and tactically (Schelling and Torres-Ronda, 2016). Due to the discontinuous high-intensity nature of most basketball-specific actions and movements, the capacity to accelerate, decelerate, change direction, jump, and shuffle is critical to success on the court (Ramos-Campo et al., 2017; Svilar and Jukić, 2018). The complexity of basketball matches proves that developing various physical characteristics can be helpful in improving match performance (Morrison et al., 2022).

Additionally, numerous articles on various basketball-related themes have caught the attention of earlier scholars. The focus of the publications is on women's basketball (Carter et al., 2005; Jiang and Lee, 2016), basketball-related game efficiency indicators (Sporiš et al., 2006), competitive balance (Meletakos et al., 2016; Scott et al., 2019), fatigue (Li et al., 2021; Rashid et al., 2020), post-workout recovery (Calleja-González et al., 2016), wheelchair basketball (Calleja-González et al., 2016; de Groot et al., 2012; de Witte et al., 2016; Vanlandewijck et al., 2004), technical skills (Klusemann et al., 2012), injuries (Conde et al., 2022), cultural innovation (Campbell, 2015), elite athletes (Bennett et al., 2017; Scanlan et al., 2011; Sotiriadou and Shilbury, 2009; Torres-Unda et al., 2013), and college basketball (Blanco and Bairner, 2019; Fortunato, 2020).

In addition to recognizing the various contributions made by authors, institutions, and nations, bibliometric analysis contributes to the artistic creation of new works (Sofyan et el., 2022). Up to now, based on research searches, bibliometric reviews on basketball games have been rare. There was only one bibliometric review paper on basketball games conducted by Saiz and Toro (2015). Therefore, this study aimed to review basketball-related scientific publications using the Scopus database. In the authors' opinion, the bibliometric review technique can significantly advance current research on the game of basketball by addressing gaps and creating new study directions. This study provides a fair and up-to-date overview of the subject of basketball using bibliometric analysis and visualisation. The following research topics are the focus of this bibliometric review, which attempts to find and evaluate the literature on training for basketball players from various angles:

1. RQ1: What is the growing trend of publication regarding training purposes of basketball players by year, the language used, and the distribution of document types?
2. RQ2: Which country is the most proactive in publishing articles on training for basketball players?
3. RQ3: Who has the most proactive author and attained top-cited concerning publishing articles related to training for basketball players?
4. RQ4: What are the most popular and significant keywords related to the training for basketball players?

**Justifications for undertaking Bibliometric Study**

There is disagreement in the field about the possible contribution of bibliometric research to developing theory. However, bibliometric research continues to be accepted and proliferates in high-quality sources (such as Scopus) (Mukherjee et al., 2022). This idea is consistent with Breslin and Bailey's (2020) observation that bibliometric studies are often overly descriptive and may lack important theoretical insights. Despite these long-lasting qualities and apparent advantages, it is essential to note that bibliometric analysis tools are not a remedy for improving theory and practice. Furthermore, Lim et al. (2022) reveal that all forms of scientific inquiry, including all forms of review methodologies, have a role in advancing the body of knowledge and understanding in general as long as they are theoretical, well-planned, well-executed, and well-written (Donthu et al., 2021). Given the availability of multiple literature review methodologies (such as content analysis or interpretation) (Gaur and Kumar, 2018) and their ability to coexist in a single review article (such as Ciasullo et al., 2022; Donthu et al., 2022). Thus, the current bibliometric review is proposed to analyse the performance and science mapping that can serve as stepping stones to complement other review methodologies for advancing theory and practice in basketball games, precisely the training aspect.

It has been shown that bibliometric analysis is a reliable technique for finding and analysing literature research and creating a system for studying the literature to uncover publication trends and patterns (Abdullah and Sofyan, 2022). Because so many studies are being published in practically every area of knowledge, bibliometric reviews have become a popular study area (Abd Aziz et al., 2022). Therefore, this review aims to significantly contribute to the advancement of science and the conduct of ever-increasing basketball-related research so that this sport continues to thrive and earn a place in the global society alongside football.

## Material and Method

### *Selecting and searching databases*

The Scopus database, which houses top-notch scientific research, was thoroughly searched in accordance with the objectives of this study. This bibliographic database provides information on high-quality, multidisciplinary research that has significantly impacted the world and enables the consolidation of data sets to contribute to this research (Santamaria-Granados et al., 2021), in addition to the databases that prior researchers from around the world have most frequently used (Abdullah, 2021a; Sweileh, Al-Jabi, AbuTaha, et al., 2017). The Scopus database was chosen because it includes more documents than Web of Science and Pubmed (Sweileh et al., 2017), and it has been frequently used in past studies (Khiste and Paithankar, 2017). In this review, Publish or Perish (PoP) and VOSviewer were utilised in conjunction with Research Information Systems (RIS) data formats to undertake bibliometric analysis (Abdullah, 2021b). The information acquired includes the author's name, the document's source, the year it was published, its title, its scientific source, its topic, and its format.

### *Data retrieval*

On October 29, 2022, data was collected from the Scopus database. Initially, the search strategy based on the TITLE-ABS-KEY was retrieved with a massive amount of metadata. Following a manual examination of existing materials, we discovered that some articles lacked a connection to basketball training. As a result, the search method was updated to include a search string based on TITLE. As a result, 422 credible and defendable sources were utilised in this investigation. This is because the minimum amount of metadata has met the requirement to undertake bibliometric research (Sofyan, 2022). The retrieved data was also valid, as Donthu et al. (2021) clarified that the minimum number of 300 papers for bibliometric analysis was sufficient. Howbeit, the lowest and maximum metadata standards for bibliometric research were not well established (Sofyan et al., 2022). A likely explanation is that neither the number of metadata numbers required for bibliometric analysis nor the minimum and maximum metadata standards that can be evaluated are specified.

