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Review Article

BADMINTON INVESTIGATIONS APPLIED TO SPORTS SCIENCES: A BIBLIOMETRIC AND SCIENTOMETRIC STUDY FROM 1991 TO 2024

INVESTIGAÇÕES EM BADMINTON APLICADAS ÀS CIÊNCIAS DO ESPORTE: UM ESTUDO BIBLIOMÉTRICO E CIENTOMÉTRICO DE 1991 A 2024

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RESUMO
O estudo identificou a produção científica de artigos na temática Badminton na área das Ciências do Esporte entre os anos de 1991 e 2024, considerando as subáreas das Ciências do Esporte, o ano, o continente e os periódicos de publicação, e as características da amostra dos estudos quanto ao tamanho, nível de rendimento, sexo e faixa etária. Os métodos determinados para a análise dos dados foram Bibliometria e Cientometria utilizando-se o termo "badminton". Determinou-se a base de dados SCOPUS para a busca de artigos nas línguas inglesa, espanhola e portuguesa. Com uma amostra resultante de 477 artigos, as subáreas com maior produção foram o Treinamento Esportivo (25,79%), seguida da Saúde (18,66%). No ano de 2023 houve a maior produção na temática Badminton (63), a Europa foi o continente com maior quantitativo de artigos publicados (235) e o *Journal of Sports Science* foi o periódico com maior número de artigos (19). Concluiu-se que a produção de artigos em Badminton é um campo em ascensão, desde 2012 há diversificação de publicações nas subáreas das Ciências do Esporte e os sujeitos dos estudos se encontram desde o nível de iniciação esportiva até o alto rendimento.
Palavras-chave: Bibliometria. Esporte. Badminton. Cientometria.

ABSTRACT
The study identified the scientific production of articles about Badminton around Sports Sciences between 1991 and 2024 considering the subfields of Sports Sciences, the year, continent and journals of publication, and the characteristics of the sample of studies in terms of size, level of performance, gender and age group. The method used to collect the data was Bibliometrics and Scientometrics, using the term "badminton". The SCOPUS database was used to search for articles in English, Spanish and Portuguese languages. With a resulting sample of 477 articles, the sub-areas with the highest production were Sports Training (25.79%), followed by Health (18.66%). In 2023 there was the highest production about badminton (63), Europe was the continent with the highest number of published articles (235) and the Journal of Sports Science was the journal with the highest number of articles (19). It was concluded that the production of articles on Badminton is a field on the rise, since 2012 there has been a diversification of publications in the subfields of Sports Sciences and the subjects of the studies range from the level of sports initiation to high performance.
Keywords: Bibliometrics. Sports. Badminton. Scientometrics.

Introduction

The consultation of existing scientific production constitutes the first stage of research planning, and the systematization of this information allows observing the current state of the themes to be studied. In the field of Information Science there are established ways to describe and evaluate scientific productions, such as the metric methods of Bibliometry, Scientometry, Infometry and Webometry[1,2,3]. The present study from the area of Sports Sciences resorted to the field of Information Science to use the methods of Bibliometrics and Scientometrics in order to investigate the worldwide scientific production related to Badminton.

The Bibliometrics analyzes the frequency, distribution and ranking of scientific production, portraying the development of an area of knowledge through a quantitative approach[1,2]. Scientometry, on the other hand, complements this analysis by interpreting quantitative data, providing information and indicators that seek to measure the productivity of a specific area, in order to outline the growth of a particular branch of knowledge[3]. To date, six

bibliometric studies applied to sports have been found in the literature. Two of these studies are related to futsal[4,5], the third addresses gymnastic exercises[6], the next deals with rugby[7], the fifth investigates topics and disciplines in the sciences of physical activity and Sport[8], and the latter analyzes relative age in Sports Science[9]. Therefore, no studies were found that applied bibliometric and scientometric methodologies in the context of Badminton, this being the defined gap.

