

AKADÉMAI KIADÓ

The predominance of sustainability perspectives in sports – A bibliometric analysis

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**SPRINT – Sports
Research International**

DOI:
[10.1556/1020.2024.00006](https://doi.org/10.1556/1020.2024.00006)
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Received: December 13, 2023 • Revised manuscript received: February 20, 2024 • Accepted: April 24, 2024

ORIGINAL RESEARCH PAPER



ABSTRACT

In the last decade, sustainability has become a keyword that must be addressed in any environment, society, or economy segment. Therefore, the relevance of sustainable operation and behaviour in complexly interrelated fields like sports is particularly actual. This study was designed to evaluate the demonstration of sports sustainability in the relevant literature by bibliometric analysis. The yearly number of publications, core topics, Sustainable Development Goal (SDG)-connection, author and affiliation patterns, most relevant journals, and terms and keywords were studied to thoroughly overview the trends. It was found that the number of papers is increasing, however, with a slight setback in the last few years. The main topics relate to several environmental, economic (social), governmental (ESG) segments, but the listed publications need more SDG connections. A high proportion of fundamental papers from the research area are from authors affiliated with a narrow group of countries, and one journal published relatively far the most articles. The most relevant keywords are *sustainability*, *physical activity*, and *sport*, while the primary topic hot spots can be classified into four clusters. In conclusion, more in-depth publications are required to reveal the underrepresented field of sports sustainability in the literature, which should simultaneously incorporate the environmental, social, and economic aspects. This would foster better understanding, public awareness, and the spread of best practices in theory and practice, which could be implemented as an attitude-formation tool.

KEYWORDS

sustainability, physical activity, health, sports research, scientometrics, SDGs

INTRODUCTION

Sustainability is one of the most current research fields: it is an issue that appears in almost all scientific fields. On the one hand, nearly all scientific fields have work to do to achieve sustainability goals. On the other hand, sustainability issues can sometimes be interpreted in collaboration but span scientific fields. Therefore, sustainability can be considered a multi-disciplinary field of science, complemented by the fact that most scientific fields are closely related to one or all sustainability (environmental, economic (social), governmental – ESG) segments [1]. The relationship between sport and sustainability is extensive; sports activities can directly or indirectly affect all areas. However, the actual manifestation of sustainability issues is sometimes not so evident, therefore, there is a basic need for studies that outline the main directions how these initiatives appear in different areas (e.g., professional and amateur sports). As we will see later, some sports activities can have severe impact on biodiversity, for example. Still, the sector's environmental impact is less decisive than that of agriculture, construction industry, transport, or even the energy sector. The sectors with the most significant ecological impact mentioned later can undoubtedly be related to sports activities (e.g., in connection with the construction of sports facilities). Still, they are more necessary for

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operating the functional system of sports activities. Unlike the adverse effects exerted on the environment, the contribution of sports to more sustainable socio-economic systems are barely assessed. However, both approaches are at least indirectly addressed legally. Due to the commitment to global environmental (climate) goals, legislative bodies and decision-makers set transparent community and state-level policies, which are mandatory regulations with, however, sometimes tricky modes of enforceability [2, 3]. Further, in parallel with the appearance of overarching objectives, the environmental consciousness has started to grow also on micro levels; the demand for sustainable and green solutions came to the foreground increasingly in everyday life, which established positive feedback mechanisms favouring the spread of sustainable concepts. At the same time, it opens up new research directions, which should be evaluated thoroughly to find ways to give sports as progressive development in terms of sustainability as evidenced in other areas (e.g., technological innovations in the industry for healthier environments) [4, 5].

In the past few years, the attention of international organizations, national legislators, and scientists has also been directed towards sustainability. As one element of this, the relationship between sport and sustainability also appeared in international legal and scientific documents. According to the resolution of the United Nations (hereinafter: UN) General Assembly adopted on September 25, 2015 (point 37 of the Resolution A/RES/70/1. Transforming our world: the 2030 Agenda for Sustainable Development), sport is also an essential factor in sustainable development, which increasingly contributes to the achievement of development and peace by promoting tolerance and respect, and that it contributes to the empowerment of women and youth, individuals and communities, and health, education, and social inclusion objectives [6]. In addition, the World Health Organization (hereinafter: WHO) highlights in its document Global Action Plan on Physical Activity 2018–2030 that walking, cycling, sports, active recreation, and investing directly in policies that promote gaming the Sustainable Development Goals (SDGs) set for 2030 can contribute to achieving many of these [7]. The revised International Charter for Physical Education, Exercise and Sport, adopted at the 38th session of the UNESCO General Conference (November 2015), also deals with the sustainability of sport [8], primarily through the definition of universal principles. The Olympic Agenda 2020, adopted at the December 2014 meeting of the International Olympic Committee in Monaco, contains several recommendations to protect Olympic values and strengthen the role of sport [9].