The search string and retrieval data in this study are depicted in Table 1. It is noted that the use of conjunction "OR" extends the search publications. In this study, the authors do not intend to use the acronyms of "exercise", "player," and "basketball". The asterisk (*) is utilised by placing it at the end of each keyword search. It has a function representing the initial word that accompanies the used keywords so that the data search is more robust or more data is obtained. In detail, the

keyword exercise* could be retrieved from the keyword exercise, exercises, exercising or exercised. In the same vein, the keyword athlete* could be athletes and athletic.

Table 1

The Search String and Retrieval Data of Sports and Fitness

| Database | Search Field | Search String |
|---|---|---|
| Scopus | TITLE-ABS-KEY = 3,915 document results | (("basketball*") AND ("player*" OR "athlete*" OR "sportsman" OR "sportswoman") AND ("exercise*" OR "training" OR "workout" OR "practice*")) |
| | TITLE = 422 document result | (("basketball*") AND ("player*" OR "athlete*" OR "sportsman" OR "sportswoman") AND ("exercise*" OR "training" OR "workout" OR "practice*")) |

Eliminating duplicate publications is the next step after data collection. This step is in line with the data analysis conducted by Abdullah et al. (2022). According to Abdullah et al. (2022), identical titles, authors, and publishers are used to remove duplicate publishing lists using conditional formatting in Microsoft Excel. Consequently, the proposed procedure determined that there were no identification documents that would be eliminated before the undertake subsequent analysis. Our study showed that 422 retained articles were available and able to run bibliometric analysis.

## Findings

This section traces the evolution of scientific publications related to basketball practice in the Scopus database between 1976 and 2022. It is important to trace the pattern of publications to uncover possible research subjects for future research. It is also important to assist future readers and researchers in determining the importance of the topic in question. This study may interest future scholars who wish to refine the factors determining the rise or fall of year-based publications.

Table 2 shows four periods of growth and development of publications related to basketball players, each experiencing significant growth. The third period (2004–2013), to be precise, in 2010, became the beginning of the growth and development of publications with 13 documents. The fourth period (2013–2022) became the peak of publication growth with 304 documents, including articles in the press. In 2022, as many as five documents were published, with seven types of documents, including articles, conference papers, reviews, book chapters, erratum, letters, and retractions. Then the languages used in the 442 documents are English (385); Spanish (18); Portuguese (11); French (8); Russian (7); Italian (5); Turkish (2); Chinese, Croatian, Czech, Greek, Persian, Polish, and Slovenian (1). Meanwhile, the most prominent scientific source for articles related to basketball players' training is the Journal of Strength and Conditioning Research, which

has published 38 documents. The Journal of Sports Medicine and Physical Fitness ranks second as the leading source in this discipline, with 19 journals published.

Table 2

Distribution of Document Type From 2003-2022 (October 17, 2022)

| Timeline | Year | Total | Document Type | | | | | | | Publication Stage | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Final | Article in Press |
| Period 1 | 1976-1991 | 7 | 7 | - | - | - | - | - | - | 7 | - |
| Period 2 | 1992-2003 | 18 | 18 | - | - | - | - | - | - | 18 | - |
| Period 3 | 2004-2013 | 93 | 84 | 3 | 1 | 3 | 1 | - | 1 | 93 | - |
| Period 4 | 2014-2023 | 304 | 281 | 13 | 6 | - | 2 | 2 | - | 299 | 5 |
| Total | | 442 | 390 | 16 | 7 | 3 | 3 | 2 | 1 | 417 | 5 |

Ket: 1=Article, 2=Conference Paper, 3=Review, 4=Book Chapter, 5=Erratum, 6= Letter, 7=Retracted

***Most productive of country***

Of the 65 countries found, with minimum criteria of 5 (default setting) documents owned by each country, 26 countries were found to meet the threshold as the most productive countries in publications related to basketball training. Spain is the most productive country, with 68 printed publications of academic scientific studies. With 47 and 43 scientific publications, Brazil and the United States are the second and third most productive countries.

Table 3

Top 26 Country Based on Number of Documents, Citations and Total Link Strength

| Country | Doc. | Citation | Total Link Strength | Country | Doc. | Citation | Total Link Strength |
|---|---|---|---|---|---|---|---|
| Spain | 68 | 633 | 47 | Poland | 13 | 165 | 3 |
| Brazil | 47 | 401 | 41 | Canada | 11 | 172 | 17 |
| United States | 43 | 958 | 26 | Lithuania | 11 | 133 | 10 |
| China | 38 | 65 | 4 | Taiwan | 11 | 77 | 1 |
| Italy | 36 | 740 | 30 | France | 10 | 262 | 14 |
| Australia | 30 | 444 | 46 | Chile | 9 | 62 | 21 |
| Turkey | 28 | 112 | 2 | Ukraine | 8 | 47 | 1 |
| Portugal | 25 | 375 | 30 | Indonesia | 7 | 2 | 0 |
| United Kingdom | 25 | 390 | 42 | Japan | 7 | 104 | 5 |
| Iran | 21 | 242 | 18 | Russian federation | 6 | 3 | 0 |
| Greece | 18 | 193 | 3 | Czech republic | 5 | 27 | 1 |
| Tunisia | 15 | 423 | 29 | India | 5 | 11 | 0 |
| Germany | 13 | 94 | 29 | Iraq | 5 | 2 | 0 |

There is no representation from the African continent in the country distribution rankings, indicating that basketball is not a popular sport on the continent. However, there are many professional athletes from Africa. Examples are Hakeem Olajuwon (Nigeria), Dikembe Mutombo (Democratic Republic of Congo), Joel Embiid and Pascal Siakam (Cameroon), and Serge Ibaka (Democratic Republic of Congo/Spain). When combined with the National Basketball Association (NBA), these ten countries represent the world's most prolific source of professional athletes, as well as the most prosperous and magnificent leagues in the world, which every professional athlete wants to join. Among them are developing countries, except Brazil. This shows that basketball is becoming increasingly popular and widely recognised by the general public in industrialised countries.

