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Bibliometric analysis: sport pedagogy and physical activity in adolescents

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Abstract
Research in the field of Sport Pedagogy and Adolescent Physical Activity has experienced dynamic development. This study examines trends and advancements in sport pedagogy and adolescent physical activity through a bibliometric analysis approach. By analyzing a total of 714 articles from 2014 to 2024, the study aims to understand the evolution, focus, and contributions of research in this field. Through bibliometric analysis of data obtained from the Scopus database, we investigate scientific publications related to sport pedagogy and adolescent physical activity. The use of VOSviewer software facilitates the visualization of collaboration networks among researchers, institutions, and research topics, providing deeper insights into the structure and dynamics of this research domain. This bibliometric method offers insights into research trends over time, identifies key topics of interest, and highlights contributions from various leading institutions and researchers in the field. The study provides valuable insights for educators, researchers, and policymakers to refine and implement effective physical activity programs aimed at addressing adolescent inactivity and promoting lifelong physical activity. Additionally, this research includes a systematic literature review to map potential future research areas based on current trends, offering comprehensive guidance for upcoming research in this field.
Keywords: Sport Pedagogy, Physical Activity, Adolescents, Bibliometric Analysis.

INTRODUCTION

As time and technology progress, sedentary behavior and lack of physical activity have increasingly become more prevalent among adolescents (Woessner et al., 2021; Ywgne et al., 2024). Sedentary behavior refers to time spent on minimal physical activity, such as prolonged sitting, watching television, playing video games, or using digital devices without significant physical movement (Yulianti et al., 2018). Sedentary behavior among adolescents is now one of the most concerning health issues in many countries (Abonie & Ackah, 2024; Ywgne et al., 2024), including Indonesia (Hanifah et al., 2023). Moreover, sedentary behavior among adolescents is a trigger for various health problems such as obesity, decreased physical fitness, and increased symptoms of anxiety (stress) (Priasmoro & Lestari, 2023). Meanwhile, one of the preventive measures against sedentary behavior is the existence of a school curriculum that includes physical education lessons, which has a significant impact in preventing sedentary behavior (Agafian Dhuha et al., 2023; Valentini & Radici, 2024). Therefore, sport pedagogy and physical activity play an important role in increasing physical activity and addressing sedentary behavior issues among adolescents today (Amor-Barbosa et al., 2022).

Sport pedagogy not only teaches physical skills but also serves as a means to educate students on the importance of physical activity in maintaining physical, mental, and social health (Ivaniuta, 2024; Andika et al., 20243). Structured physical education also aims to build character, motor skills, and a positive attitude towards sports (Anindito & Nabillah, 2023; Filho, 2022). Through an enjoyable and relevant approach, physical education programs can encourage adolescents to be more active, reduce sedentary habits, and develop sustainable healthy lifestyle habits (Faxriddin Qizi, 2022). Furthermore, integrating physical activity into the curriculum can raise students' awareness of the dangers of a sedentary lifestyle, such as the increased risk of obesity, posture problems, and mental issues often

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associated with a lack of physical activity (Freitas et al., 2021; Tafuri et al., 2024). Thus, the application of effective and creative sport pedagogy is essential in shaping a healthier and more active adolescent generation, capable of overcoming the negative impacts of the increasingly widespread sedentary behavior (Takhistov et al., 2022).

In recent decades, the field of sport pedagogy has seen significant development. Various new approaches and methodologies in teaching sports, managing physical activities in schools, and their impact on students have been extensively researched. To understand the direction of development in this field, bibliometric analysis is one tool that can be used to further investigate the existing literature and gain a deeper understanding of the emergence of concepts related to sport pedagogy and physical activity in adolescents.

By applying bibliometric analysis, researchers can explore the evolution of sports pedagogy and understand the impact of physical activity on cognitive, social, and emotional development. Additionally, this approach can reveal research gaps that have yet to be explored, provide insights for future research directions, and support evidence-based decision-making in the development of sports pedagogy and physical activity for adolescents.