Sport can also be considered an outstanding policy area in the European Union. Articles 6 and 165 of the Treaty on the Functioning of the European Union (TFEU) define the powers and actions of the Union in the field to promote European sport. In addition, however, following the Commission's White Paper on Sport of July 11, 2007, numerous commission announcements and parliamentary resolutions were adopted. Numerous normative regulations were also adopted, such as the establishment of the Erasmus + EU

education and training, youth and sports program and the Regulation (EU) 2021/817 of the European Parliament and of the Council of 20 May 2021 on the repeal of Regulation (EU) 1288/2013. The European Parliament's 2021 resolution on EU sports policy: evaluation and possible next steps [10] dedicates an independent subsection to sustainability and deals with many socio-political aspects of sport. The European Parliament highlights the importance of developing sports and organizing ambitious sporting events from an environmental protection point of view. In addition, it emphasizes that sports should be aligned with the principles of the European Green Agreement and contribute to environmental education and behavioural change.

During our research, we evaluated the documents that deal with specific sustainability issues in sports. These works can be classified into two large groups: on the one hand, most publications deal with a small slice of sport and sustainability, and only a few works comprehensively assess all three segments of sport and sustainability. An example is the Routledge Sport and Sustainable Development Handbook, which takes the UN's 17 Sustainable Development Goals and thematically presents the embeddedness, role, and possibilities of sport in the 17-goal system [11]. In relation to this, the referenced WHO document also highlights that the "Policy actions on physical activity have multiplicative health, social and economic benefits, and will directly contribute to achieving SDG3 (good health and well-being), as well as other Goals including SDG2 (ending all forms of malnutrition), SDG4 (quality education), SDG5 (gender equality), SDG8 (decent work and economic growth), SDG9 (industry, innovation, and infrastructure), SDG10 (reduced inequalities), SDG11 (sustainable cities and communities), SDG12 (responsible production and consumption), SDG13 (climate action), SDG15 (life on land), SDG16 (peace, justice and strong institutions) and SDG17 (partnerships)" [7].

The UNESCO Charter emphasizes that all stakeholders must ensure that their activities are economically, socially, and environmentally sustainable (Article 5). The IOC's (International Olympic Committee) Sustainability Strategy adopted in 2017 also underlines, for example, that sustainability must be incorporated into all aspects of the Olympic Games [12]. Below, we briefly review the most relevant questions that shed light on the three-dimensional relationship between sport and sustainability.

- a) Regarding the research on *the environmental sustainability* of sport, it is worth highlighting that a change of perspective is also perceptible in fields that have not been considered significant contributors to climate change. One of these areas is sports and sports-related activities [13, 14]. As proposed, sports-based environmental stress is not listed as one of the most significant threats; however, there are some core issues with room for improvement [15]. Several sources of concern can be highlighted regarding the problems above, which can be classified into three categories: construction/establishment of facilities, traveling, and sports activities [16]. Landscape alteration often occurs with the construction



of facilities by extensively disturbing soil and water bodies (e.g., sealing, drainage), which may lead to the loss of arable land and habitats [17]. Moreover, sports have a huge carbon footprint associated with traveling [18, 19]. In professional sports (e.g., football), teams and fans usually cover long distances to reach the event venues, sometimes taking charter flights [20]. Some sports activities are known for their significant inherent environmental concern (e.g., multiple emissions in technical sports) [21]. Further, in sporting events, additional waste and noise generation by the spectators and the light pollution from the facilities during operation after sunset are also issues to address [22, 23].

Recently, several initiatives have aimed to mitigate the direct and indirect risks and adverse climate-related effects bound to conventional practices in sports [24]. Energy efficient design of newly constructed facilities and such renovation of brownfield projects decrease the financial and non-financial expenses of establishment and maintenance of buildings. The carbon footprint of traveling can be lowered by measures classified into two types. Active intervention may be the organizational issue of frequency and distance reduction of visits [25, 26]. Despite being an efficient step towards green operation, there is still much interest in holding highly visited international (global) sports events across state borders (co-hosting), which counteract the offsetting effect of smaller-scale climate-favouring achievements [27]. Therefore, passive interventions such as low-emission technologies in transportation deserve particular attention and support from both the demand and supply sides [28]. Nowadays, the generation of waste directly before, during, and after events is mitigated by general progress in packaging technologies, material use, and the alteration in consumption patterns. In parallel, public waste management is increasing the recycled and reused materials ratio [29].

When addressing the individual sustainable development segments in each sector, it can be concluded that, in general, not only the sectors embodying individual human activities (e.g., industry, agriculture, services, etc.) affect the natural environment and its values but the environment also has a significant impact on people and businesses. Climate change and various environmental risks often have an adverse effect on sports activities. These stakeholders are the athletes engaged in sports activities and the experts who support their work. On the other hand, they also affect other persons interested in sports events (e.g., fans and spectators). For example, extremely high temperatures and dry summers are not conducive to the health of the older age group, so it can be observed that the participation of the more significantly affected age groups in sports events is more moderate. Athletes performing sports are already exposed to a significant physical load, so suitable environmental conditions must be available for practicing the activity. At the same time, one can more and more frequently witness, for example, sudden heavy rainfall during a football sports event or the formation of critical urban heat islands, e.g., during running or cycling competitions [30].