### *Most productive of auhtors*

From a total of 1,416 authors, it was found that 14 authors met the threshold with predetermined criteria, namely having at least five documents. Figure 1 shows the density visualisation for the 14 most active authors indicated by the total link strength. The more concentrated the red colour appears, the higher the total link strength. Scanlan, A.T., has 11 documents, 169 citations, and ten total link strengths, leading him to be the most productive author compared to others. Moreira, A., Fox, J.L., and Ramirez-Campillo, R. had seven total link strengths in the second. And in third place is Aoki, M.S., who has six total link strengths. One disadvantage of bibliometric studies is the potential for author names to be identical, and they express concern about it (Sofyan and Abdullah, 2022a).

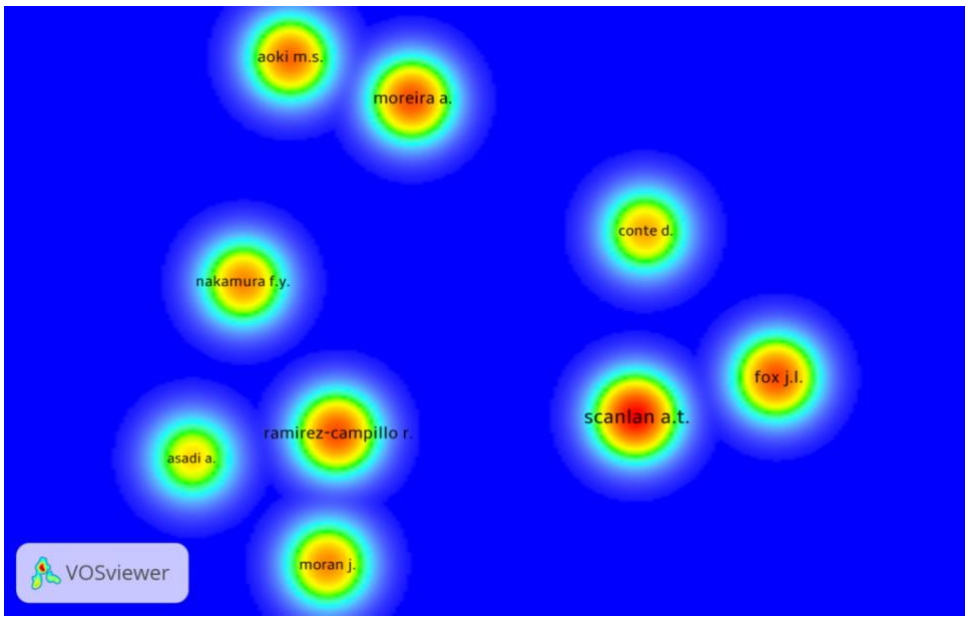


Figure 1

Density visualization for authors

### *Top Citations*

Table 4 shows the ten authors who received the highest citations from their articles. The article written by Manzi et al. (2010) with the title "Profile of weekly training load in elite male professional basketball players" received the most citations, namely 198 citations until this article was written. The research articles conducted by them indicate that the need for a workable and reliable approach to evaluating the training load of each individual is justified. In this study, they demonstrated that session-rate of perceived exertion could be used to evaluate training load without the need for more sophisticated methods (i.e., heart rate monitoring). During a significant part of the competitive season, the session-rate of perceived exertion approach allows the discovery of periodisation trends in weekly planning in elite professional basketball (1 vs. 2 weekly fixture model). Other researchers are described in the table below.

Table 4

Top Ten Author Most Citation

| Cites | Authors | Title | Year | Source |
|---|---|---|---|---|
| 198 | V. Manzi, S. D'ottavio, F.M. Impellizzeri, A. Chaouachi, K. Chamari, C. Castagna | Profile of weekly training load in elite male professional basketball players | 2010 | Journal of Strength and Conditioning Research |
| 160 | D. Matavulj, M. Kukolj, D. Ugarkovic, J. Tihanyi, S. Jaric | Effects of plyometric training on jumping performance in junior basketball players | 2001 | Journal of Sports Medicine and Physical Fitness |
| 115 | M.E. Brown, J.L. Mayhew, L.W. Boleach | Effect of plyometric training on vertical jump performance in high school basketball players | 1986 | Journal of Sports Medicine and Physical Fitness |
| 102 | B.-O. Lim, Y.S. Lee, J.G. Kim, K.O. An, J. Yoo, Y.H. Kwon | Effects of sports injury prevention training on the biomechanical risk factors of anterior cruciate ligament injury in high school Female basketball players | 2009 | American Journal of Sports Medicine |
| 100 | E.J.A.M. Santos, M.A.A.S. Janeira | Effects of complex training on explosive strength in adolescent male basketball players | 2008 | Journal of Strength and Conditioning Research |
| 96 | T.C. Valovich McLeod, T. Armstrong, M. Miller, J.L. Sauers | Balance improvements in female high school basketball players after a 6-week neuromuscular-training program | 2009 | Journal of Sport Rehabilitation |
| 76 | J.L. Fox, R. Stanton, A.T. Scanlan | A Comparison of Training and Competition Demands in Semiprofessional Male Basketball Players | 2018 | Research Quarterly for Exercise and Sport |
| 75 | M. BalÄ›iunas, S. Stonkus, C. Abrantes, J. Sampaio | Long term effects of different training modalities on power, speed, skill and anaerobic capacity in young male basketball players | 2006 | Journal of Sports Science and Medicine |
| 74 | L. Torres-Ronda, A. Ric, I. Llabres-Torres, B. De Las Heras, X. Schelling I Del Alcazar | Position-Dependent Cardiovascular Response and Time-Motion Analysis During Training Drills and Friendly Matches in Elite Male Basketball Players | 2016 | Journal of Strength and Conditioning Research |
| 72 | H. SchrÃ¶der, E. Navarro, J. Mora, D. Galiano, A. Tramullas | Effects of Î±-tocopherol, Î²-carotene and ascorbic acid on oxidative, hormonal and enzymatic exercise stress markers in habitual training activity of professional basketball players | 2001 | European Journal of Nutrition |

***Keyword***

The co-occurrence of author keywords generated by VOSviewer was examined in this study. After that, concurrent keyword networks were performed using VOSviewer software (van Eck and Waltman, 2010, 2021) and thesaurus files to remove duplicate terms from our database. This software is a popular keyword-processing tool (Hoppen and Vanz, 2016). The 904 keywords in our database were used in this study. Before exploring the findings, a thesaurus file with alternative spellings, abbreviations, and combinations of singular and plural has been created (Abdullah, 2022). Keyword design is a significant component that must not be overlooked in order to identify multiple publications that are linked to the research study's topic (Sofyan and Abdullah, 2022b). The minimum number of occurrences is six, after which the thesaurus file is checked along with the retrieval metadata.