Using a bibliometric approach, this study thoroughly examines the evolution of research on sport pedagogy and adolescent physical activity over a ten-year period, from 2014 to 2024. The study aims to map research trends, identify emerging key themes, and explore the contributions of various authors, journals, and institutions in the form of scientific publications in the field of sport pedagogy. The bibliometric analysis of sport pedagogy and physical activity in adolescents aims to explore various publications related to this topic, focusing on research trends, pedagogical approaches used, and the implications of the research for physical education practices. The sections of this study are structured as follows: The next section explains the research methodology, and the third section presents the bibliometric study results. The fourth section concludes the study and provides recommendations for further research in the field of Sport Pedagogy. Additionally, academics, coaches, and researchers can use these findings as a reference to design and implement more effective and relevant physical education programs that meet students' needs.

METHODS

To investigate documents relevant to this finding, we employed bibliometric analysis. Bibliometric analysis serves as a valuable tool for mapping vast scientific literature, similar to systematic literature reviews, ensuring the quality and accuracy of the information used and the results produced (İri & Ünal, 2024). The bibliometric review approach used in this study allows researchers to gain a comprehensive understanding of the knowledge landscape, identify trends, patterns, and relationships among existing research, thus enhancing understanding of the evolution and implications in the field (Han et al., 2023). Furthermore, bibliometric analysis enables researchers to explore collaboration networks among authors, countries, and research topics, which in turn can reveal underlying relationships between these entities (Chen et al., 2023).

For our bibliometric analysis focused on sport pedagogy and physical activity in adolescents, we selected Elsevier's Scopus database as the primary source for this bibliometric research. This involved a comprehensive background analysis covering approximately 288 publications on sport pedagogy and physical activity in adolescents over a 10-year period, from 2014 to 2024. On October 31, 2024, we initiated the search within the Scopus database with the aim of collecting journals and articles. Within this bibliographic repository, which includes over 1000 multidisciplinary subjects, we conducted a bibliometric study focusing on similarity visualization methods.

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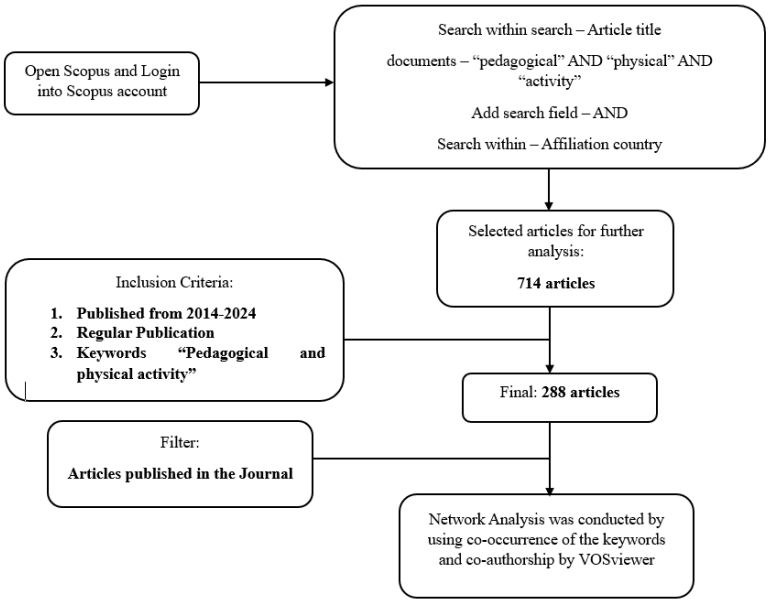

Figure 1: The Process of Document Article Screening in Scopus

The bibliometric data collection process began with accessing the Scopus database. Researchers first logged into the system using a registered account to gain access to various scientific articles. After successfully logging in, a search was conducted using the keywords **"pedagogical" AND "physical" AND "activity"**, focusing on article titles. To refine the search results and enhance data relevance, an additional search field was applied using the **AND** operator, along with a restriction based on the **affiliation country** of the authors.

The initial search yielded **714 articles**, which were identified as potential candidates for further analysis. However, not all of these articles were immediately included in the study. Inclusion criteria were applied to ensure that only articles meeting specific standards were selected. These criteria required that the articles be published within the timeframe of **2014 to 2024**, be **regular publications**, and contain relevant keywords, namely **"Pedagogical and physical activity"**.

Additionally, an extra filtering process was implemented, considering only **articles published in scientific journals**. This further refined the selection, ensuring higher quality and relevance. After completing the selection process, the final number of articles that met all criteria and were ready for analysis was **288 articles**.

