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PHYSICAL EDUCATION AND THE SDGS: A DECADE OF RESEARCH TRENDS THROUGH BIBLIOMETRIC ANALYSIS -2015-2024

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Abstract
This study aims to map scientific trends and global contributions in the field of physical education, sports, and physical activity in relation to the achievement of the Sustainable Development Goals (SDGs) through a bibliometric approach. A total of 393 documents indexed in the Scopus database (2015–2024) were analyzed using VOSviewer software version 1.6.20. The methods applied included co-word analysis to identify key themes, co-authorship analysis to explore collaboration networks, and co-citation analysis to trace the most influential literature. The findings indicate a significant increase in publication output since 2020. Research output is predominantly composed of journal articles (61%), highlighting the prevalence of both empirical and conceptual contributions. In terms of source type, 79% of the documents were published in peer-reviewed scientific journals, indicating strong engagement with reputable academic platforms. Spain emerged as the most productive country, with Baena-Morales, S. as the leading author and Universitat d'Alacant as the most prolific institution. Dominant keywords such as sustainable development goals, physical activity, and humans reflect a growing global focus on integrating physical activity and physical education within the sustainability agenda. This study underscores the need for enhanced multidisciplinary collaboration and increased engagement from developing countries to accelerate the achievement of the SDGs through physical education.

Keywords: Physical education, physical activity, SDGs, sport

Introduction

Sustainable development is a global concept that has evolved since the introduction of the Millennium Development Goals (MDGs), which outlined eight key targets to address development challenges, particularly in developing countries(Baena-Morales & González-Víllora, 2023; Stewart, 2015). Fifteen years later, this initiative was expanded through the Sustainable Development Goals (SDGs), comprising 17 interconnected global objectives set to be achieved between 2015 and 2030 (Stewart, 2015). However, various studies indicate that the progress toward achieving the SDGs remains uneven and faces significant challenges across multiple sectors (Zamora-Polo et al., 2019). This highlights the urgent need for cross-sectoral collaboration among governmental and non-governmental institutions to accelerate the implementation of the global agenda.

The fields of sport and physical education play a strategic role in supporting sustainable development. At the Sixth International Conference of Ministers and Senior Officials Responsible for Physical Education and Sport (MINEPS VI), UNESCO identified three priority areas: expanding access to sport and physical activity, integrating inclusive and high-quality physical education, and

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leveraging sport as a tool for development and peace (De Soysa & Zipp, 2019). These priorities align closely with several SDGs, particularly SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), and SDG 10 (Reduced Inequalities).

Education for Sustainable Development (ESD) has also emerged as a critical approach for achieving the SDGs. ESD aims to equip learners with the knowledge, skills, values, and attitudes necessary to contribute to a society that is economically, socially, and environmentally sustainable (Stewart, 2019; Tsyhura & Harkusha, 2023). UNESCO and UNECE advocate for the integration of ESD at all levels of education, including physical education, as part of a holistic framework that fosters environmental awareness, social responsibility, and healthy lifestyles (Boni et al., 2016; UNESCO, 2020). In line with these developments, research exploring the link between physical education, sport, and physical activity in the context of the SDGs has gained increasing momentum. Consequently, bibliometric analysis is needed to map research trends, scholarly collaborations, and the thematic evolution of this field. This study aims to identify recent scientific contributions that integrate physical education and sport within the framework of sustainable development. The main objectives of this study were to (1) analyze publication trends, documents types, sources, and country contribution in physical education, sports, and physical activity research related to SDGs, (2) identify prominent authors, affiliated institutions, subject areas, and funding sponsors contributing to this field, and (3) evaluate highly cited articles that have guined consistent academic attention.

Literature Review

Physical literacy

Physical literacy is a fundamental concept in modern physical education, developed by Margaret Whitehead. It emphasises not only motor skills and movement competence but also includes dimensions such as motivation, confidence, knowledge, and understanding that encourage individuals to engage in lifelong physical activity (Whitehead, 2010). This concept aligns with a holistic approach to sustainable learning, where physical activity is not merely viewed as a component of physical fitness but as an integral part of character education, social responsibility, and the development of healthy lifestyles. Physical literacy supports the achievement of SDG 3 (Good Health and Well-being) and SDG 4 (Quality Education), particularly in relation to sub-targets that emphasise the importance of education in fostering life skills and overall well-being.

In the context of empirical research, (Cairney et al., 2019) found that children with higher levels of physical literacy tend to engage in more physical activity, exhibit better emotional regulation, and achieve higher academic outcomes. Physical literacy also serves a crucial mediating role between social environmental support and the development of healthy behaviours. Their study confirms that enhancing physical literacy through physical education can be a long-term preventive strategy to address various public health issues such as obesity, sedentary lifestyles, and stress. Thus, the development of physical literacy is not solely a matter of physical education but a vital component of broader solutions to contemporary health challenges.

Sustainable development goals

The Sustainable Development Goals are a global agenda established by the United Nations (UN) to create a more just, inclusive, and sustainable world by 2030. The SDGs consist of 17 goals that encompass various aspects of development, ranging from poverty alleviation and improved

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quality of education to good health and well-being (UNESCO, 2024). The 2024 UN report highlights that, although progress has been made in several sectors, global achievements remain uneven, mainly due to the long-term impacts of the COVID-19 pandemic and the worsening climate crisis (United Nations, 2024).

In the health sector, the report indicates a significant regression in access to basic health services, including immunization and maternal and child health care, particularly in developing countries (United Nations, 2024). This underscores the urgency of integrating preventive and promotive approaches into health policies and practices. In the context of education, there is a growing gap in access and learning quality, especially among marginalized groups and in rural areas (United Nations, 2024). Therefore, transformative and inclusive learning strategies—such as integrating sustainability-based values into higher education—are essential to support the holistic achievement of the SDGs. Education plays a central role in advancing the SDGs, not only as a goal in itself but also as a lever for achieving other goals (UNESCO, 2020). Transformative education can foster critical awareness, social values, and sustainable behaviors among the younger generation (Rodríguez Aboytes & Barth, 2020).

Sport for development and peace

Sport for Development and Peace (SDP) positions sport and physical activity as strategic tools for social development, community empowerment, and the promotion of peace. Sport can be leveraged to achieve a range of development goals, such as reducing inequalities, empowering women, and creating inclusive spaces for social engagement (UNESCO, 2015). Within the context of physical education, this theory provides opportunities to engage students in community-based projects, values education, and the strengthening of social cohesion through sporting activities. A study by (Burnett, 2020) Conducted in South Africa, the study revealed that community sports programs contribute to increased youth participation in social activities, the development of life skills, and the reinforcement of social identity and self-confidence among marginalised adolescents. In addition, (Baena-Morales et al., 2023) emphasize that implementing a physical education curriculum grounded in SDP values can raise students' awareness of social justice, gender equality, and peace-related issues. This suggests that physical education, when integrated with SDP principles, can make a significant contribution toward achieving SDG 5 (Gender Equality), SDG 10 (Reduced Inequalities), and SDG 16 (Peace, Justice, and Strong Institutions). Therefore, physical education can serve as an effective instrument of social transformation through a human-centred development approach.