The node size affects how often a particular term is displayed in the VOSviewer (see Figure 2). Relationships between keywords are shown as lines. The thickness of the line, which represents the rate of co-occurrence, determines the strength of the nexus link. The overlay diagram in Figure 2 shows the author's keywords, emphasising their relationship to other keywords through colour, node size, text size, and connecting line thickness. As a result, only 35 of the 904 keywords met this requirement with a minimum of 6 occurrences of the keyword. The dark purple diagram nodes reflect previously researched terms, while the yellow nodes represent recently discovered terms during and after 2020.

The VOSviewer results allow us to conclude that the most frequently used keywords in 2014 and 2016 were "training" with (34 occurrences), "vertical jump" (14 occurrences), "periodisation" (8 occurrences), "cortisol" and "creatine kinase" (7 occurrences), "testosterone" with (6 occurrences), In addition, the keyword strength with "basketball" indicated that "training" had (20 links), "vertical jump" had (2 links), "periodisation" (1 link), "cortisol" (1 link), and "creatine kinase" (3 links).

In publications between 2016 and 2018, our cluster mapping results show most of the authors' keywords as follows: "basketball" (125 occurrences), "exercise" (22 occurrences), "strength training" (15 occurrences), "fatigue" (9 occurrences ), "performance" (14 occurrences), and "power" (10 occurrences). In addition, the keyword strength with "basketball" indicates that "exercise" (9 links), "strength training" (3 links), "fatigue" (2 links), "performance" (6 links), and "power" (4 links).

Compared to other terms on the network, "team sports" was identified as the most commonly used keyword between 2018 and 2020, with 33 occurrences. The next most common

keywords during this period were “athletes” with 20 occurrences, followed by “agility” and “sports” with 14 occurrences, and “muscle strength” with 11 occurrences).

The newest keywords starting after 2020 are “athletic performance”, with 18 occurrences, and “maturation”, with 6 occurrences. The keyword “athletic performance” has 17 links with other keywords. This keyword has (10 links) with “basketball”, “muscle strength” (4 links), “plyometric exercise” and “plyometric training” (2 links) ), “resistance training” (1 link), “training load” (1 link), “team sports” (3 links), “power” and “agility” (1 link), “stretch-shortening cycle” (1 link ), “fatigue” (1 link), “physical fitness” (4 links), “ahletes” (1 link), “sports” and “adolescent” (3 links), “exercise” (2 links), “training” (2 links). “Maturation” has four links with other keywords. This keyword has three links with “team sports”, one link each with “agility”, “physical fitness”, and “stretch-shortening cycle”.

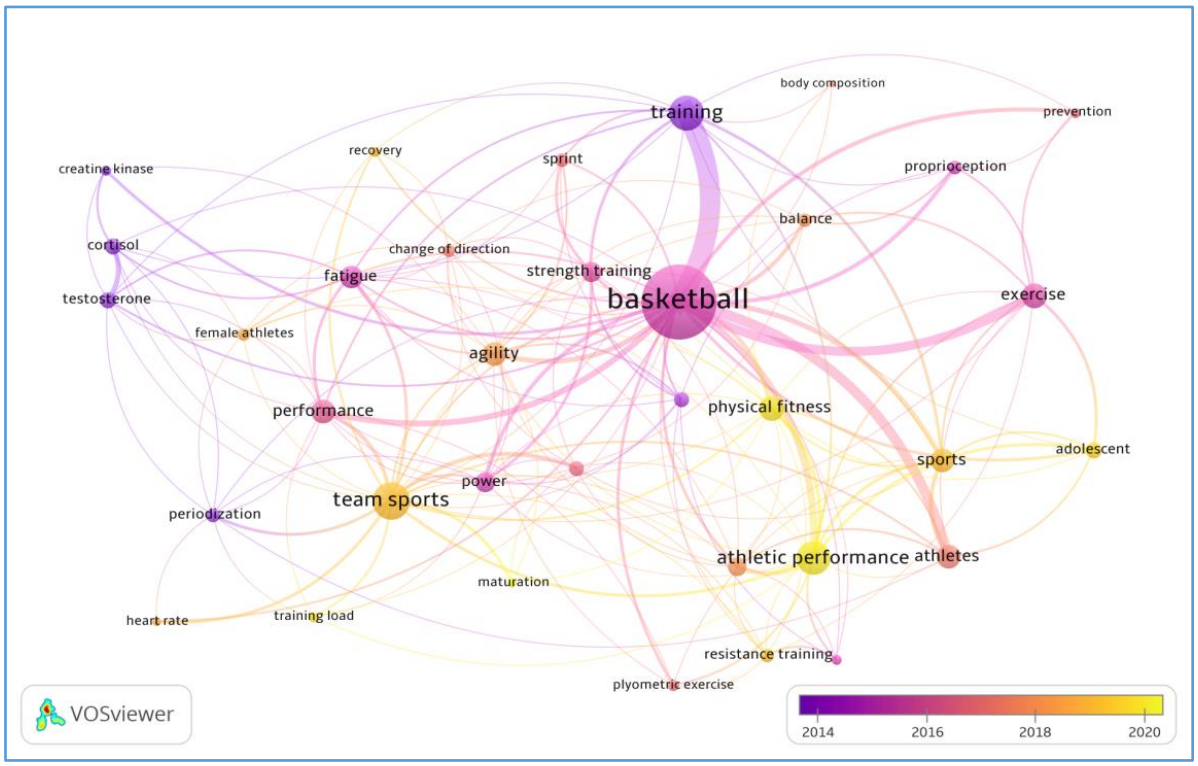


Figure 2

Overlay visualisation of the co-occurrence of authors’ keywords

From 35 keywords in 6 different color nodes (clusters) that have been assembled into the same cluster (blue, red, yellow, dark purple, navy blue, green). The keyword “basketball” is the most popular, denoted by a yellow node that falls into the 4th cluster of five keywords. Keywords are grouped together with “balance,” “exercise,” “prevention,” and “proprioception.” It shows how basketball is associated with the terms that go with it. Further study of these keywords is needed to understand the basketball problem more deeply.