The final step in this process was conducting a **network analysis**. This analysis was performed using **VOSviewer**, a software tool that enables researchers to explore relationships between articles based on **keyword co-occurrence** and **co-authorship**, which identifies patterns of collaboration among authors. Through this analysis, research trends and scholarly networks related to pedagogy and physical activity were identified, providing deeper insights into the field. The keywords used in this search are listed below.

TITLE-ABS KEY (pedagogical AND physical AND activity) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "PSYC") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA,"HEAL") OR LIMIT-TO (SUBJAREA, "MEDI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Physical Education")OR LIMIT-TO (EXACTKEYWORD , "Physical Activity") OR LIMIT-TO (EXACTKEYWORD, "Human") OR LIMIT-TO (EXACTKEYWORD, "Article") OR LIMIT-TO (EXACTKEYWORD, "Male") OR LIMIT-TO (EXACTKEYWORD, "Female") OR LIMIT-TO (EXACTKEYWORD , "Humans")) AND (LIMIT TO (LANGUAGE , "English")) AND (LIMIT-TO (OA, "all"))

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RESULTS AND DISCUSSION

Over the past decade, we will analyze trends in scientific publications regarding the number of works produced on sport pedagogy and physical activity in adolescents. We will also provide an in-depth review of the historical development of these publications. Through this bibliometric analysis, readers can gain comprehensive insights into the expansion and shift in research focus, advancements in methods used, and other factors influencing publications over the past decade.

Results

Publication Trends

From 2014 to 2024, researchers from more than 100 countries have published articles related to sport pedagogy and physical activity in adolescents. The overall publication trend in Sport Pedagogy and Physical Activity from 2014 to 2024 is illustrated in Figure 2. The following graph shows that in 2014, only 6 articles were published. Additionally, it is evident that there was a rise in publications in 2019, with 21 articles. Two significant increases in publications occurred in 2020 with 36 publications and in 2021 with 51 publications. During the years 2020-2021 this significant increase is most likely related to the impact of the COVID-19 pandemic. The pandemic caused drastic changes in people's lifestyles globally, including an increase in sedentary behavior due to social restrictions, lockdowns, and the shift to online learning, which reduced daily physical activity among adolescents. However, in 2023, there was a decline to 44 publications and in 2024, there was an increase to 47 publications.

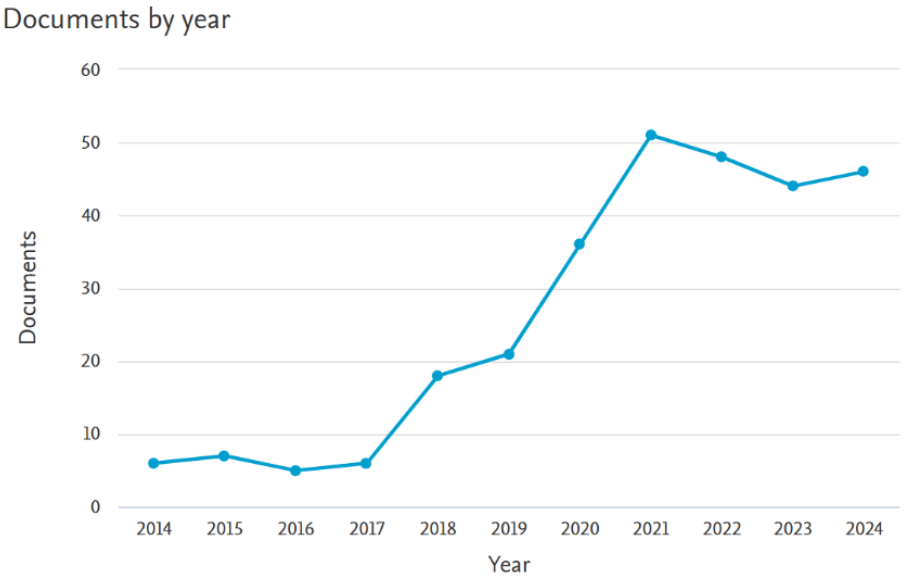

Figure 2: Annual Publication Distribution

Most Cited Authors

Figure 3 shows that among the top 10 most productive researchers, Kolokoltsev, M., and Romanova, E., published articles in the field of sport pedagogy and physical activity in adolescents during the period from 2021 to 2023. For most researchers, after initiating their studies, they continue to publish articles, highlighting the significance of research on sport pedagogy and physical activity in adolescents.