Methodology

Research design and approach of the study

This study employs a bibliometric analysis approach aimed at understanding research trends, identifying influential authors and institutions, and mapping the relationships between topics within the field of physical education, sports, and physical activity in relation to the achievement of the Sustainable Development Goals (SDGs). Bibliometric analysis enables the exploration of large volumes of scientific data to gain in-depth insights into the development and patterns of scholarly research (Donthu et al., 2021). This method provides not only descriptive information about publications, authors, institutions, and countries but also illustrates citation patterns, collaboration networks, document types, and thematic distributions (Hassan & Duarte, 2024). By combining

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quantitative data with qualitative interpretation, bibliometric analysis serves as a powerful tool to systematically examine publication trends and the intellectual structure of a research field (Paul & Barari, 2022).

In this study, network analysis was utilized to explore the relationships among various elements in the academic literature, including authors, institutions, keywords, and journals. This technique visualizes patterns of collaboration, citation networks, and the intellectual structure of the discipline. The specific analyses applied were: (1) co-word analysis to identify topic trends and major themes; (2) co-authorship analysis to examine collaboration patterns among authors, institutions, and countries; and (3) co-citation analysis to identify the most influential articles and authors based on shared citation patterns. All visualization and mapping processes were conducted using VOSviewer version 1.6.20, a software specifically designed for generating interpretable bibliometric network maps.

Data collection procedure

The data were retrieved from the Scopus database, selected due to its broad indexing coverage, high academic credibility, and capacity for exporting data suitable for systematic bibliometric analysis (Oktavianus et al., 2025). Scopus is recognized as one of the most reliable sources for international research, particularly in large-scale bibliometric studies that require integrated scientific data.

The search results were analyzed using VOSviewer version 1.6.20, which is specifically designed to visualize and explore bibliometric networks. This tool enables the mapping of publications based on keyword co-occurrence, citation, co-citation, and co-authorship networks, offering conceptual and structural insights into the knowledge base of a specific domain (Kusnoto et al., 2024). In this study, VOSviewer was used to produce bibliographic and keyword co-occurrence maps. The document search was conducted on March 18, 2025, using the Scopus database and applying the inclusion criteria detailed in Table 1. The search strategy focused on literature addressing the contribution of physical education, physical activity, and sport to the achievement of the SDGs. The initial search yielded 443 documents, which were subsequently filtered based on the following criteria: (1) publication year between 2015 and 2024, (2) fully published (final) documents, and (3) written in English. After filtering, a total of 393 documents met the inclusion criteria and were exported in CSV format for further analysis using VOSviewer.

Table 1. *Document search criteria*

Criteria	Description
Source Database	Scopus
Search within	Article title, abstract, keyword
Search Document	TITLE-ABS-KEY ("physical education" OR "physical activity" OR sport AND "Sustainable Development goals" OR "Education for Sustainable Development Goals")
Documents found	443
Years	2015-2024
Publication Stage	Final
Publication Language	English
Documents Final	393

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Results

Analysis of research output trends, document types, sources, and countries in physical education, physical activity and sport research to promote the SDGs

An analysis of research output trends, as illustrated in Figure 1, shows a significant increase in the number of publications from only 2 documents in 2015 to 109 documents in 2024. A major surge began in 2020 (with 26 documents) and continued to rise steadily, reaching its peak in 2024. The average number of publications per year has shown consistent growth since 2020, indicating increasing academic interest in the subject. Research trends related to physical education, sport, and physical activity in the context of the Sustainable Development Goals (SDGs) have demonstrated substantial growth over the past decade.

This surge in publication activity after 2020 is likely influenced by heightened global attention to public health issues due to the COVID-19 pandemic. The pandemic spurred research on the importance of active lifestyles and physical education as vital components in strengthening public health resilience (Jurak et al., 2020). With growing scholarly focus on this area, the field of physical education and sport is expected to continue playing a pivotal role in advancing the SDGs on a global scale.

Figure 1. *Distribution graph by year of publication of physical education, physical activity, and sport research to promote the SDGs*