An article written by Balčiunas et al. (2006), entitled "Long-term effects of different training modalities on power, speed, skill, and anaerobic capacity in young male basketball players", was the most popular article of the six clusters in this analysis. This article was also published in the Journal of Sports Science and Medicine, 5(1), 163–170. This article has research results showing that while anaerobic capacity and skill can be maintained at initial levels with both training modalities, they can only be improved in players of the endurance group. Given the game's specific cardiovascular and metabolic characteristics, endurance training (intermittent high-intensity training) may be more useful for preparing junior players.

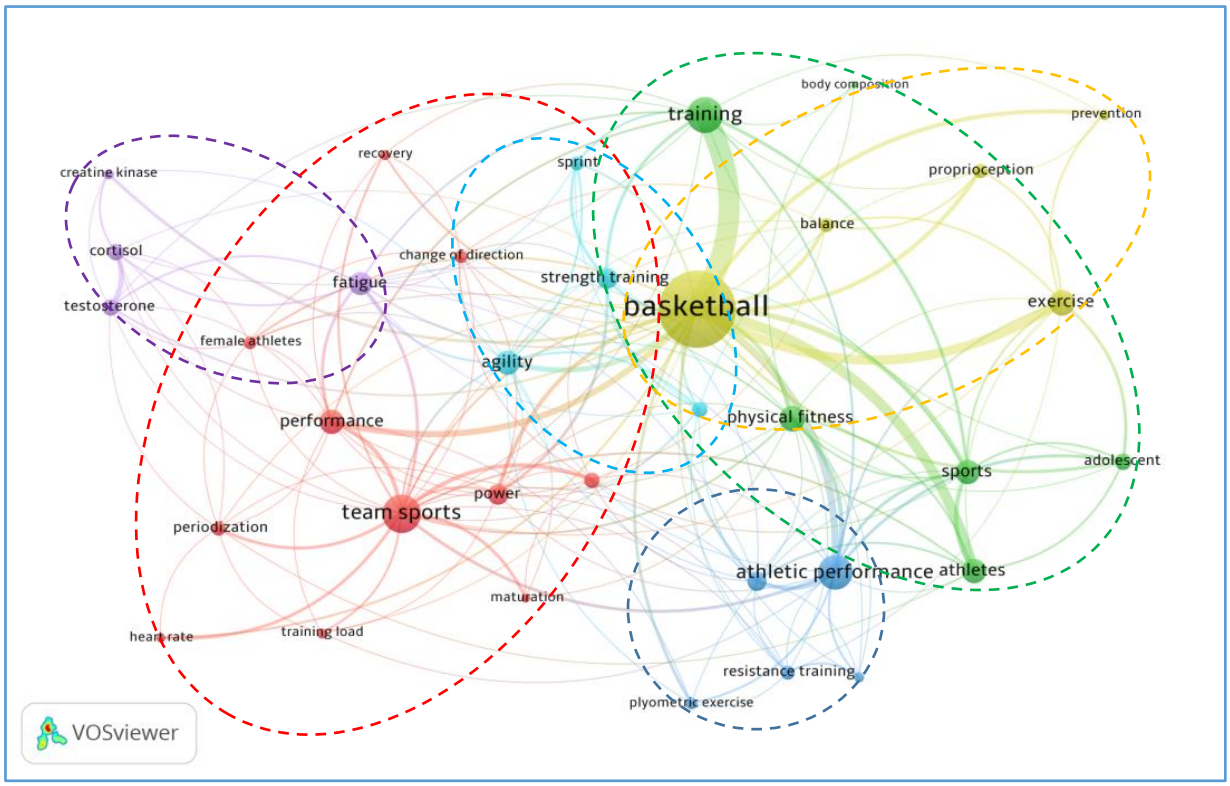


Figure 3

Network visualisation of the co-occurrence of authors' keywords

## Discussion

Based on popular keywords that emerged during and after 2020, we can analyse in more depth the role of training for basketball players to improve their performance. The keywords in question are "maturation", "athletic performance", "training load", "physical fitness", and "adolescent". Of the five keywords, we can combine them into an interesting relationship analysis. Because the ability to measure these physical traits apart from skills is very important, as physical capacities and skills often require different training stimuli to develop (Morrison et al., 2022).

Basketball is usually described as a physiologically discontinuous form of sport (Abdelkrim et al., 2007), requires a large amount of strength, agility, and speed (Ziv and Lidor, 2009), all of which are directly related to a player's technical ability (Apostolidis et al., 2004). Basketball involves many movements with near-maximum intensity (Abdelkrim et al., 2007). So, good ergonomics skills I, II, and III are needed. The VO2max of adolescent basketball players varies greatly, and much of this variation can be attributed to biological maturation, years of training experience, and body composition. Biological maturation and training history indirectly affect aerobic performance through body mass and fat-free mass but independently show a positive relationship with them (Carvalho et al., 2013). The developmental trajectory of young athletes is significantly influenced by their training experience, which is often expressed as years of formal training (Coutinho et al., 2016), and also by biological maturation, particularly in adolescence (Guimarães et al., 2021). Arede et al. (2019) provide evidence of differences between players in technical skill and physical fitness with regard to maturity status and suggest that biological maturity also has a significant influence. Young basketball players perform better as a result of the extra effects of training experience and biological development (Guimarães et al., 2021).