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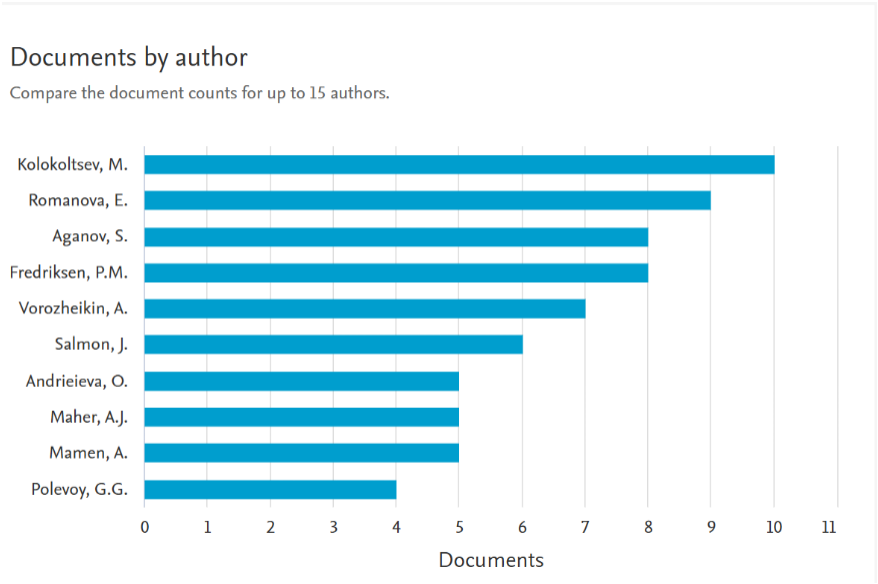

Figure 3: Author Productivity Over Time

Table 1 shows the 10 authors with the most impactful articles in the research on sport pedagogy and physical activity in adolescents. The first position is held by the article published by Martins, with a total of 222 citations. The second position is held by the article published by Goodyear, with a total of 135 citations. The third position is held by the article published by Gordon, with a total of 80 citations. The fourth position is held by the article published by Ferriz-Valero, with a total of 79 citations. The fifth position is held by the article published by Idris, with a total of 71 citations. Meanwhile, consecutively, the articles published by Resaland, Dyrstad, Smith, and García-López each have a totalof fewer than 70 citation

Distribution and Citation Network by Country

In Figure 4, countries with the greatest impact are grouped using the VOSviewer software, based on the number of documents and publications produced in the last ten years. Co-authorship analysis was used to assess collaboration trends among these influential countries. Similar to researchers, we also pursue opportunities to discover new knowledge through collaboration by exchanging diverse knowledge (Mori & Sakaguchi, 2019). Furthermore, as shown in Figure 4, researchers from Europe dominate studies related to sedentary behavior. However, it is still possible for researchers from other continents to contribute by enhancing international collaboration through joint research programs and international conferences, utilizing local data to provide new perspectives, and increasing publications in reputable journals. One of them is the Asian continent which has unique social, economic, and cultural characteristics that can enrich research on sedentary behavior. By implementing these strategies, more researchers from other continents are expected to contribute to the global academic discussion on sedentary behavior and enrich perspectives in this field.

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Table 1: 10 Most-Cited Articles Based on Scopus

No	Document Title	Authors & Year	Citations Total
1	Adolescents' perspectives on the barriers and facilitators of physical activity: A systematic review of qualitative studies	(Martins et al., 2014)	222
2	Young people and their engagement with health-related social media: new perspectives	(Goodyear et al., 2019a)	135
3	Social and emotional learning through a teaching personal and social responsibility based after-school program for disengaged middle-school boys	(Gordon et al., 2016)	80
4	Gamification in physical education: Evaluation of impact on motivation and academic performance within higher education	(Ferriz-Valero et al., 2020)	79
5	Academic experiences, physical and mental health impact of COVID-19 pandemic on students and lecturers in health care education	(Idris et al., 2021)	71
6	Active Smarter Kids (ASK): Rationale and design of a cluster-randomized controlled trial investigating the effects of daily physical activity on children's academic performance and risk factors for non-communicable diseases	(Resaland et al., 2015)	67
7	Young people learning about health: the role of apps and wearable devices	(Goodyear et al., 2019b)	54
8	Physically active academic lessons: Acceptance, barriers and facilitators for implementation	(Dyrstad et al., 2018)	52
9	Physical activity levels and motivational responses of boys and girls: A comparison of direct instruction and tactical games models of games teaching in physical education	(Smith et al., 2015)	51
10	The effects of a sport education season on empathy and assertiveness	(García-López & Gutiérrez, 2015)	49