The interest in obtaining information about scientific production related to Badminton arose due to the expansion of the sport, both in the competitive field and as curricular content of School Physical Education[10,11]. We sought to investigate whether the number of studies on the subject has also grown, as well as to obtain other information that bibliometric and scientometric methods can provide.

As it is a sport on the rise, the bodies responsible for the management of Badminton have sought to train their coaches through courses chancellored by the Badminton World Federation. In addition to the competitive focus, Badminton has reached universities and schools, expanding the training of future teachers and teachers already in action through the programs Shuttle Time and Shuttle Time University. Manuals in 19 languages and instructional videos are also available with the aim of training a greater number of instructors, ensuring at least a basic quality training[12]. In addition, the Badminton World Federation, as the highest international body, has funded research related to the sport in various areas of Sports Science[13]. These initiatives demonstrate the commitment of the institutions that regulate this sport to foster its growing practice, not only with regard to the number of educated people, but also the quality of the information disseminated. Gaya[14] highlights that, unfortunately, many studies do not aim to contribute to the advancement of sport. Instead, they use its key stakeholders—such as practitioners, athletes, and coaches—merely as data sources for research in various subfields, without ensuring that the resulting knowledge is meaningfully reintegrated into the sporting context, for instance, through practical applications in sports training. Based on this criticism, it is understood that studies of the nature proposed here are useful for the community involved in the sport.

Gaya[14] and Tubino[15] understand sports science as an interdisciplinary area that covers several subareas, such as medicine, sports psychology, sociology, biomechanics, pedagogy and any other field of human knowledge that presents scientific relationships with sports elements. Thus, in the present study, it was decided to subdivide Sports Sciences into the following categories: Health (Medicine, Physiology and Physiotherapy), Sports Psychology, Biomechanics, Pedagogy, Sports Training, Game Analysis and others (including Neurosciences, Optical Engineering and Sociology). This division aimed to identify the niches in which scientific productions related to Badminton fall within the different areas of knowledge.

The objective of the study was to identify the scientific production of articles on Badminton in the area of Sports Sciences, between the years 1991 and 2024, considering the subareas of Sports Sciences, the year, the continent and the journals of publication, and the characteristics of the sample of studies in terms of size, income level, gender and age group.

Methods

Type of research

The research was characterized as descriptive and exploratory, with quantitative approach[16].

Sample

The sample consisted of 477 articles, selected from the SCOPUS database. The articles were classified according to the subareas of Sports Sciences proposed by Gaya[14] and Tubino[15].

Procedures

The research procedures used to achieve the objectives of this study originate from the field of Information Science, specifically through the methods of Bibliometrics and Scientometrics, and follow the sequence outlined below:

1. Survey of publications on Bibliometrics, Scientometrics, Librarianship, Information Science and bibliometric studies in the sports context to develop the theoretical framework;
2. Identification and selection in the SCOPUS database of publications of articles that contained the descriptor " badminton" in the title, in English, Spanish and Portuguese;
3. Classification of selected articles in the subareas of Sports Science;
4. Identification of the year, continent and periodicals of publication, as well as categorization of the study sample in terms of size, income level, gender and age group, based on reading the abstracts and, when necessary, the full text.

The SCOPUS database was chosen for its interdisciplinary character, its availability of articles in final version and its accessibility was through the electronic address: https://www-scopus-com.ez27.periodicos.capes.gov.br/home.uri.

In addition to being from the area of Sports Sciences and taken from the SCOPUS database, another inclusion criterion considered articles published between the years 1991 and 2024. The searches took place from April to August 2017, march to April 2018, January to March 2022 and September 2024. The initial search resulted in 713 articles, however, the final sample consisted of 477 publications, after excluding 236 articles that did not belong to the area of Sports Sciences. The rejected articles were related to Materials Engineering (analyzing products such as shuttlecocks, shoes and rackets) or Information Technology (software development for the analysis of athletes ' performance), in addition to the removal of duplicate articles.