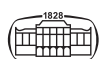
In addition, the adverse effects of climate change can also be felt in the organization of sports events, as some climate factors limit the spaces available for sports activities and cause significant difficulties in the organization of sports activities. In this context, the president of the International Olympic Committee highlighted at the Smart Cities & Sport Summit event in November 2023 that several sustainability goals have been integrated into the organization in connection with the 2024 Paris Olympics: for example, the goal of Paris 2024 is to halve carbon dioxide emissions compared to previous games. In addition, this was the first time the IOC allocated the same number of quota places to male and female athletes to achieve gender equality [31].

b) Regarding *the economic sustainability role of sport*, most authors deal with related business issues. Regarding the role of sport in the EU, the European Parliament emphasizes that it creates an added value of 279.7 billion euros in the EU, which is 2.12% of the EU's GDP, and provides jobs for nearly six million people [10]. Sports activities operate in a specific business model, while consumers are connected to a broad segment of society. Organizing a major sporting event (e.g., the Olympics or World Championships) can also impact the economic actors and entrepreneurs of the country or settlement providing the venue.

The UNESCO Charter emphasizes that suitable and safe spaces, facilities, and equipment are essential for quality physical education, exercise, and sports (Article 8). In ensuring these conditions, the clients of sports investments play an indispensable role, primarily by providing the green aspects of public procurement, the contractors of the investments by integrating the principles of green construction and establishing a quality assurance and control system that guarantees the enforcement of sustainability aspects from the side of state regulation. The sustainable management and operation of sports facilities is also a considerable challenge. However, the green construction industry has already developed many tools for this (such as BIM (Building Information Modelling), IoT (Internet of Things), or their connected solutions). An excellent example is that the Olympic House, which gathers all IOC employees under one roof, was evaluated as one of the most sustainable buildings in the world and received the highest level of LEED (Leadership in Energy and Environmental Design) green building certification, Platinum [9].

In the same way, it is essential to integrate the innovations developed by local economic actors in sports in the provision of sports equipment. Further, incorporating raw materials from local farms and the local workforce is also fundamental. A striking example of the integration of innovations is the hydrogen production and temporary refuelling station implemented in the IOC Olympic House [9].

OECD's Principles for Leveraging local benefits from global sporting events [32] and The OECD Recommendation on Global Events and Local Development already pointed out in its document [33] that global events, such as



the Olympic and Paralympic Games, cultural festivals or world exhibitions, have long been seen as opportunities to boost local growth and optimize local assets. The organizers of the sports events tried to exploit long-term infrastructure investments, boost tourism and trade, create jobs, and promote community involvement.

The resolution of the European Parliament [10] emphasizes the importance of the green transition of the sports sector, with particular regard to the construction, expansion, and renovation of the sports infrastructure. The Parliament expressed the need to support sustainable sports facilities in the framework of the new European Bauhaus by creating active spaces, building a sustainable sports infrastructure, and investing in sports in public areas. The Parliament's resolution highlights the importance of innovation and cross-sectoral cooperation in sports, especially the further development of digital tools to encourage participation in physical activity.

c) Perhaps the most widely researched question is the examination of the *social sustainability aspects of sport*. Many authors deal with the impact of sports on social processes, people's habits, and lifestyles. Some also point out that sport is not only a tool for disease prevention and health promotion but also impacts the development of social inclusion and integration [34]. The UNESCO document referred to earlier under the subheading of the values and benefits of sport highlights that physical education, exercise, and sport can bring many benefits to individuals, communities, and society as a whole (Article 2), especially development, peace, with peace and in the realization of post-conflict goals. The European Parliament's resolution highlights that sport plays a crucial role in European citizens' social, cultural, and educational lives and supports values such as democracy, respect, solidarity, diversity, and equality [10]. Among other things, Parliament highlights the need for sports policy and sports legislation to support gender equality, a zero-tolerance approach to racism and violence in sports, and the inclusion of people with mental and physical disabilities in sports activities and programs. The resolution also addresses the need to develop sports infrastructure, especially in disadvantaged areas, to increase the amount of physical activity, including daily physical activities, active breaks, and physical activity outside of school. In connection with this, the concept of active cities appears, which promotes exercise in the daily life of European citizens, including at work, and enhances and develops active and sustainable mobility and means of transport.

Clearly, the deficits of sustainable operation in sports have already been recognized, and which is pointing even more forward, countermeasures have also been initiated by stakeholders [35]. Among the stakeholders influencing the green transition of sports, however, authors of scientific publications get little attention. Studies also focus on determining the sustainable nature of sports by assessing certain aspects or a selected group of sports [36]. At the same time, the number of papers dealing with the sustainability of sports is still low

compared to other research areas. In the last three years, publishers and journals have identified this gap of information sources and the educational value of scientific literature in forming trends and practices. Based on this recognition, several special issues were launched dedicated to the issue of sustainability in sports and sports management [37, 38]. These publications highlight one or more general or specific aspects of the topic, while complementary evaluations of the papers published to date are scarce [39]. Such integrative and statistically well-founded research thoroughly overviews the existing literature, the main findings, and past and current trends. It anticipates future patterns and directions in the focused topic [40].

If we examine sustainability studies in the Web of Science (WoS) database, we find more than 261,000 studies. According to the scientific field classification of the WoS, among the scientific fields dealing with sustainability, Sport Sciences is in the 143rd place, and Hospitality, Leisure, Sports, Tourism is in the 28th place. Intending to fill the gap produced by the lack of synthesizing studies, this paper aims to shed light on integrating sustainability aspects in sports research on a temporal basis from a bibliometric perspective. To highlight the current issues, the most relevant publications were listed to evaluate the number of documents, the main research areas covered, the alignment with the United Nations' Sustainable Development Goals [41], the most active authors, the most relevant journals, the most frequently used keywords, and terms. With the help of the VosViewer program, we also identified the research clusters that are most relevant in the scientific study of sport and sustainability. By analysing these clusters, we try to shed light on the most pertinent questions from the point of view of the scientific study of sport and sustainability.