Coaches are increasingly using training load measurement as a strategy to improve athletic performance as it helps in managing player development (Hernandez et al., 2017). In general, it is estimated that situational and individual factors will have an impact on training load and performance in games (Piñar et al., 2022). It is becoming increasingly clear that the training load certainly greatly affects the performance of players. Of course, this must pay attention to age, diet composition, body anatomy, weather, and psychological factors so that in giving the training load there is no overuse or malpractice occurring in the exercise that results in injury during exercise.

## Conclusion

This study provides a quantitative description of the dominant pattern in the field in this study by summarising the findings of a bibliometric examination of the literature on training for basketball players. However, there are limitations to the analysis technique and categorisation of records, which must be taken into account. It is important to remember that bibliometric reviews can be conducted using a variety of databases, such as Google Scholar or Web of Science (WoS), PubMED, and ERIC. A bibliometric review is also hardly worth it on its own. Only publications that match the search criteria and screening requirements specified in the methodology ("exercise" and "basketball") are included.

A clear explanation of the future of basketball training given in this work will greatly help scholars and researchers. It is also useful to significantly add to the already known knowledge of

training for basketball players. This research reveals the status of exercise research for basketball players and the existing knowledge gaps, which can inspire the creation of new studies and global scientific results relevant to training for basketball players and the advancement of this sports industry.

## Researchers' Contribution

The processes related to the introduction, methods, findings and discussion sections of the study were carried out by all authors.

## Conflict of Interest

The author declared that writing this review does not include any conflicts of interest.

## Acnkowledgement

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## References

Abd Aziz, F. S., Harith, S. H., Abdullah, K. H., & Sofyan, D. (2022). Trends and evolution of road user behaviour research: a bibliometric review. *International Journal of Information Science and Management*, *20*(3), 69–93.

Abdelkrim, N. Ben, El Fazaa, S., & El Ati, J. (2007). Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. *British Journal of Sports Medicine*, *41*(2), 69–75. https://doi.org/10.1136/bjsm.2006.032318

Abdullah, K. H. (2021a). Publication trends of leadership excellence: A bibliometric review using VOSviewer. *Advances in Business Research International Journal*, *7*(1), 1–11.

Abdullah, K. H. (2021b). Publication trends on halal tourism: A bibliometric review. *Halalpshere*, *1*(2), 41–53. https://doi.org/10.31436/hs.v1i2.29

Abdullah, K. H. (2022). Mapping of literature on safety knowledge research using ScientoPy and VOSviewer. *Journal of Metrics Studies and Social Science*, *1*(1), 36–49. https://doi.org/10.56916/jmsss.v1i1.75

Abdullah, K. H., & Sofyan, D. (2022). Middle managers and dilemmas in the organisation. *Asian Journal of Research in Business and Management*, *4*(2), 35–49. https://doi.org/10.55057/ajrbm.2022.4.2.4

Apostolidis, N., Nassis, G. P., Bolatoglou, T., & Geladas, N. . (2004). Physiological and technical characteristisc of elite young basketball players. *The Journal of Sports Medicine and Physical Fitness*, *44*(2), 157–163.

Arede, J., Ferreira, A. P., Gonzalo-Skok, O., & Leite, N. (2019). Maturational development as a key aspect in physiological performance and national-team selection in elite Male basketball players. *International Journal of Sports Physiology and Performance*, *14*(7), 902–910. https://doi.org/10.1123/ijspp.2018-0681

Balčiunas, M., Stonkus, S., Abrantes, C., & Sampaio, J. (2006). Long term effects of different training modalities on power, speed, skill and anaerobic capacity in young male basketball players. *Journal of Sports Science and Medicine*, *5*(1), 163–170.

Bennett, E. V., Scarlett, L., Hurd Clarke, L., & Crocker, P. R. E. (2017). Negotiating (athletic) femininity: the body and identity in elite female basketball players. *Qualitative Research in Sport, Exercise and Health*, *9*(2), 233–246.

https://doi.org/10.1080/2159676X.2016.1246470

Blanco, D. V., & Bairner, A. (2019). College basketball governance in the Philippines: actors, stakeholders, issues, and challenges. *Sport in Society*, *22*(3), 361–383. https://doi.org/10.1080/17430437.2018.1490265

Breslin, D., & Bailey, K. (2020). Expanding the conversation through 'Debate Essays' and 'Review Methodology' papers. *International Journal of Management Reviews*, *22*(3), 219–221. https://doi.org/10.1111/ijmr.12234

Calleja-González, J., Terrados, N., Mielgo-Ayuso, J., Delextrat, A., Jukic, I., Vaquera, A., Torres, L., Schelling, X., Stojanovic, M., & Ostojic, S. M. (2016). Evidence-based post-exercise recovery strategies in basketball. *Physician and Sportsmedicine*, *44*(1), 74–78. https://doi.org/10.1080/00913847.2016.1102033

Campbell, B. (2015). Hot sauce and white chocolate: And1 and ghetto style in basketball. *Communication Design*, *3*(1), 51–61. https://doi.org/10.1080/20557132.2015.1057374

Carter, J. E. L., Ackland, T. R., Kerr, D. A., & Stapff, A. B. (2005). Somatotype and size of elite female basketball players. *Journal of Sports Sciences*, *23*(10), 1057–1063. https://doi.org/10.1080/02640410400023233

Carvalho, H. M., Coelho-E-Silva, M. J., Eisenmann, J. C., & Malina, R. M. (2013). Aerobic fitness, maturation, and training experience in youth basketball. *International Journal of Sports Physiology and Performance*, *8*(4), 428–434. https://doi.org/10.1123/ijspp.8.4.428

Ciasullo, M. V., Lim, W. M., Manesh, M. F., & Palumbo, R. (2022). The patient as a prosumer of healthcare: insights from a bibliometric-interpretive review. *Journal of Health Organization and Management*, *36*(9), 133–157. https://doi.org/10.1108/JHOM-11-2021-0401