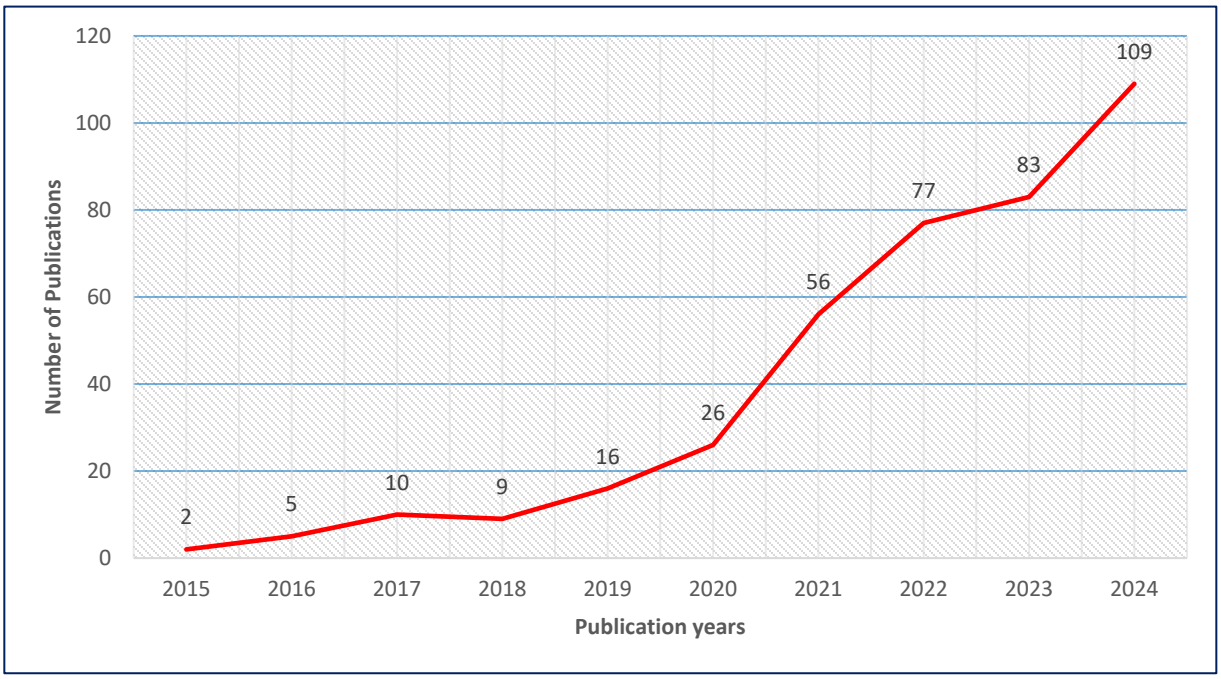

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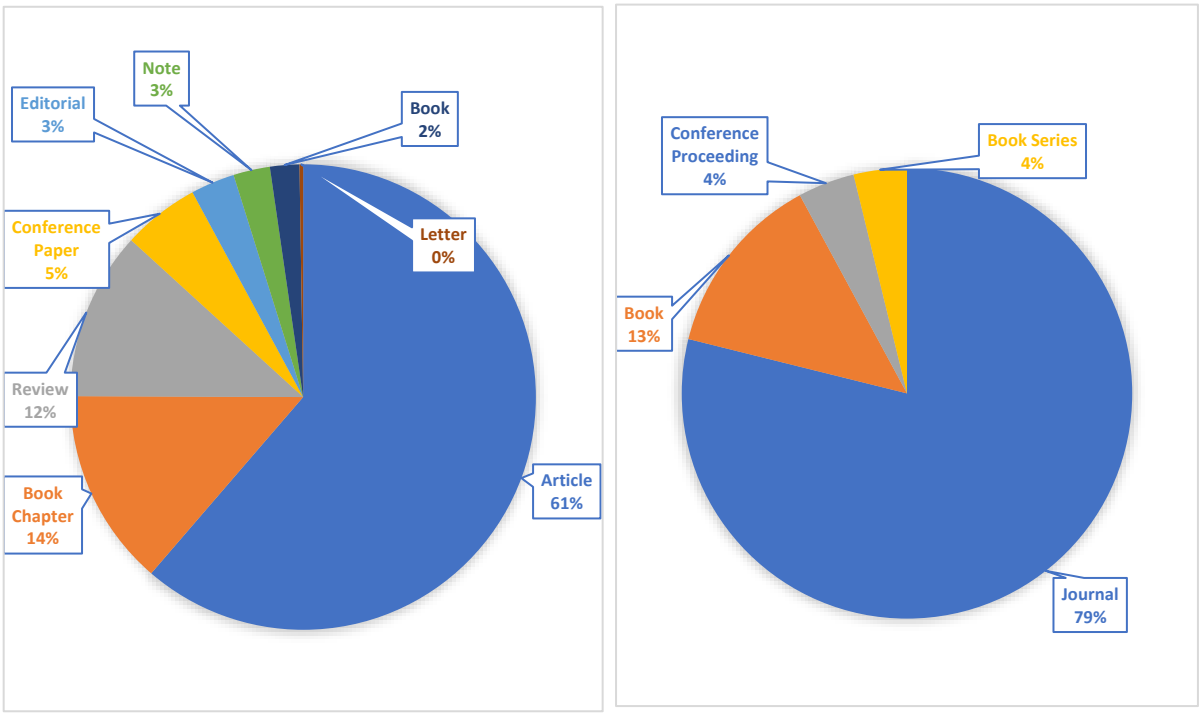
Figure 2. *Document type (a) and Source (b) research on physical education, physical activity and sport to promote SDGs*



The analysis of Figure 2 reveals that journal articles represent the most dominant form of publication in research related to physical education, sport, and physical activity in support of the Sustainable Development Goals (SDGs), accounting for 61% (241 documents) of the total output. This is followed by book chapters at 14% (54 documents) and review articles at 12% (46 documents), indicating a notable contribution of conceptual frameworks and systematic reviews to this field. Meanwhile, conference proceedings 5% (21 documents), editorials 3% (12 documents), notes, books, and letters contributed smaller shares but still reflect the diversity of scholarly dissemination formats in this area of study. In terms of source types, peer-reviewed academic journals constitute the predominant platform for dissemination, comprising 79% (310 documents) of the total. This is followed by books 13% (52 documents), conference proceedings 4% (16 documents), and book series 4% (15 documents). These figures underscore the critical role that journals play in legitimizing and amplifying scientific discourse in this field. Furthermore, the presence of publications across a variety of formats, especially those with practical, multidisciplinary, or community-based orientations, suggests that research in this area is not only growing in volume but also in its methodological and contextual reach. The dominance of journal publications reinforces the perception that this area of inquiry is receiving substantial and sustained attention from the global academic community.

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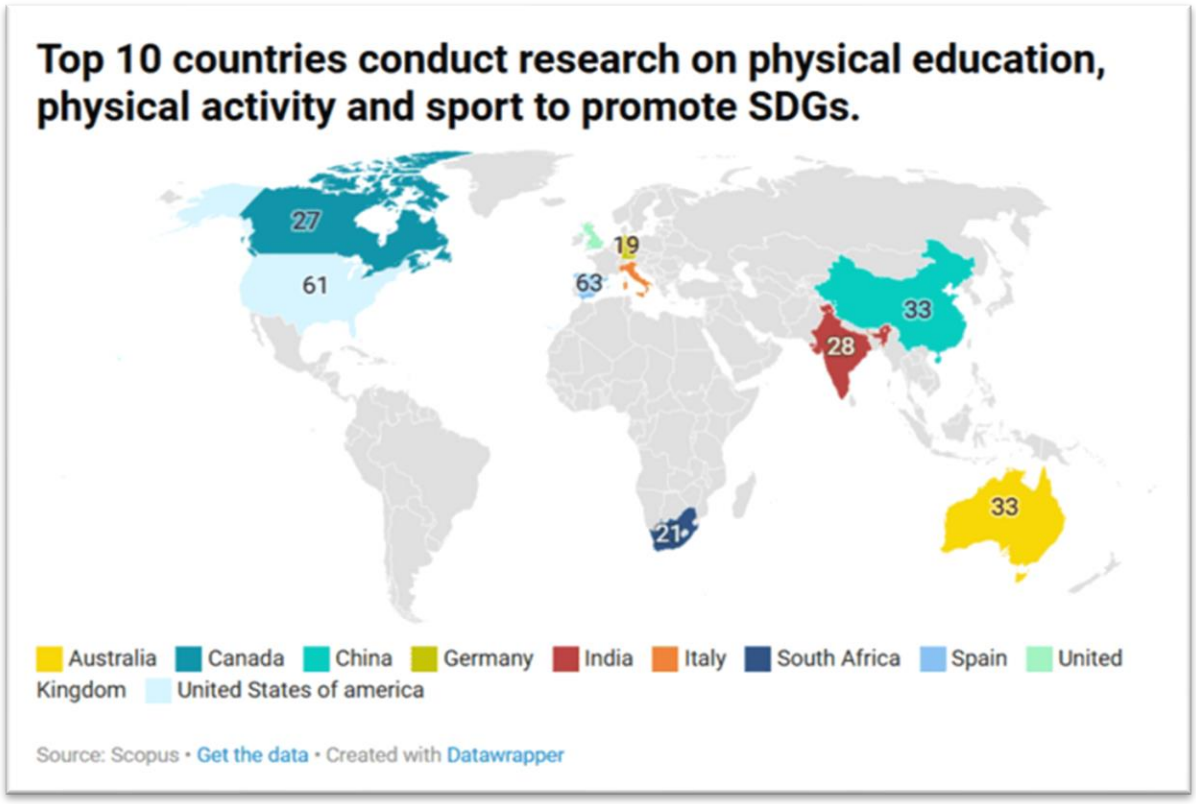
Figure 3. *The ten countries that published the most research on physical education, physical activity, and sport to promote the SDGs in the last ten years*