MATERIALS AND METHODS

Data collection and investigation

Data for this bibliometric analysis was extracted from the Web of Science Core Collection database. The search was run using the term combination [TOPIC = "*sport*" AND "*sustainability*"], applied to the documents published between 1990 and 2024.

During and after the search, yielded publications were involved in a process aiming to provide a precise and in-depth demonstration of targeted literature information. The data investigation process is presented in Fig. 1.

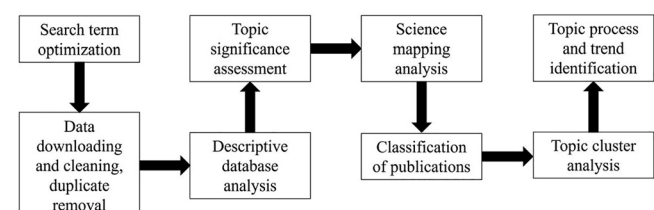


Fig. 1. The process of data collection and investigation



Different word combinations were applied to find the term combination providing a sufficient amount (between 500 and 1500, self-determined) of publications. Consequently, the terms “*sport*” AND “*sustainability*” were applied to the available literature published between 1990 and November 2023. Then, listed items ($N = 817$) were thoroughly reviewed, duplicates and incorrect references were removed, and a complementary search for undiscovered documents was conducted. These previous were the basis for an extensive descriptive analysis covering the scientometric data of publications. After that, the temporal changes in topic significance were evaluated in the studied period. The science mapping analysis revealed the scientific areas introduced by the publications, enabling the classification of listed papers. Finally, the cluster analysis highlighted the most trending topics in the literature, whereby insight could be given into the research preferences and directions in sports research.

Statistical analysis

The Web of Science analysis function was used to analyse the data regarding the number of publications, the focused research areas, and the connection to the United Nations’ Sustainable Development Goals (SDGs). The most active authors, relevant journals, and frequently used keywords and terms were studied using the Bibliometrix software in R [42]. The clusters of the primary research hot spots were created with VosViewer [43].

RESULTS

The temporal publication progress in sports sustainability

By the temporal change of publications having the afore topic terms, four periods can be identified (Fig. 2). Between 1991 and 2006, studies on the topic were sporadic, with seven years without any relevant publications (I). Between 2007 and 2015,

the yearly number of papers was relatively low (<20); however, the connection between sports and sustainability started to integrate into the common knowledge through papers highlighting major environmental concerns around direct and indirect sports-related emissions (II). Between 2016 and 2021, the number of new publications increased progressively (III), followed by a setback in 2022 and 2023 (IV). The general increase in sports-related publications with sustainability perspectives was also observed by Ulloa et al. [44], who carried out a comprehensive literature review for the period between 1964 and 2020. The last slight decrease in papers in the previous years can be attributed to the quantitative and qualitative article content and publication dates of special issues launched around the topic [39].

The topic classification of publications

The results of a more in-depth evaluation of the studied publications show that all three segments (environmental-social-governmental, ESG) of the broadly defined sustainability are represented among the top four research areas (Fig. 3). Despite this pattern, there is a gap in the literature of the penetration of ESG into sports. However, papers on the individual assessment of the three topics are available [45, 46]. According to Dmuchowski et al. [47], the benefits of ESG preferences over conventional decisions are visible and perceivable in several sectors, and the trends tend to broaden to all parts of economics having any financial interest and social involvement. Therefore, a more thorough review of sports regarding ESG criteria is presumed in the future.

The SDG-relation of publications

With no breakthrough regarding complex ESG involvements to date, there are insufficiencies in the connection between sports research and the SDGs, with the relative majority (38.31%) of studies not disclosing information on their ESG involvement (Fig. 4). In the case of integration, authors find the linkage to Sustainable Cities and Communities the most frequently, followed by Good Health and

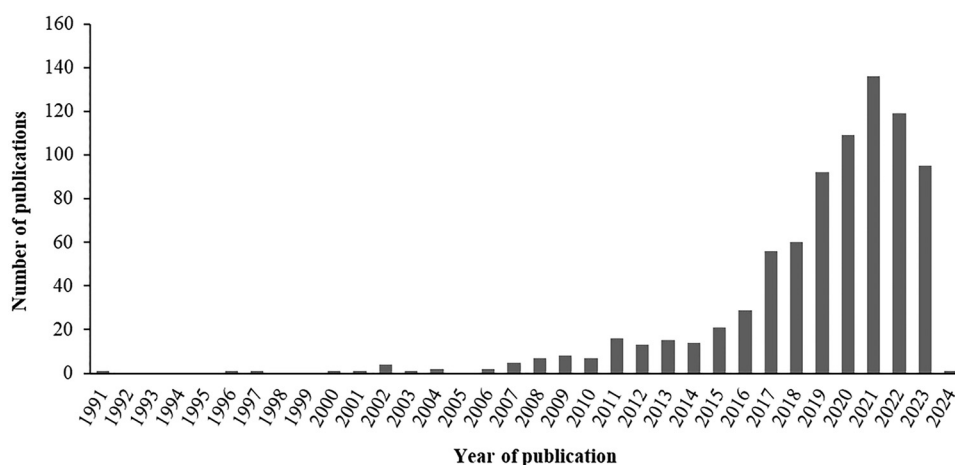


Fig. 2. The yearly progress of sustainability-related publications in sports research (as of 29th November 2023, $N = 817$)