Statistical analysis

The collected data were analyzed through descriptive statistics creating bibliometric and scientometric indicators. The information obtained was organized in a spreadsheet prepared in Microsoft Excel 2010 for Windows®software.

Results

To ensure better reading clarity, the results will be presented according to the objectives set for the study.

Identification of articles considering the subareas of Sports Sciences and the year of publication

A total of 477 articles with the descriptor "badminton" in the title were identified. These articles were classified into seven subareas of Sports Science, namely: Health (89 articles), Sports Psychology (74 articles), Biomechanics (37 articles), Pedagogy (49 articles), Sports Training (123 articles), Game Analysis (74 articles) and others (31 articles) (Figure 1).

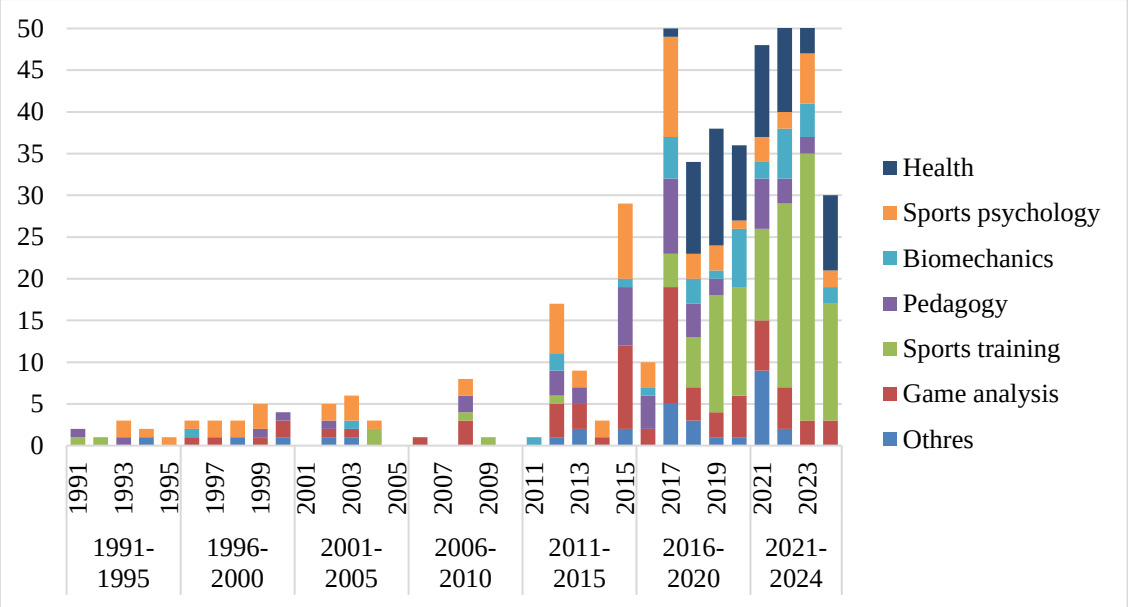

Figure 1. Articles considering the subareas of Sports Sciences and the year / range of publication.
Source: Authors

Articles from the subareas Sports Training and Health represented the highest percentages among the others, with 25.79% and 18.66%, respectively. In sequence, the articles of the subareas Sports Psychology and Game Analysis (15.51% each), followed by Sports Pedagogy (10.27%) and Biomechanics (7.76%). The articles identified as Others (6.5%) addressed topics related to Neuroscience, Optical Engineering, Sociology and Nutrition, which, although directly related to sports, did not fit the other subareas proposed in the classification.

The articles were published over a period of 33 years (1991 to 2024) and analyzed in terms of absolute frequency per year. During the first 21 years, scientific production on the topic of badminton remained limited, with noticeable growth beginning in 2012, when 17 articles were published. In 2014 and 2016, there was a reduction in the number of articles published (4 and 9 articles, respectively). Since 2017, there has been exponential growth in scientific production, with peak publication years in 2017, 2022, and 2023, with 50, 58, and 63 articles published, respectively. Between 2018 and 2020, there was a slight reduction in production, followed by a resumption in subsequent years. It is not possible to determine the total volume of articles published in 2024, since they can still be registered until the end of the year.