A bibliometric analysis of metadata from Scopus, as illustrated in Figure 3, shows that research on physical education, sport, and physical activity in the context of the SDGs has involved contributions from 98 countries worldwide. The top ten publishing countries are predominantly developed nations, with Spain leading the list with 63 publications, followed by the United States (61) and the United Kingdom (58). Australia and China each contributed 33 publications, indicating active engagement from two different continents. India (28), Canada (27), South Africa (21), Germany (19), and Italy (17) complete the top ten list.

The dominance of these countries reflects strong institutional support and research policies that align with global health and education agendas associated with the SDGs. Notably, South Africa's inclusion signals the active involvement of countries from the Global South, underscoring the global relevance of this research area across diverse socio-cultural contexts. These findings highlight the critical importance of international collaboration in advancing physical education and promoting active lifestyles as strategic pathways toward sustainable development on a global scale.

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Analysis of authors, subject areas, top affiliates, and funding sponsors in physical education, physical activity, and sport research to promote the SDGs

An analysis of key contributors in the field of physical education, sport, and physical activity related to the Sustainable Development Goals (SDGs) reveals that Baena-Morales, S. is the most prolific author with 19 publications, followed by Ferriz-Valero, A. with 10 publications and García-Taibo, O. with 8 publications. These three authors have been consistently engaged in interdisciplinary research that integrates physical education with sustainable development issues, particularly within the domains of social sciences and public health. The prominence of European-based scholars, especially from Spain, further reinforces the country's position as a leading hub for research in this area.

From a subject area perspective, the majority of publications fall within the social sciences (190 documents), followed by medicine (150 documents) and environmental science (93 documents). This distribution confirms that the intersection of physical education and the SDGs is multidisciplinary, encompassing social, health, environmental, and technological dimensions. Such an interdisciplinary approach aligns with the integrative framework promoted by the 2030 Agenda for Sustainable Development (UNESCO, 2020), wherein sport and physical activity are viewed as vital tools for advancing education, social inclusion, and public health.

Table 2. *Top ten authors and subject areas that research on physical education, physical activity, and sport to promote the SDGs in the last ten years*

Top Authors		Top Subject Areas	
Author	Total	Subject Area	Total
Baena-Morales, S.	19	Social Sciences	190
Ferriz-Valero, A.	10	Medicine	150
García-Taibo, O.	8	Environmental Science	93
Fröberg, A.	6	Computer Science	53
Lundvall, S.	5	Energy	49
Salvo, D.	5	Health Professions	48
Burnett, C.	4	Business, Management and Accounting	47
González-Serrano, M.H.	4	Biochemistry, Genetics and Molecular Biology	23
González-Víllora, S.	4	Economics, Econometrics and Finance	19
Merma-Molina, G.	4	Engineering	19

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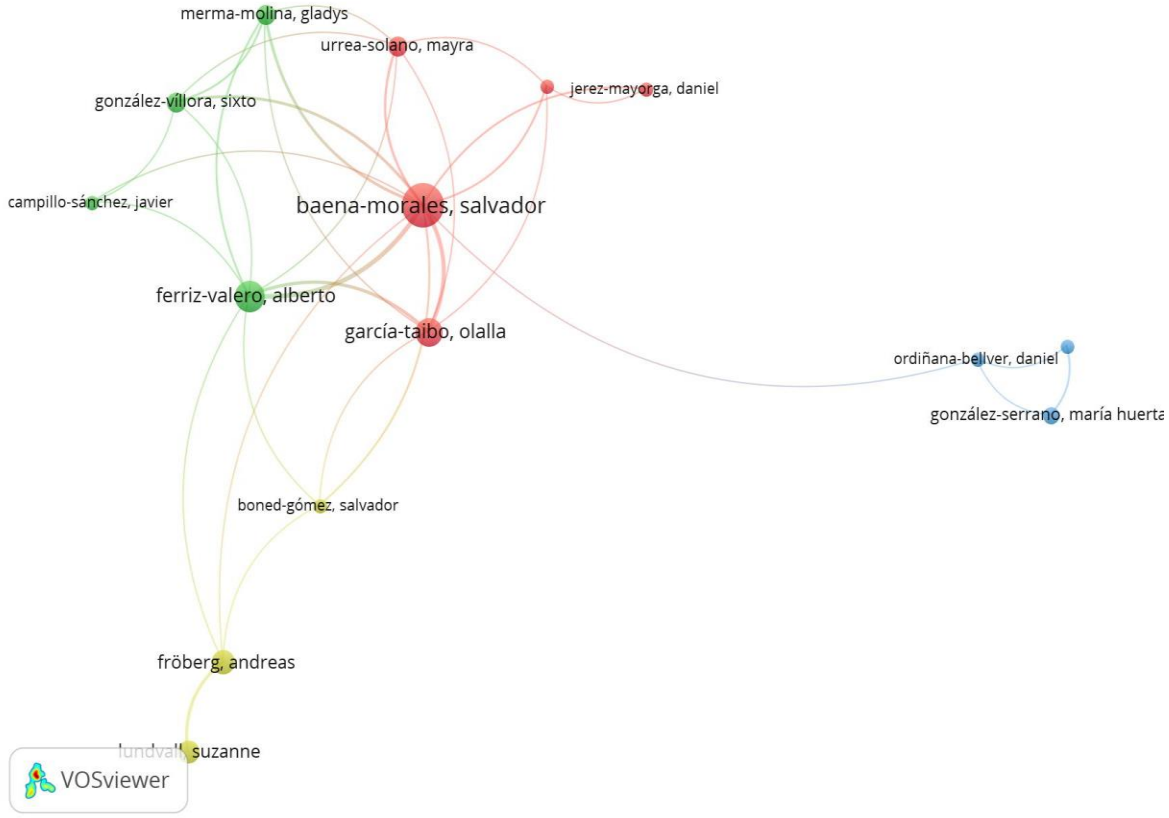
Figure 4. *Mapping interconnected author visualizations research on physical education, physical activity, and sport to promote the SDGs in the last ten years*



The author collaboration network visualized using VOSviewer illustrates the relationships and strength of collaboration among researchers in the field of physical education, sport, and physical activity in support of the SDGs. As shown in Figure 4, the visualization reveals several author clusters that are strongly interconnected in this research area. The primary cluster, highlighted in red, centers around Baena-Morales, Salvador, and García-Taibo, Olalla, who form the core of the most prominent collaborative network. Their strong ties with co-authors such as Urrea-Solano, Mayra, and Jerez-Mayorga, Daniel, demonstrate their consistent contributions to the field. In addition to the dominant red cluster, there are other collaboration groups, including a green cluster led by Ferriz-Valero, Alberto, and González-Víllora, Sixto, as well as yellow and blue clusters with more limited connectivity. Cross-cluster collaboration is also evident, such as the linkage between Fröberg, Andreas, and researchers in the red cluster, indicating the presence of intellectual bridges across research groups.