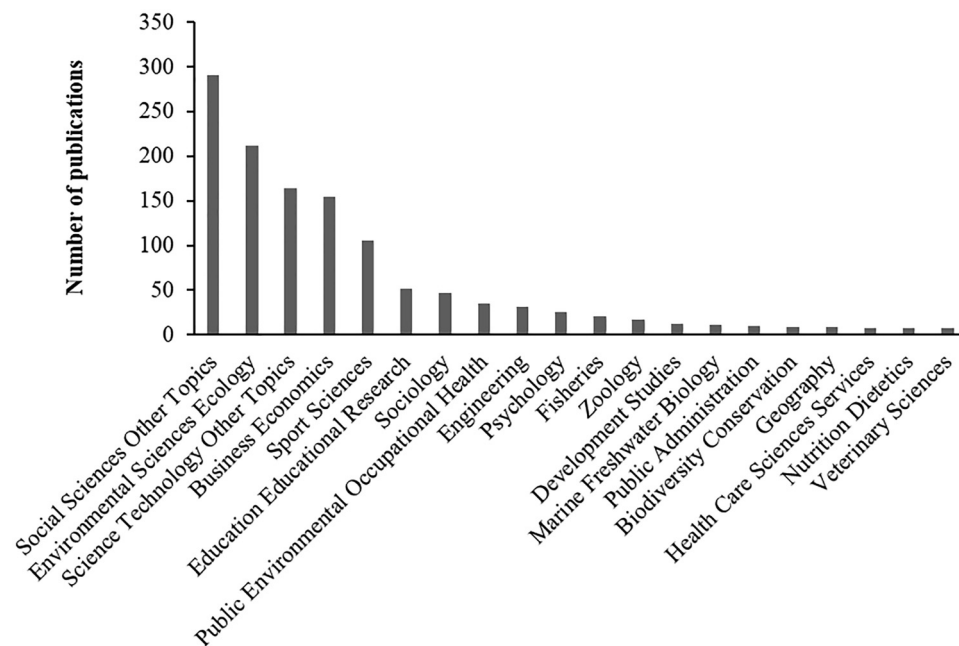


Fig. 3. The top 20 primary research areas of studies published in sports research. (The number of related publications in the specific area.)

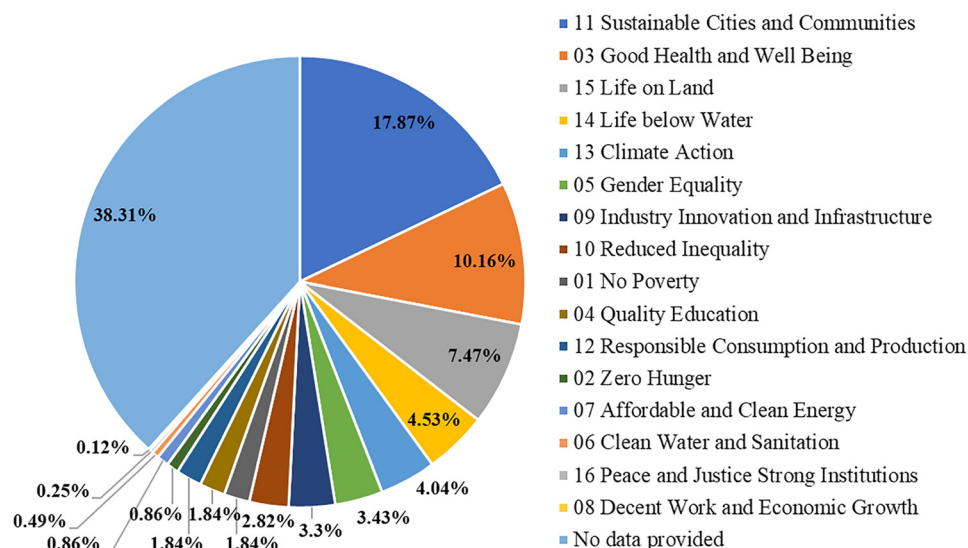


Fig. 4. The ratio of publications related to specific Sustainable Development Goals ($N = 817$)

Well Being, and Life on Land. When considering the operational sustainability of sports on different scales, the initiatives bound to the afore three Goals can be well recognized: in modern communities, sport is handled as a tool in establishing communities in both cities (Goal 11) and rural areas (Goal 15), for which the key determination must appear on the individual level (Goal 03). More specific SDGs are represented in less than 5% of the publications. Morgan et al. [48] found that sports have a high contribution potential to SDGs, which should be further strengthened primarily on an organizational level. Dai and Menhas [49] emphasized that sports activities are generally connected to all SDGs, relying mainly on sport's health-preserving effects.