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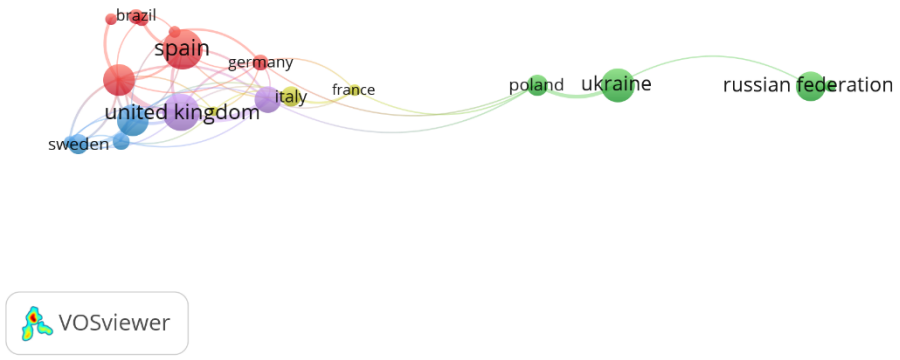

Figure 4: Citation Network Visualization by Country

Figure 4, the top 10 countries based on document production in this field are listed, with Spain leading with 38 documents, followed by the United Kingdom with 34, and Ukraine, Australia, and Norway, each contributing 30, 28, and 28 documents, respectively. Based on the number of citations for published articles, Table 2 lists the top 10 countries. The country with the highest number of citations is the United Kingdom, ranked first with 708 citations. Spain ranks second with a total of 534 citations. Norway ranks third with a total of 336 citations. Australia ranks fourth with a total of 334 citations. The United States ranks fifth with a total of 321 citations. Meanwhile, Ukraine, Sweden, Germany, Poland, and Denmark have fewer than 300 citations. Governments in developed countries can support researchers who are developing fitness technologies with additional funding and data. The top four countries are all developed nations.

Table 2: Source: Scopus Database, Country Distribution Based on Citations, Documents, and Link Strength

Country	Citations	Document	Total Link Strength
United Kingdom	708	34	29
Spain	534	38	13
Norway	336	28	18
Australia	334	28	25
United States	321	22	17
Ukraine	185	30	5
Sweden	125	15	10
Germany	77	11	10
Poland	76	16	7
Denmark	73	7	6

Most Frequently Used Keywords in the Study

Keywords provide essential information about the content of an article, and when two or more keywords appear together in the same article, it is referred to as co-keywords. Co-keyword analysis is used to explore the relationships between concepts or themes in a body of literature, identify association patterns, and help uncover clusters of related research topics (Alipour et al., 2022). This method is highly

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effective for revealing the knowledge structure and research trends in a particular literature, highlighting connections between ideas and themes, and identifying emerging and declining trends across different research fields (Ozek et al., 2023). In the context of scientific knowledge, co-word analysis is effectively used to identify popular research topics and define the boundaries of the research (Osareh et al., 2023).

In this study, we created a co-keyword graph using the co-keyword function in VOSviewer, applying a fractional counting method, setting a minimum occurrence of 6 for keywords, and using author keywords as the unit of analysis. Each cluster has been grouped and presented in Table 3 and Figure 5, the cluster analysis.