As of 2012, the subareas of publication showed greater diversification within the main area of Sports Sciences. The subareas of Sports Training, Health, Game Analysis and Sports Psychology gained greater prominence in the articles published in the following years (Figure 1).

Identification of articles considering the subareas of Sports Sciences and continents

This result took into account the geographical location of the scientific journal to determine the continent of publication of the articles. There was a prevalence of journals from the European continent on Badminton, totaling 235 articles published (49.27%), followed by Asia (31.24%), North America (14, 47%), South America (3.77%), Oceania (1.05%), Africa (0.21%) and Central America (0%) (Figure 2).

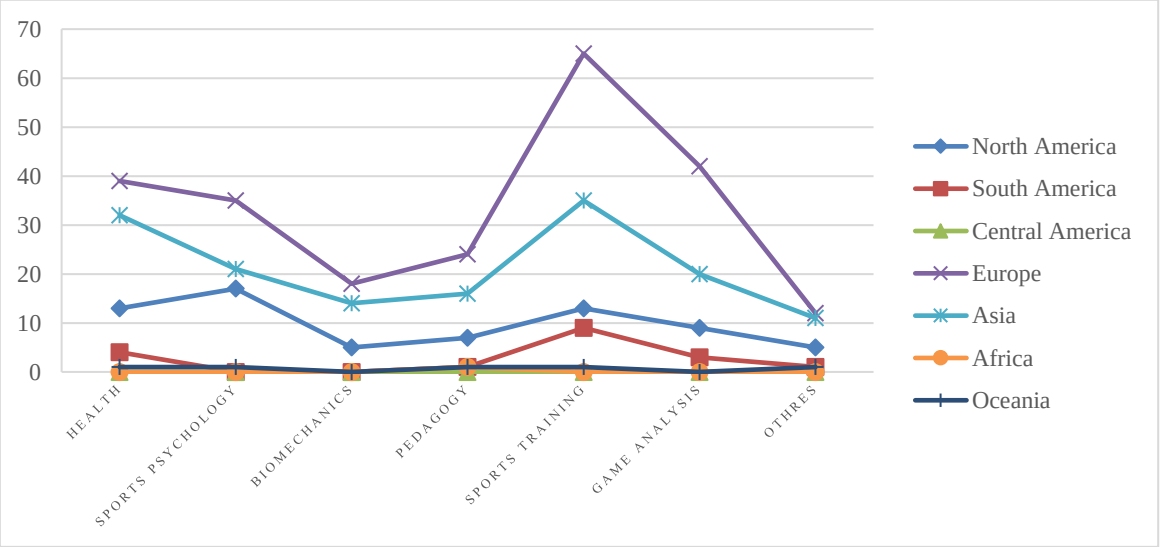

Figure 2. Articles considering the subareas of Sports Science and continent.
Source: Authors

Among the articles published in Europe, there is representativeness in all subareas of Sports Science, the most frequent being Sports Training (65), Game Analysis (42) and Health (39). In Asia, the most prevalent subareas are Sports Training (35), Health (30) and Sports Psychology (21).

Identification of articles considering the journals of publication

We identified 242 Journal sources that published articles on the subject, as shown in Table 1.

Table 1. Number of articles per journal of publication.