The key authors, affiliations, and terms in sports sustainability

As the evaluation was extended to title terms, a tree field plot could be created in the affiliation-title term-author relation (Fig. 5). Most publications belong to authors with affiliations from Canada, Spain, and the United Kingdom. In detail, while one author establishes the leading position of Canada, the contribution is spread among several authors in the cases of Spanish and UK affiliations. It seems also apparent that sport sustainability issues emerge in countries which have a prominent position in general sustainability topics. *Development*, *study*, and *sustainable* were the most used title terms

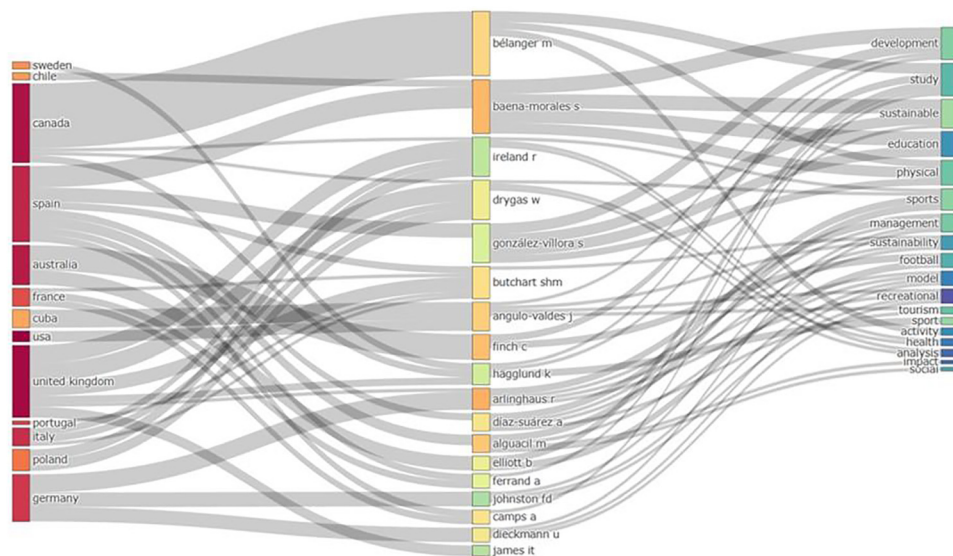


Fig. 5. Tree field plot of the country affiliation (first column) and most frequently used title terms (last column) for the top 18 authors (middle column) publishing the most papers in sustainable sports research

among the studied publications, which are also strongly connected to the sustainability assessment of other fields (e.g., agriculture). The pattern aligns with the leading role of Western European countries and institutions in sports science [50]. Additionally, the expansion of principles and intentions in sustainable development fostered the advancement of scientific publications in both quantity and quality, whereby these key terms most commonly turn up in publications [51].

The most relevant journals in sports sustainability

The list of the hosting journals is somewhat uneven by the number of included relevant publications. The journal with the most papers carried out in sustainable sports research is

Sustainability ($N = 35$). It is followed by ones with less than five papers in each (Fig. 6). The leading position of *Sustainability* is based on the fact that the journal initiated several calls for related papers, complemented by special issues around the topic [39, 52]. This pattern proves that above-average representation of particular research areas in journals can affect its presence and weight even on a scientometric scale [53].

The most relevant terms and keywords in sports sustainability

The literature scan was broadened to the abstracts of assessed papers. Within this procedure, it was found that the

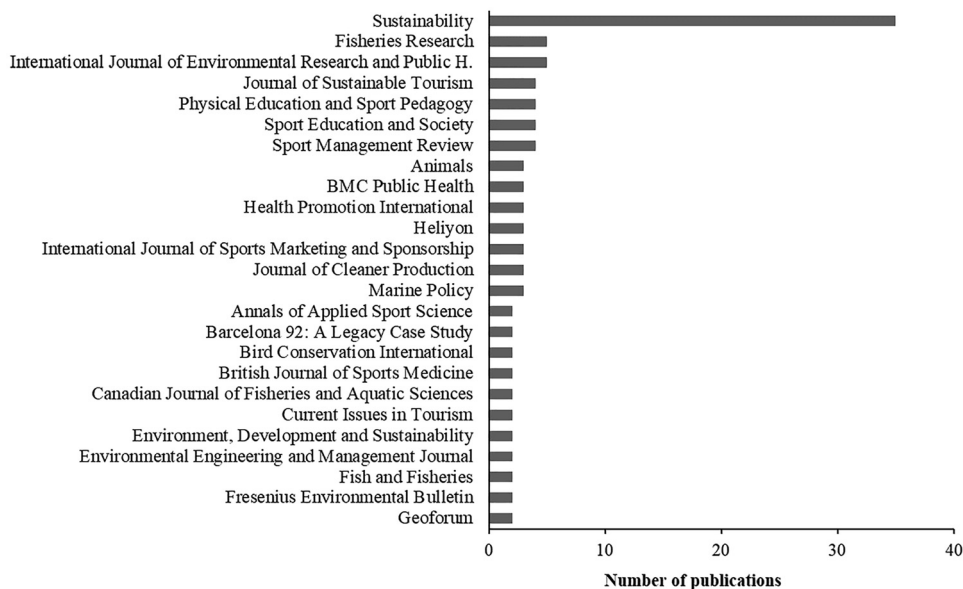


Fig. 6. Journals with the most publications in sustainable sports research



without revealing sustainability issues. Earlier [58] and more recent [59] articles on general sports science questions also show the abovementioned trend. It means that dealing with the topic of sports does not mean the implicit integration of sustainable aspects so far. Further, the trend of keyword usage gives adequate indication of past and recent emphasizes in sport perspectives, however, it does provide with reliable predictions on future preferences due to fast and sometimes unforeseeable progress in the socio-economic regard.