Coutinho, P., Mesquita, I., & Fonseca, A. M. (2016). Talent development in sport: A critical review of pathways to expert performance. *International Journal of Sports Science and Coaching*, *11*(2), 279–293. https://doi.org/10.1177/1747954116637499

de Groot, S., Balvers, I. J. M., Kouwenhoven, S. M., & Janssen, T. W. J. (2012). Validity and reliability of tests determining performance-related components of wheelchair basketball. *Journal of Sports Sciences*, *30*(9), 879–887. https://doi.org/10.1080/02640414.2012.675082

de Witte, A. M. H., Hoozemans, M. J. M., Berger, M. A. M., van der Woude, L. H. V., & Veeger, D. (H E. J. (2016). Do field position and playing standard influence athlete performance in wheelchair basketball? *Journal of Sports Sciences*, *34*(9), 811–820. https://doi.org/10.1080/02640414.2015.1072641

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*(April), 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Donthu, N., Lim, W. M., Kumar, S., & Pattnaik, D. (2022). The journal of advertising's production and dissemination of advertising knowledge: A 50th anniversary commemorative review. *Journal of Advertising*, *51*(2), 153–187. https://doi.org/10.1080/00913367.2021.2006100

Fortunato, J. A. (2020). The NCAA commission on college basketball: ınstitution maintenance and reputation management in practice. *Journal of Global Sport Management*, *5*(2), 147–166. https://doi.org/10.1080/24704067.2019.1576019

Gaur, A., & Kumar, M. (2018). A systematic approach to conducting review studies: An assessment of content analysis in 25 years of IB research. *Journal of World Business*, *53*(2), 280–289. https://doi.org/10.1016/j.jwb.2017.11.003

Guimarães, E., Baxter-Jones, A. D. G., Williams, A. M., Tavares, F., Janeira, M. A., & Maia, J. (2021). The role of growth, maturation and sporting environment on the development of performance and technical and tactical skills in youth basketball players: The INEX study. *Journal of Sports Sciences*, *39*(9), 979–991. https://doi.org/10.1080/02640414.2020.1853334

Hernandez, D., Casamichana, D., & Sanchez-Sanchez, J. . (2017). La cuantificación de la carga de entrenamiento como estrategia básica de prevención de lesiones. *Revista de Preparación Física En El Fútbol*, *24*(2), 33–39. https://www.researchgate.net/publication/320677274

Hoppen, N. H. F., & Vanz, S. A. de S. (2016). Neurosciences in Brazil: a bibliometric study of main characteristics, collaboration and citations. *Scientometrics*, *109*(1), 121–141. https://doi.org/10.1007/s11192-016-1919-0

Jiang, R. S., & Lee, P. C. (2016). An evolution of the migration of taiwanese female basketball players: From the 'american dream' to the 'chinese dream.' *International Journal of the History of Sport*, *33*(18), 2253–2270. https://doi.org/10.1080/09523367.2017.1311865

Khiste, G. P., & Paithankar, R. R. (2017). Analysis of bibliometric term in scopus. *International Journal of Library and Information Science*, *3*(3), 81–88.

Klusemann, M. J., Pyne, D. B., Foster, C., & Drinkwater, E. J. (2012). Optimising technical skills and physical loading in small-sided basketball games. *Journal of Sports Sciences*, *30*(14), 1463–1471. https://doi.org/10.1080/02640414.2012.712714

Li, F., Li, Z., Borović, I., Rupčić, T., & Knjaz, D. (2021). Does fatigue affect the kinematics of shooting in female basketball? *International Journal of Performance Analysis in Sport*, *21*(5), 754–766. https://doi.org/10.1080/24748668.2021.1945878

Lim, W., Jeong, Y., & Yoo, B. (2022). Rheological information of pudding-thick liquids prepared using commercial food thickeners marketed in korea for dysphagic patients according to the manufacturers' guidelines. *Clinical Nutrition Research*, *11*(1), 1. https://doi.org/10.7762/cnr.2022.11.1.1

Manzi, V., D'Ottavio, S., Impellizzeri, F. M., Chaouachi, A., Chamari, K., & Castagna, C. (2010). Profile of weekly training load in elite male professional basketball players. *Strength And Conditioning*, *24*(5), 1399–1406.

Mateos Conde, J., Cabero Morán, M. T., & Moreno Pascual, C. (2022). Prospective epidemiological study of basketball injuries during one competitive season in professional and amateur Spanish basketball. *Physician and Sportsmedicine*, *50*(4), 349–358. https://doi.org/10.1080/00913847.2021.1943721

Meletakos, P., Chatzicharistos, D., Apostolidis, N., Manasis, V., & Bayios, I. (2016). Foreign players and competitive balance in Greek basketball and handball championships. *Sport Management Review*, *19*(4), 391–401. https://doi.org/10.1016/j.smr.2015.09.002

Morrison, M., Martin, D. T., Talpey, S., Scanlan, A. T., Delaney, J., Halson, S. L., & Weakley, J. (2022). A systematic review on fitness testing in adult male basketball players: tests adopted, characteristics reported and recommendations for practice. In *Sports Medicine* (Vol. 52, Issue 7). Springer International Publishing. https://doi.org/10.1007/s40279-021-01626-3

Mukherjee, D., Lim, W. M., Kumar, S., & Donthu, N. (2022). Guidelines for advancing theory and practice through bibliometric research. *Journal of Business Research*, *148*(April), 101–115. https://doi.org/10.1016/j.jbusres.2022.04.042

Petway, A. J., Freitas, T. T., Calleja-González, J., Leal, D. M., & Alcaraz, P. E. (2020). Training load and match-play demands in basketball based on competition level: A systematic review. *PLoS ONE*, *15*(3), 1–21. https://doi.org/10.1371/journal.pone.0229212

Piñar, M. I., García, D., Mancha-Triguero, D., & Ibáñez, S. J. (2022). Effect of situational and ındividual factors on training load and game performance in liga femenina 2 basketball female players. *Applied Sciences (Switzerland)*, *12*(15). https://doi.org/10.3390/app12157752

Ramos-Campo, D. J., Rubio-Arias, J. A., Ávila-Gandía, V., Marín-Pagán, C., Luque, A., & Alcaraz, P. E. (2017). Heart rate variability to assess ventilatory thresholds in professional basketball players. *Journal of Sport and Health Science*, *6*(4), 468–473. https://doi.org/10.1016/j.jshs.2016.01.002

Rashid, D. M. S., Faraj, S. M. S., & Hedayatpour, N. (2020). The effect of triceps brachii fatigue on shot accuracy of male and female basketball players. *International Journal of Performance Analysis in Sport*, *20*(2), 206–218. https://doi.org/10.1080/24748668.2020.1736410

Sáiz, D. S. L. J., & Toro, D. E. O. (2015). Editorial: Scientific advances in science bibliometric data Basketball: 1990-2015. *Revista de Psicologia Del Deporte*, *24*(3), 7–8.