	Journals	***f***
1	Journal of Sports Sciences	19
2	Journal of Physical Education and Sport	17
3	Frontiers in Psychology	15
4	International Journal of Human Movement and Sports Sciences	13
5	Revista Brasileira de Medicina de Esporte	11
6	British Journal of Sports Medicine PLoS ONE Journal of Human Kinetics Sports	08
7	International Journal of Environmental Research and Public Health	07
8	Applied Sciences	06
9	Journal of Human Sport and Exercise Retos Science and Sports	05
10	Journal of Human Movement Studies Scandinavian Journal of Medicine and Science in Sports European Journal of Sport Science Sport Mont Acta Medica Mediterranea Applied Bionics and Biomechanics Journal of Physics: Conference Series	04

11	Other journals (n=80)	3 or less

Source: Authors

The Journal of Sports Sciences stands out, having registered the highest number of publications, totaling 19 articles. Regarding the number of authors per work, it was observed that 52.2% of the articles were written by more than three authors, 20.34% by three authors, 17.82% by two authors and 9.64% by only one author.

Characteristics of the study sample in terms of size, income level, gender and age group

The characterization of the sample of articles was carried out based on the reading of the available abstracts, taking into account the variables, size, income level, gender and age group. Among the 477 articles analyzed, it was possible to determine the sample size in 390 of them (Table 2). Single case studies accounted for 18 articles, while most of the investigations were conducted with samples of 2 to 49 subjects. It is noteworthy that 18.24% of the abstracts analyzed did not specify the sample size.

Table 2. Characteristics of the sample published articles.

Sample characteristics	Category	*f*	%
Size	Unique case	18	3.77
	From 2 to 49	265	55.56
	50 to 100	47	9.85
	More than 100	60	12.58
	Undefined	87	18.24
Income level	Elite / Professional	185	38.78
	Amateur	57	11.95
	Beginners	43	9.01
	Schoolers	46	9.64
	Various	48	10.06
	Coaches	7	1.47
	Undefined	91	19.08
Sex	Male	122	25.58
	Female	31	6.5
	Both	155	32.49
	Undefined	169	35.43
Age group (AG)	0-10 years	10	2.1
	11-20 years	82	17.19
	21-30 years	59	12.37
	31-40 years	6	1.26
	41-50 years	2	0.42
	51-60 years	1	0.21
	Over 61 years	0	0
	Undefined	210	44.03
	More than one AG	107	22.43

Source: Authors

Regarding the level of performance of the sample, in 91 articles the information could not be confirmed. Most publications investigated elite/professional Badminton players

(38.78%), followed by studies with schoolchildren (11.95%) and studies that included more than one sample level (10.06%).

Regarding the gender of the participants, it was possible to identify this variable in 308 abstracts. Studies that included both sexes represented 32.49% of the total analyzed. However, a significant portion of the articles did not specify the gender of the participants (35.43%) or age group (44.03%). For this last variable, the age groups with the highest prevalence were 11 to 20 years (17.19%) and 21 to 30 years (12.37%).

Discussion

The articles published on the badminton theme were well diversified in terms of the subareas of Sports Science. The analysis of the data showed the predominance of studies in the subareas of Sports Training and Health. These results corroborate, in part, the study by Devís-Devís et al.[8], which identified the prevalence of the subareas of Medicine and Physiology, treated here as health area, in the historical evolution of scientific knowledge applied to sports practices investigated. They also corroborate the study of Amaral and Massei[17] in karate, which identified the sub-area of Sports Training as the most recurrent in publications.

Gaya[14] emphasizes that the field of sport is clearly characterized as multidisciplinary but criticizes the lack of studies that respond to the specific demands of sports practices. Many subdivisions within the study of the sports phenomenon do not allow for the delimitation of a field of knowledge that fully encompasses the complexity of sport. Accordingly, Devís-Devís et al.[8] highlighted that the epistemological identity of research areas is often questioned, generating debates in the academic community about the relative importance of each area.

The analysis of the articles available in the SCOPUS database revealed that, over 20 years (1991 to 2011), the scientific production in Sports Sciences about Badminton was incipient. The increase in scientific production occurred from the year 2012, with peak publications in 2015, 2017, 2022 and 2023. In the last five years (2019 to 2024), there has been a stabilization in the volume of publications. These results corroborate the study by Bilgiç e Işin[9], who identified 2018 as the peak year for publications on the topic of the relative age effect in Sports Sciences. However, these results demonstrate a delay in the advancement of studies on badminton within the field of Sports Sciences, compared to the study by Villarejo, Palao and Ortega[7] on rugby, which recorded a steady progression starting in 2003.