This visualization suggests that while several strong collaboration centers have emerged, some authors remain in relatively isolated networks, such as Ordoñana-Belver, Daniel, and González-Serrano, María Huerta, occupying more independent positions. Overall, the analysis indicates that over the past decade, research in this area has become increasingly centralized around a few key author

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groups, particularly those based in Europe. This model highlights the growing importance of cross-institutional and international academic collaboration in advancing interdisciplinary research on sport and sustainable development.

Table 3. *Top ten affiliation and funding sponsor research on physical education, physical activity and sport to promote the SDGs in the last ten years*

Top Affiliation		Top Funding Sponsor	
Affiliation	Total	Funding Sponsor	Total
Universitat d'Alacant	23	U.S. Department of Health and Human Services	12
Universitat de València	12	National Institutes of Health	11
Universidad Pontificia Comillas	11	UK Research and Innovation	11
Organisation Mondiale de la Santé	10	Universidad de Alicante	8
Universidad Internacional de Valencia	8	European Commission	7
University of Johannesburg	7	Fundação para a Ciência e a Tecnologia	6
Göteborgs Universitet	7	Medical Research Council	5
Universidad de Castilla-La Mancha	6	Ministério da Educação e Ciência	5
Johns Hopkins Bloomberg School of Public Health	6	Wellcome Trust	5
University of Toronto	6	World Health Organization	5

An analysis of institutional affiliations and funding sponsors, as presented in Table 3, shows that research on physical education, sport, and physical activity in support of the SDGs is primarily dominated by academic institutions from Europe and North America. The Universitat d'Alacant (Spain) emerges as the most productive institution with 23 publications, followed by the Universitat de València (12 publications) and Universidad Pontificia Comillas (11 publications), underscoring the leading role of Spanish institutions in this field. Other notable contributors include the University of Johannesburg, Göteborgs Universitet (Sweden), and the Johns Hopkins Bloomberg School of Public Health (USA), reflecting the global dimension of academic collaboration in promoting sustainable development through sport and physical activity.

In terms of funding, governmental and international agencies play a prominent role. The U.S. Department of Health and Human Services and the National Institutes of Health (NIH) are the top research sponsors, funding 12 and 11 publications, respectively. They are followed by UK Research and Innovation (11) and the European Commission (7), reflecting strong policy support for this topic in developed countries. The involvement of the World Health Organization (WHO) and the Wellcome Trust further highlights the importance of a cross-sectoral approach to promoting health, education, and social equity through physical activity. These findings suggest that a robust research ecosystem, characterized by institutional leadership and strong donor engagement, plays a strategic role in guiding scientific efforts toward impactful and globally relevant outcomes.

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Trend analysis in popular articles that are regularly cited

An analysis of the ten most cited articles reveals that a prominent theme in the global academic literature is the urgent need to increase physical activity and its connection to public health and sustainability issues. The most frequently cited article is by (Guthold et al., 2020), with 2,165 citations, which highlights global trends in insufficient physical activity among adolescents through a large-scale analysis of 298 population-based surveys. This is followed by the influential report by (Whitmee et al., 2015) cited 1,850 times, which discusses human health in the Anthropocene era and emphasizes the importance of cross-sectoral approaches to achieve planetary and human well-being. Other highly cited works, such as (Reis, 2016) and (Sallis et al., 2020) Propose large-scale intervention strategies and examine the relationships between the built environment, physical activity, and obesity. Collectively, these articles reflect a synergistic integration of public health perspectives, environmental interventions, and contributions to various SDG targets—particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). The high citation counts of these works underscore the importance of interdisciplinary scientific collaboration and the strong global relevance of the topic in current development agendas (Baena-Morales et al., 2023; Salvo et al., 2021).

Table 4. *Ten articles with the highest number of citations*

No	Author's name	Article Title	Total of Citation
1	Guthold, R., Stevens, G.A., Riley, L.M., Bull, F.C.	Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants (Guthold et al., 2020)	2.165
2	Whitmee, S., Haines, A., Beyrer, C., Vega, J., Yach, D.	Safeguarding human health in the Anthropocene epoch: Report of the Rockefeller Foundation-Lancet Commission on planetary health (Whitmee et al., 2015)	1.850
3	Reis, R.S., Salvo, D., Ogilvie, D., Goenka, S., Brownson, R.C.	Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people moving (Reis, 2016)	513
4	Allen, L., Williams, J., Townsend, N., Foster, C., Wickramasinghe, K.	Socioeconomic status and non-communicable disease behavioural risk factors in low-income and lower-middle-income countries: a systematic review (Allen et al., 2017)	467
5	Turner-Skoff, J.B., Cavender, N.	The benefits of trees for livable and sustainable communities (Turner-Skoff & Cavender, 2019)	193
6	Sallis, J.F., Cerin, E., Kerr, J., De Bourdeaudhuij, I., Owen, N.	Built environment, physical activity, and obesity: Findings from the international physical activity and environment network (IPEN) adult study (Sallis et al., 2020)	157

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7	Hanson, M., Barker, M., Dodd, J.M., Thangaratinam, S., Yang, H.	Interventions to prevent maternal obesity before conception, during pregnancy, and post-partum (Hanson et al., 2017)	147
8	Salvo, D., Garcia, L., Reis, R.S., Ding, D., Pratt, M.	Physical activity promotion and the united nations sustainable development goals: Building synergies to maximize impact (Salvo et al., 2021)	139
9	Ramirez-Rubio, O., Daher, C., Fanjul, G., Thondoo, M., Nieuwenhuijsen, M.J.	Urban health: An example of a health in all policies Approach in the context of SDGs implementation (Ramirez-Rubio et al., 2019)	136
10	Jiménez-García, M., Ruiz-Chico, J., Peña-Sánchez, A.R., López-Sánchez, J.A.	A bibliometric analysis of sports tourism and sustainability (2002-2019) (Jiménez-García et al., 2020)	131

Trends in bibliometric analysis of frequently appearing keywords

Over the past decade, the relationship between physical education, physical activity, and the Sustainable Development Goals (SDGs) has become a central focus in academic literature. Bibliometric analysis serves as a valuable tool for identifying emerging trends and mapping the intellectual landscape of this field (Baena-Morales & González-Víllora, 2023). By examining the most frequently occurring keywords, researchers can gain insights into the direction of scholarly inquiry and the theoretical as well as practical contributions of the field to sustainable development.