Santamaria-Granados, L., Mendoza-Moreno, J. F., & Ramirez-Gonzalez, G. (2021). Tourist recommender systems based on emotion recognition—a scientometric review. *Future Internet*, *13*(1), 1–38. https://doi.org/10.3390/fi13010002

Scanlan, A., Dascombe, B., & Reaburn, P. (2011). A comparison of the activity demands of elite and sub-elite Australian men's basketball competition. *Journal of Sports Sciences*, *29*(11), 1153–1160. https://doi.org/10.1080/02640414.2011.582509

Schelling, X., & Torres-Ronda, L. (2016). An integrative approach to strength and neuromuscular power training for basketball. *Strength and Conditioning Journal*, *38*(3), 72–80. https://doi.org/10.1519/SSC.0000000000000219

Scott, B. F., Johnson, J. E., Lower, L. M., & Wanless, E. A. (2019). Competitive balance in interscholastic basketball: An examination of policy and non-policy factors. *Journal for the Study of Sports and Athletes in Education*, *13*(3), 191–213. https://doi.org/10.1080/19357397.2019.1674592

Sofyan, D. (2022). The development of sports management research in ındonesia in the early twenty-first century: A bibliometric analysis. *Indonesian Journal of Sport Management*, *2*(1), 28–37. https://doi.org/10.31949/ijsm.v2i1.2248

Sofyan, D., & Abdullah, K. H. (2022a). College sport publication trends over 15 decades: A bibliometric analysis. *Khizanah Al-Hikmah : Jurnal Ilmu Perpustakaan, Informasi, Dan Kearsipan*, *10*(1), 69–82. https://doi.org/10.24252/kah.v10i1a7

Sofyan, D., & Abdullah, K. H. (2022b). Scientific developments in educational innovation research in Indonesia and Malaysia: a scientometric review. *International Journal of Educational Innovation and Research*, *1*(1), 42–51. https://doi.org/10.31949/ijeir.v1i1.2312

Sofyan, D., Abdullah, K. H., & Hafiar, H. (2022). The philosophy of sport and physical education: four decade publication trends via scientometric evaluation. *Physical Education Theory and Methodology*, *22*(3), 437-449. https://doi.org/10.17309/tmfv.2022.3.20

Sofyan, D., Abdullah, K. H., Akinci, A. Y., Oluwatoyin, I. M., Rojo, J. R., Shompong, S., & Tanucan, J. C. M. (2022). Sports activities during the Covid 19 pandemic: A Bibliometric Analysis. *Journal of Metrics Studies and Social Science*, *1*(1), 50–60. https://doi.org/10.56916/jmsss.v1i1.76

Sotiriadou, K. (Popi), & Shilbury, D. (2009). Australian elite athlete development: an organisational perspective. *Sport Management Review*, *12*(3), 137–148. https://doi.org/10.1016/j.smr.2009.01.002

Sporiš, G., Šango, J., Vučetić, V., & Mašina, T. (2006). The latent structure of standard game efficiency indicators in basketball. *International Journal of Performance Analysis in Sport*, *6*(1), 120–129. https://doi.org/10.1080/24748668.2006.11868360

Svilar, L., & Jukić, I. (2018). Load monitoring system in top-level basketball team. *Kinesiology*, *50*(1), 25–33. https://doi.org/10.26582/k.50.1.4

Sweileh, W. M., Al-Jabi, S. W., AbuTaha, A. S., Zyoud, S. H., Anayah, F. M. A., & Sawalha, A. F. (2017). Bibliometric analysis of worldwide scientific literature in mobile - health: 2006-2016. *BMC Medical Informatics and Decision Making*, *17*(1), 1–12. https://doi.org/10.1186/s12911-017-0476-7

Sweileh, W. M., Al-Jabi, S. W., Sawalha, A. F., Abutaha, A. S., & Zyoud, S. H. (2017). Bibliometric analysis of worldwide publications on antimalarial drug resistance (2006-2015). *Malaria Research and Treatment*, *2017*. https://doi.org/10.1155/2017/6429410

Torres-Unda, J., Zarrazquin, I., Gil, J., Ruiz, F., Irazusta, A., Kortajarena, M., Seco, J., & Irazusta, J. (2013). Anthropometric, physiological and maturational characteristics in selected elite and non-elite male adolescent basketball players. *Journal of Sports Sciences*, *31*(2), 196–203. https://doi.org/10.1080/02640414.2012.725133

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

van Eck, N. J., & Waltman, L. (2021). Manual de VOSviewer. *Univeristeit Leiden*, *July*. http://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.1.pdf

Vanlandewijck, Y. C., Evaggelinou, C., Daly, D. J., Verellen, J., Van Houtte, S., Aspeslagh, V., Hendrickx, R., Piessens, T., & Zwakhoven, B. (2004). The relationship between functional potential and field performance in elite female wheelchair basketball players. *Journal of Sports Sciences*, *22*(7), 668–675. https://doi.org/10.1080/02640410310001655750

Ziv, G., & Lidor, R. (2009). Physical attributes, physiological characteristics, on-court performances and nutritional strategies of female and male basketball players. *Sports Medicine*, *39*(7), 547–568. https://doi.org/10.2165/00007256-200939070-00003