With regard to the continents of publication, Europe and Asia stood out compared to the others. This fact can be attributed to the popularity of Badminton in Asia, where the sport is widely practiced and concentrates the largest number of medals at World Championships and Olympic Games, followed by Europe, represented by champions from countries such as Denmark, Spain, Great Britain and the Netherlands. The higher production of articles in Europe may also be related to the presence of high-impact journals in the subareas of Sports Sciences, attracting researchers from other continents. These findings corroborate the recent study on the relative age effect in sports science[9], which recorded the highest concentration of publications in Europe (62.14%).

The results indicated a great diversity of publishing journals, totaling 242 different sources. This diversity reflects both the supply of journals and the demand of researchers, who generally prioritize the quality of the journal based on indexes such as JCR, SJR, h-index, Qualis-specific in Brazil, among others. Although bibliometric studies in the area of sports have not analyzed the number of journals, this study suggests that researchers seek partnerships for publication, since most articles were produced by more than three authors. These collaborations expand research networks and enable the division of responsibilities in the preparation of manuscripts, as indicated by Silva et al.[18]

With regard to the sample size, in 55.56% of the studies analyzed the samples included from 2 to 49 subjects. Most of the articles focused on elite/professional athletes, in accordance with the findings of Moore et al.[4] e de Palazón, Ortega, García-Angulo[5] in futsal. Many sports researchers structure their studies from what is called the "gold standard" to then expand the investigations to lower-level players. However, this approach limits scientific knowledge about amateur, beginner, and school-level players, revealing gaps that can be identified and justified through bibliometric and scientometric studies such as the present one.

Regarding the sex of the sample, studies in Badminton stood out for including both sexes and, to a lesser extent, only males. Similar results were observed by Moore et al.[4] and Palazón, Ortega, García-angle[5] in futsal, reflecting the cultural impact on sports practice. In Brazil, for example, it was only in the 1980s that the National Sports Council granted the right to practice various sports by women, including football / futsal[19]. Thus, studies on the distribution of Badminton players by sex and continent, linked to the Badminton World Federation, can contribute to a better understanding of the characteristics of this sport.

Finally, it should be noted that language represented a limitation of this study. Although English is the predominant language in scientific production, it is known that there are articles in Mandarin and other East Asian languages that were not considered due to limitations in the authors' language proficiency.

Conclusion

The study presents new information on the production of scientific articles on Badminton in the period from 1991 to 2024. The subareas Sports Training and Health stood out in quantitative terms of publications. Sports Training focused on studies that sought to understand how different variables influence teaching-learning-training in badminton, aiming to improve sports performance. The Health subarea, on the other hand, addressed studies focused on the prevention and treatment of injuries, in order to minimize the impacts of these problems throughout sports practice.

From 2012, the production of articles began to show growth peaks and a greater stabilization in its number of publications. The largest number of articles was published in journals from the European continent, followed by Asia. The journal with the highest number of articles published was Journal of Sports Sciences, followed by Journal of Physical Education and Sport, Frontiers in Psychology and International Journal of Human Movement and Sports Sciences. The largest volume of studies was conducted with samples ranging from 2 to 49 subjects, predominantly elite/professional players of both sexes, with the age range often unspecified.

As academic and professional implications, the productions of this nature in the area of Physical Education allied to the area of Information Sciences help the systematization of future studies, since they bring a holistic view of certain themes. The need for authors to pay careful attention to the preparation of their work abstracts is emphasized. In reviewing the 477 abstracts analyzed, essential information about the samples was often missing, which hindered the identification of important data in the studies and limited the ability to conduct methodological metric analyses.

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