Table 5. *Top ten research keywords on physical education, physical activity and sport to promote the SDGs in the last ten years*

No	Key Word	Occurrences	Total Link Strength
1	sustainable development goals	228	1994
2	physical activity	145	2072
3	humans	139	2229
4	article	84	1386
5	sports	57	365
6	female	54	961
7	public health	50	700
8	sustainability	47	257
9	male	45	822
10	adult	38	730

The analysis results show that the keyword "sustainable development goals" ranks highest with 228 occurrences and a total link strength of 1,994. This indicates that the current literature is strongly focused on connecting physical education and sport practices with the achievement of the SDGs. A number of scoping reviews (Fröberg & Lundvall, 2021; Lundvall & Gerdin, 2021). (2021) affirm that physical education can support multiple SDGs, including SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), and SDG 5 (Gender Equality). The keywords "physical activity" and "humans" also appear with high frequency and strong link strength (145 and 139 occurrences, with a total link

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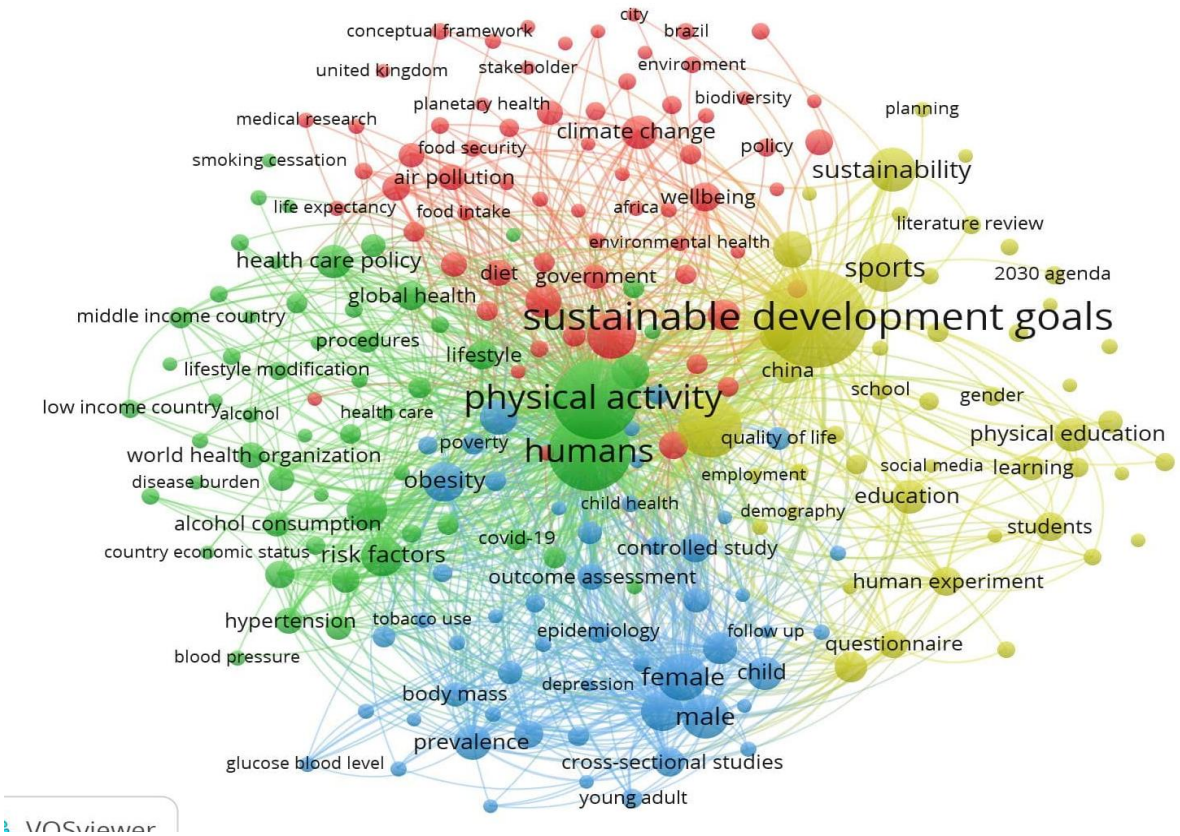
strength of 2,072 and 2,229, respectively), highlighting the centrality of human physical activity as a key component in promoting health and sustainability. Physical activity is not only examined as a health practice but also as an interdisciplinary approach that intersects with environmental awareness and community development.

Keywords such as "article", "female", "male", and "adult" reflect a wide methodological scope in the literature, covering various age groups and genders, and often involving review-based approaches such as systematic reviews or meta-analyses. The presence of "public health" and "sustainability" further underscores the integration of public health and sustainability perspectives in both the theoretical and practical dimensions of physical education. Finally, the appearance of the keyword "sports" confirms that sport remains an important domain in discussions of contributions to the SDGs, although it shows a slightly lower link strength compared to physical activity. This may reflect an academic tendency to conceptualize physical activity in broader terms beyond competitive sport alone.

Figure 5. *Visualization of keyword mapping occurring simultaneously in physical education, physical activity and sport to promote the SDGs*



The visualization in Figure 5, generated using VOSviewer, illustrates the keyword co-occurrence mapping within studies linking physical activity, Sustainable Development Goals (SDGs), and various aspects of public health and education. Keywords such as “sustainable development goals”, “physical