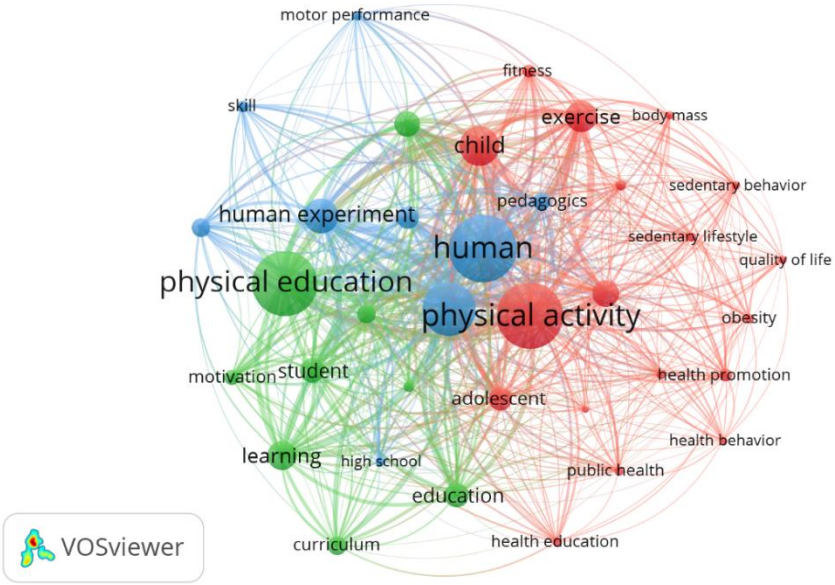

Figure 5: Network Visualization in Sport Pedagogy and Physical Activity in Adolescents

Table 3: Clusters and Keywords Based on VOSViewer

Cluster	Item	Colour	Percent	Total
1	Adolescent, body mass, child, exercise, fitness, healt behavior, health education, health promotion, lifestyle, obesity, physical activity, physical fitness, pubic health, quality of life, school, sedentary behavior, sedentary lifestyle.	Red	54%	17
2	Controlled study, curriculum, education, learning, motivation, physical education, psychology, student.	Green	26%	8
3	Adults, article, high school, human, human experiment, motor performance	Blue	20%	6

Discussion

Based on the research findings, several key discoveries have emerged regarding research trends and contributions in the field of sport pedagogy and physical activity in adolescents from 2014 to 2024. The analysis of publication trends reveals fluctuating patterns over the years, with the highest peak in 2021, indicating an increased interest and investment in this field of study. This growth highlights the growing recognition of the importance of sport pedagogy in supporting physical activity in adolescents. The article with the highest impact based on citation was written by Martins et al. (2014), titled "Adolescents' perspectives on the barriers and facilitators of physical activity: A systematic review of qualitative studies," which has collected 155 citations. This article examines adolescents' perspectives

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on the barriers and facilitators of physical activity through a systematic review, finding that attitude, motivation, family support, and positive experiences in physical education play important roles in physical activity participation.

Figure 3 highlights the significant contributions of the 10 most productive researchers, such as Martins, J., Goodyear, V.A., Gordon, B., Ferriz-Valeri, A., and Idris, F., who have published numerous articles providing insights into this field. Their contributions not only enrich academic discussions but also reflect a commitment to developing knowledge and innovation in the adaptation of sport pedagogy and physical activity for adolescents. Additionally, citation analysis emphasizes the significant influence of Martins, J., highlighting the wide-reaching impact of his work in this area. Tables 2 and 3 provide an overview of global research productivity and impact. The United Kingdom emerges as the leader in terms of the number of cited documents, followed by Spain and Norway. This leadership is more clearly illustrated in Figure 4, which shows the collaborative network among countries. The United Kingdom is at the center, with strong collaborations involving Spain and Australia, demonstrating the global nature of research efforts in sport pedagogy and physical activity for adolescents.

Furthermore, this study utilizes keyword analysis to reveal thematic clusters and relationships between research topics. This methodological approach allows for the identification of key themes and emerging trends in the literature, providing a structured understanding of the interconnections between ideas and facilitating future research directions. By mapping keyword clusters, this study contributes to refining and expanding the scientific discourse on sport pedagogy and physical activity for adolescents. From the emerging keywords, it is clear that sport pedagogy and physical activity for adolescents are important topics to explore. Physical activity has a significant impact on sedentary behavior and obesity. This can be seen in the clusters and keyword occurrence percentages, such as in cluster 1: "Adolescents, body mass, children, exercise, fitness, health behavior, health education, health promotion, lifestyle, obesity, physical activity, physical fitness, pelvic health, quality of life, school, sedentary behavior, sedentary lifestyle," which are frequently mentioned in the documents analyzed. However, there are still many issues that have not been explored in depth or require further investigation, such as how sport pedagogy approaches to adolescent physical activity can influence obesity levels or sedentary behavior habits.