Cluster analysis of topic hot spots in sports sustainability

During our research, with the help of the VosViewer program, we evaluated the literature from the point of view of performing a cluster analysis based on the research topics and key terms analysed in the studies. Each cluster group is built around one or more core hot topics, which are the most decisive and frequent terms used in relation to sport sustainability. These key terms are interrelated and are in



Term	Year of publication (approx.)	Term frequency (approx.)
football	2021	10
leisure	2021	10
health promotion	2021	10
sustainability	2020	40
sport	2020	30
CSR	2020	10
physical activity	2020	20
environment	2020	20
physical education	2020	20
tourism	2019	10
management	2019	10
sport fishing	2019	10
sustainable development	2018	10
sport tourism	2018	10
environmental impact	2018	10

different distance from the sub-terms, which interval reflects on the strength of the actual scientific relationship among the individual terms.

As shown in Fig. 9, four extensive clusters could be identified based on the studies involved: the largest cluster was formed by governmental and regulatory issues related to sports events (cluster marked in red). The second cluster deals with the issue of social sustainability related to the activities of the competitors (cluster marked in blue). A defining cluster covers the relationship between health preservation by physical education (cluster marked in green). Finally, the smallest group was the literature dealing with the sustainability of sport fishing (cluster marked in yellow). The distinct separation can be drawn back to the fact that publications usually deal with one or more aspects of sport sustainability, focusing on specific fields and segments (e.g., fishing practices, addressing health issues), while comprehensive, exhaustive, and simultaneous overview of topics from different clusters is scarce. Therefore, on the one hand, this cluster analysis provides with substantial information on the most trending topic focuses from the last few decades of sport sustainability evaluations, while, on the other hand, it also gives indication of what are the recently differentiated areas that should be studied in each other's context more in future assessments.

DISCUSSION

The most important findings of the studies belonging to each cluster are summarized below.

- a) Governmental and regulatory sustainability issues related to sports events.

As seen above, the organization of sports events is a significant challenge in sports sustainability, which many international organizations and documents address in depth. Although there are many sports events at the international level, the cooperation of sports-related organizations of individual states [60–62] and the effectiveness of sports policy are crucial in this area [63–65]. In addition, many authors emphasize the role of federations in managing their sport [66–68] and call attention to the need for closer coordination and cooperation with authorities and those involved in the value chain of individual processes [69–71]. As the WHO highlights in The Global Action Plan on Physical Activity 2018–2030, increasing physical activity is a fundamental challenge. To this end, system-level policy solutions are necessary – in line with SDG17 – comprehensive and integrated through an intersectoral approach and the involvement and cooperation of the widest possible range of stakeholders [7]. The UN, for example, Sport for the Climate

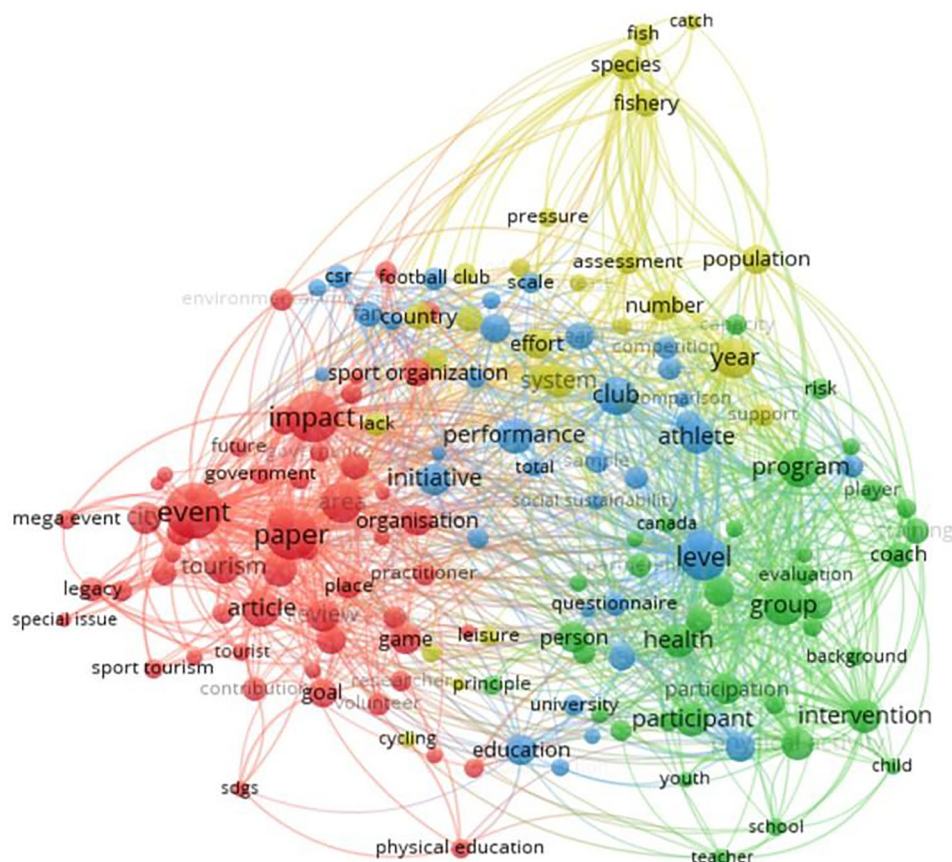


Fig. 9. The most relevant terms as research hot spots of listed publications based on the cluster analysis

Action on the Raze for Zero [72], invited sports organizations and stakeholders to join the new climate initiative, which aims to support and guide sports players in achieving global climate change goals.