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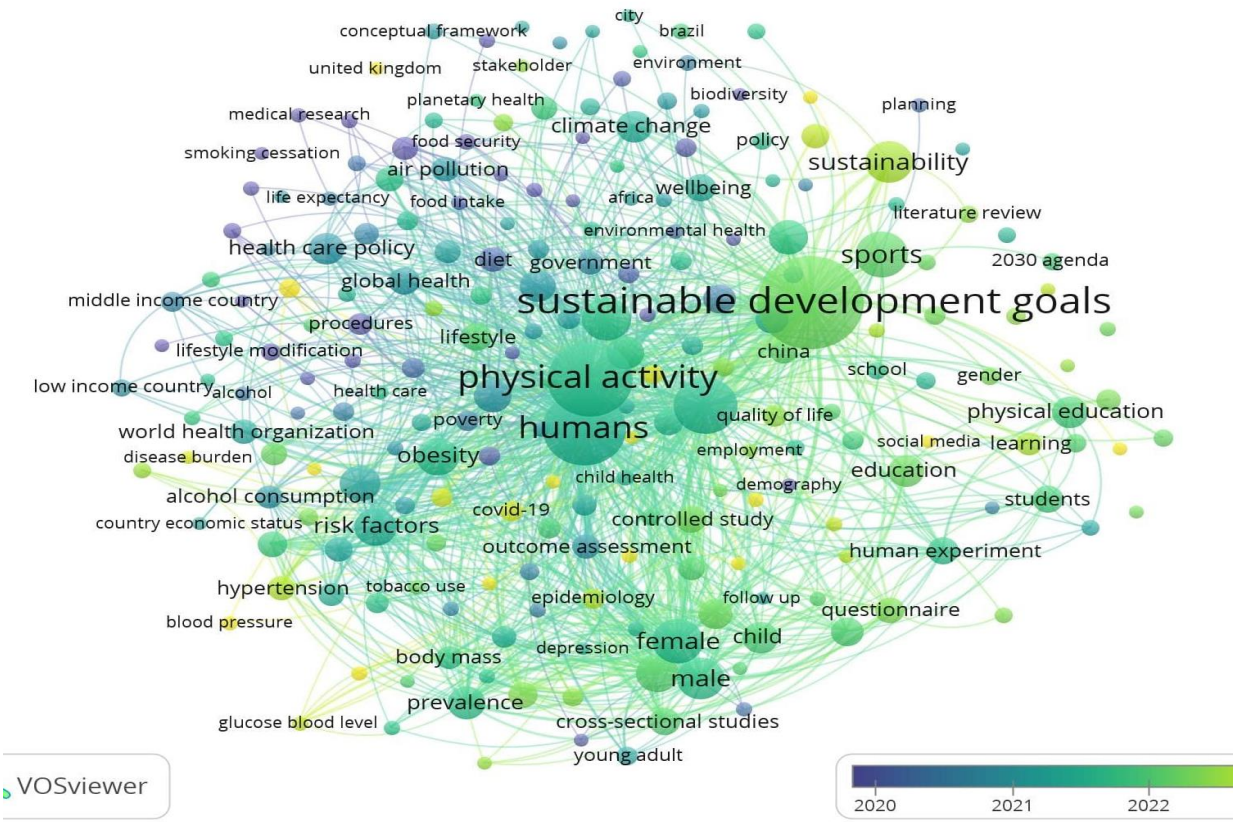
activity", and "humans" appear in central positions with large node sizes, indicating both high frequency and strong interconnections with other keywords across thematic clusters. The visualization identifies four main thematic clusters: (1) The red cluster focuses on environmental issues and global policy, with keywords such as climate change, air pollution, and planetary health, highlighting the interdependence between physical and environmental sustainability; (2) The green cluster relates to public health and health policy, including terms like health care policy, risk factors, and alcohol consumption, emphasizing the importance of preventive health approaches in supporting the SDGs;

(3) The blue cluster reflects a focus on demographics and clinical data, with keywords such as female, male, prevalence, and obesity, illustrating the role of epidemiological studies in measuring the impact of physical activity on populations; (4) The yellow cluster emphasizes education and sport, with keywords like sports, physical education, students, and learning. This affirms the strategic role of physical education in promoting the SDGs through pedagogical approaches and active participation. Research (Ramirez-Rubio et al., 2019) and (Salvo et al., 2021) Supports these findings, asserting that the integration of physical activity promotion, public health initiatives, and environmental awareness is a vital strategy in implementing the SDGs, particularly SDG 3 (Good Health and Well-being) and SDG 4 (Quality Education).

Figure 6. *Overlay visualization of keywords based on the years in physical education, physical activity and sport to promote the sdgs of the last ten years*



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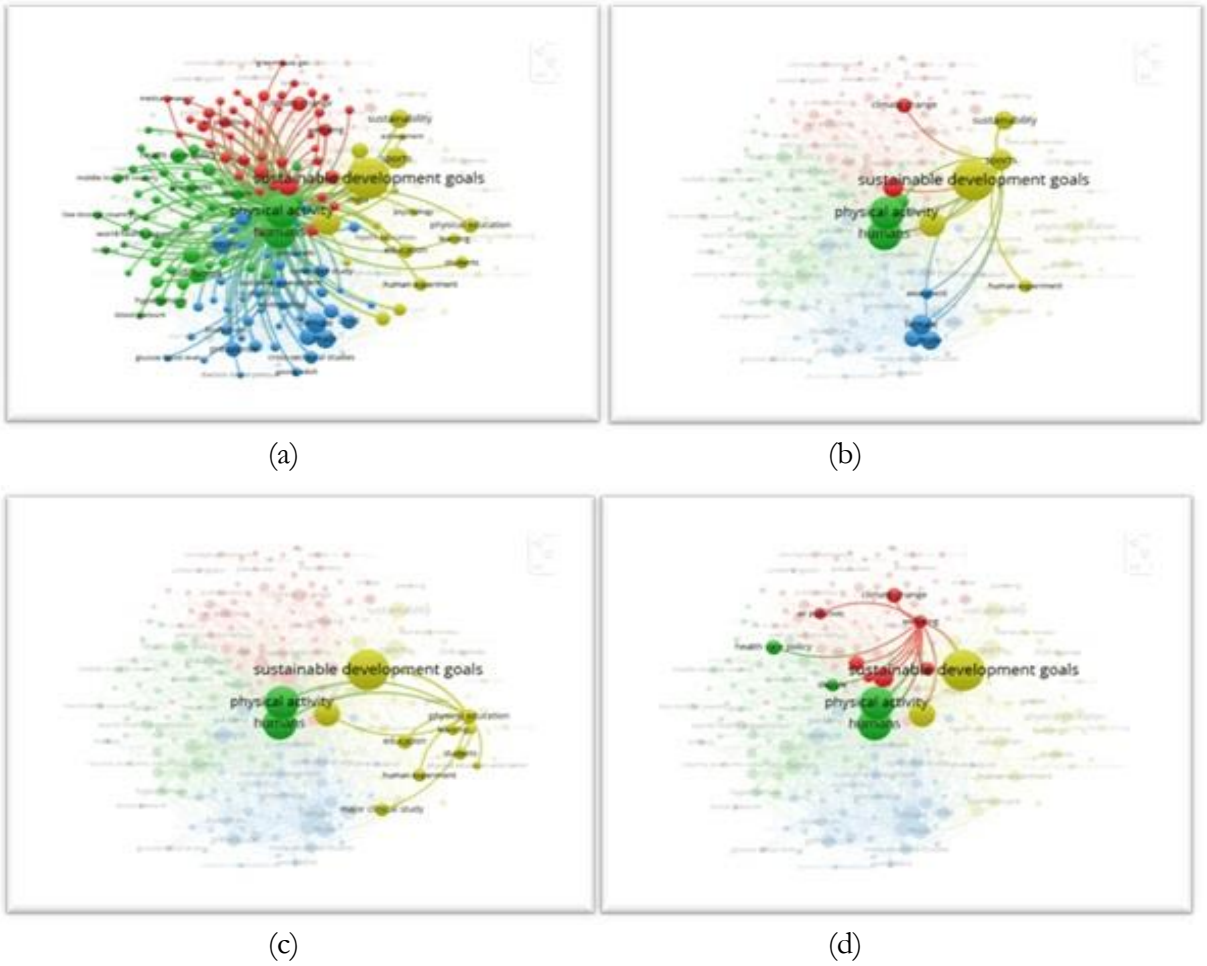
Based on the overlay visualization in Figure 6 generated by VOSviewer, it is evident that research related to physical activity, Sustainable Development Goals (SDGs), and humans occupies a central and dominant position within the bibliometric landscape. The yellow-green color gradient indicates that themes such as sustainability, sports, physical education, students, and education have gained increasing scholarly attention in the last two to three years (2022–2023), reflecting a growing emphasis on the role of physical education and sport in advancing the SDG agenda. In addition, keywords such as climate change, pollution, obesity, and mental health highlight the strong interconnection between physical activity and broader environmental and public health issues. Meanwhile, terms such as questionnaire, controlled study, and cross-sectional study reflect the predominant methodological approaches used in this research area. Overall, the overlay map suggests that the integration of sport, physical activity, and physical education within the framework of sustainable development represents a rapidly evolving and increasingly relevant research domain, aligning with contemporary global priorities.