Overall, this comprehensive analysis provides valuable insights into the evolution, trends, and collaborative dynamics of research in sport pedagogy and physical activity for adolescents. These findings not only provide valuable information for current scientific knowledge but also serve as a guide for future research aimed at increasing physical activity in adolescents to prevent obesity or sedentary behavior through sport pedagogy interventions.

Bibliometric analysis indicates a growing number of publications on sports pedagogy and physical activity, with increasing emphasis on evidence-based approaches and innovative methods in physical education. Studies examining the relationship between physical activity and adolescent mental health have gained more attention in recent years, as reflected in citation trends (Zhang et al., 2024). Additionally, global collaboration in this field continues to expand, with more interdisciplinary research linking sports pedagogy to health sciences, psychology, and educational technology (Meier et al., 2023). Understanding these trends can help guide future research in developing more effective strategies to enhance adolescent physical activity (Ni, 2023).

This study has several limitations that should be considered. First, the reliance on English-language publications indexed in Scopus may result in language bias, overlooking valuable research published in other languages. Second, the use of Scopus could introduce publication bias, as it does not cover all relevant literature, particularly from non-indexed sources or more specific areas. Third, the analysis is limited to data available up to 2024, which may not include the most recent developments after this period. Fourth, despite the keyword selection, some relevant articles may have been missed, which could affect the completeness of this study. Finally, although bibliometric analysis provides quantitative insights, it may not capture the qualitative nuances or contextual details provided by individual studies, suggesting the need for careful interpretation of these findings. These limitations highlight the need for future research to address these gaps and provide a more comprehensive understanding of sport pedagogy and physical activity for adolescents.

These limitations highlight the need for future research to address these gaps and provide a more comprehensive understanding of sport pedagogy and physical activity for adolescents, particularly in the field of education. One possible direction for development is exploring multilingual studies to be

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more inclusive and reflect a broader global perspective on sport pedagogy. Additionally, a mixed-methods approach that combines bibliometric analysis with qualitative methods, such as in-depth interviews and case studies, could offer a more contextualized understanding of how sport pedagogy is applied in different educational systems worldwide. With the advancement of digitalization in education, further research could also explore the role of technology, such as virtual reality (VR), AI-based fitness applications, or gamified learning, in enhancing adolescents' physical activity within school environments.

Furthermore, longitudinal analysis can be conducted to understand trends in adolescent participation in physical activity over time and evaluate the effectiveness of educational interventions aimed at increasing their engagement in sports. Contextual studies in underrepresented regions are also crucial, as research in this field is still predominantly led by developed countries, while data from developing nations particularly in Asia, Africa, and Latin America remains limited. By implementing these strategies, future research is expected to provide more comprehensive and applicable insights in shaping more inclusive and effective policies and practices in sport pedagogy across different educational systems.

CONCLUSION

Overall, this study provides a comprehensive insight into the evolution, trends, and collaborative dynamics of research in sport pedagogy and physical activity for adolescents from 2014 to 2024. The analysis reveals fluctuating publication patterns with a significant peak in 2021, highlighted by the influential article by Martins et al. (2014), titled "Adolescents' perspectives on the barriers and facilitators of physical activity: A systematic review of qualitative studies." Leading researchers such as Martins, J., Goodyear, V.A., Gordon, B., Ferriz-Valeri, A., and Idris, F., have played a crucial role in advancing knowledge through their productive publications. The dominance of Spain in document production and the United Kingdom in citation production, along with strong international collaborations visualized in Figure 4, emphasizes their leadership and influence in shaping the global research agenda. However, limitations related to language bias, publication selectivity, and the bibliometric approach suggest future research directions that explore broader literature sources and qualitative dimensions to deepen the understanding and application of sport pedagogy and physical activity for adolescents in a more comprehensive manner. However, limitations related to language bias, publication selectivity, and the bibliometric approach indicate the need for future research to explore a broader range of literature sources and qualitative dimensions. Future studies could focus on longitudinal analysis to understand long-term trends in sport pedagogy and physical activity among adolescents, exploring socio-cultural factors influencing physical activity across different regions, and developing more effective intervention models to enhance adolescent participation in physical activity within various educational and social contexts.

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