Figure 7. *Some examples of specific keywords to promote the SDGs based on keywords: a) physical activity, b) sports, c) physical education, d) wellbeing.*



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"Figure 7 presents a visual mapping of the co-occurrence of specific keywords related to efforts in promoting the Sustainable Development Goals (SDGs) through four central terms: (a) physical activity, (b) sports, (c) physical education, and (d) wellbeing. Each visualization highlights keyword clusters most strongly associated with these central terms, as well as their strategic positioning within the bibliographic knowledge network. In visualization (a), 'physical activity' is closely linked with terms such as 'humans,' 'risk factors,' and 'public health,' indicating that physical activity is consistently examined in the context of population health and preventive interventions, which are relevant to SDG 3 (Good Health and Well-being). Visualization (b) for 'sports' shows a strong association with 'sustainability,' 'education,' and 'social inclusion,' reflecting the role of sports as an integrative tool in social development and sustainable education. Next, visualization (c) emphasizes 'physical education' as part of a cluster that includes 'students,' 'learning,' and 'human development,' strengthening its contribution to SDG 4 (Quality Education) and SDG 5 (Gender Equality). Meanwhile, visualization (d) reveals that 'wellbeing' is closely related to issues such as 'climate change,' 'policy,' and 'lifestyle factors,' highlighting a cross-sectoral approach in efforts to create sustainable and holistic wellbeing.

These four visualizations reinforce that physical education, sports, and physical activity not only support the SDGs individually but also form a thematically interconnected ecosystem both conceptually and practically. This underscores the importance of a multidisciplinary and collaborative approach in advancing the sustainable development agenda through the realm of physical education and physical activity.

Discussion

The bibliometric analysis reveals a significant increase in the number of publications addressing the relationship between physical education, sport, physical activity, and the Sustainable Development Goals (SDGs) since 2020. This surge is closely linked to the growing global awareness of the importance of active lifestyles in response to public health crises, particularly during and after the COVID-19 pandemic. (Jurak et al., 2020), confirm that the pandemic acted as a catalyst for research emphasizing physical activity as a recovery strategy for public health and well-being. This finding aligns with SDG 3 (Good Health and Well-being), which prioritizes preventive interventions such as physical activity to combat non-communicable diseases (NCDs), obesity, and mental health issues.

Furthermore, the dominance of peer-reviewed journal articles (61%) and the high proportion of publications indexed in reputable scientific outlets (79%) demonstrate that this topic has gained significant academic legitimacy and is increasingly recognized in global scholarly discourse. The prominence of high-income countries such as Spain, the United States, and the United Kingdom indicates the role of strong institutional capacity and supportive research policies in advancing this field. Baena-Morales, S., the most prolific author, is widely cited for his theoretical contributions to integrating Education for Sustainable Development (ESD) within physical education curricula (Baena-Morales & González-Víllora, 2023). Likewise, institutions such as Universitat d'Alacant exemplify organizational leadership in promoting interdisciplinary collaboration and high-impact research.

Keyword analysis further illustrates emerging thematic trends. Terms such as sustainable development goals, physical activity, and humans reflect the integration of physical education within global sustainability agendas. (Salvo et al., 2021) argue that physical activity intersects with multiple SDG targets, including SDG 3 (Health), SDG 4 (Education), SDG 5 (Gender Equality), and SDG 11 (Sustainable Cities and Communities). These intersections indicate the multidimensional nature of physical education as a platform for public health, environmental awareness, and social inclusion. As

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such, the field is shifting from a traditional performance-based perspective to one that incorporates values, education, and transformative learning for sustainability.

Despite these positive developments, the participation of low- and middle-income countries remains limited. This emphasizes the need to enhance international collaboration and build research capacity in the Global South. (Schimmel, 2015) highlights that sport and physical education in developing countries can serve as powerful tools for youth empowerment, equity, and peacebuilding provided they are supported by inclusive policies and global partnerships. To accelerate the global achievement of the SDGs, it is crucial to bridge the research gap through increased funding, methodological training, and equitable institutional collaboration between developed and developing nations.

Conclusion and Recommendations/Implications

This study provides a comprehensive overview of the research landscape in the field of physical education, sports, and physical activity, contributing to the achievement of the Sustainable Development Goals (SDGs) over the past decade. The bibliometric results show a significant increase in the number of publications since 2020, reflecting the growing global attention to issues of health, education, and sustainability. The dominance of scientific articles and journal publications indicates that this field has secured a strong position in the international academic discourse. The findings also reveal that developed countries, particularly Spain, have become centers of scientific activity, with significant contributions from specific institutions and authors. Key topics that emerged, such as physical activity, public health, education, and sustainability, highlight the close interconnection between physical education and global development challenges. Author collaboration visualizations reveal a strong network structure, yet still concentrated in certain clusters, suggesting opportunities for broader and more inclusive collaboration.

The main implication of this study is the importance of strengthening contributions from developing countries and integrating interdisciplinary approaches in studying and implementing sustainability-based physical education. Moving forward, research should focus on the development of learning models, policy interventions, and the evaluation of the impact of physical activity on various SDG dimensions, in order to expand the strategic role of physical education in sustainable global development.

Disclosure statement

No potential conflict of interest was reported by the authors.

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