Also appearing in this cluster in many documents is the need to balance the focus of professional sports on commercial interests with social functions [73–75]. A significant part of the literature deals with specific sustainability issues of organizing prominent sports events in this cluster [76]. In addition, many authors highlight the need for transnational measures, indispensable for eliminating corruption in sports [77, 78].

b) Social sustainability factors related to the activities of the competitors.

In relation to athletes, many literature sources deal with elite sports [79–81] and leisure sports activities [82, 83] in terms of specific questions (e.g., financing, infrastructure). Additionally, several authors pay special attention to the dysfunctions of the player transfer market [84–87]. Some aspects of sport-related social sustainability also appear in this cluster [88–90], such as the illegal influence of sports competitions, anti-doping measures [91–93], eliminating unjustified gender discrimination [94–96], challenges related to the dual careers of athletes [97–99], and specific issues of sports broadcasting [100–102]. Some authors' research focuses on the action against abuses committed in the gambling sector [103–105] and the issue of e-sports [106–108]. Additionally, a relatively large group within this cluster is the number of publications dealing with the appropriate educational role of coaches, sports personnel, teachers, and youth workers [109–113].

c) Health prevention in physical education.

Another significant manifestation of sustainability issues is the topic of health prevention with the help of physical education, highlighting the social interrelations of the ESG approach. Bácsné Bába et al. [114] revealed a complex linkage between health consciousness and sustainability, which is confirmed by, among others, a growing supply of and demand for outdoor activities. Wendtlandt and Wicker [115] evidenced by a questionnaire that this trend was temporarily interrupted by the COVID-19 lockdowns, which did not set the environmental consciousness of respondents back. This can result from the general integration of sustainable considerations in everyday life and can be traced back to extensive health promotion programs in sports organizations, educational institutions, and workplaces [116–118]. Thurm et al. [119] underlined the role of teachers and institutions in contributing to environmental and sustainability education by physical activity. The authors concluded that such an aware attitude from teachers and students can result in a complex development of children's mental, social, and physical skills. On the other hand, adverse health effects related to sports activities were also reported, primarily from a professional point of view. For instance, despite the sustainability initiatives, Gilbo and Koenigstorfer [120] listed violent behaviour, doping, and

sports injuries as potential and still emerging occurrences. Additionally, the deficiencies in sports health expenditures also trigger negative trends, while it was proposed that financial health promotion in sports is positively correlated with environmental quality [121]. Therefore, a synthesized approach and dedicated measures are required to exploit the benefits of health prevention and its contribution to sport sustainability.

d) Recreational fishing and related sustainability issues.

One of the most focused areas of the studied publications is the sustainability aspects of sports and recreational fishing practices. In the case of Australia, for instance, Burgin [122] refers to the recent state of biodiversity of areas affected by fishing activities as vulnerable, with species patterns exposed highly even to minor changes in fishing practices. Moreover, during fishing, the target species and the adjacent fauna can be impaired simultaneously; perishing caused by bycatching is considered significant collateral damage [123, 124]. Lubich et al. [125] also observed this vulnerability in Brazil by demonstrating that approximately 59% of the literature on sport fishing restricted sustainability issues to ecological aspects, while only 3% of the papers integrated all three segments of ESG in their evaluation. This trend indicates the general scheme that most publications highlight environmental concerns alone. From a European perspective, Carpio et al. [126] identified the invasive species as threats to freshwater biodiversity. European regulations do not cover this issue and are not raised at the forefront of public awareness. The role of regulations was also emphasized by Mosley et al. [127], who pointed out that the pressure of overexploitation of fish stocks and scarce interventions can lead to the collapse of populations, having severe ecological, social, and economic consequences. These findings present that fishing has a substantial role in evaluating sustainability in sports activities, which, due to its intimate connection with natural and semi-natural environments, allows attention to be drawn to sustainability concerns, especially in the ecological regard [128].

CONCLUSION

This study focused on the bibliometric progress in the literature of sports sustainability in the last three decades. Based on the main findings, it can be said that despite the growing number of studies in the field, a more thorough penetration of sustainability is required in sports research. It implies both the (i) qualitative and (ii) quantitative segments in research; (i) a more profound understanding of the sustainability-related issues is needed by conducting more empirical and experimental studies, whereby the number of publications would increase, while (ii) it would also be essential to integrate environmental, social, and governance aspects in these assessments simultaneously. This would extend the primarily common ecological perspective to a more complex evaluation. By this means, more in-depth literature analyses could involve more publications, thereby



increasing the representativeness of such studies. The limitation of this research is that the authors aimed to review the field of sports sciences in the broadest sense; it did not deal with research trends related to sustainability in related scientific fields. Instead, it was designed to give a general picture of sports science's most critical sustainability issues and provide recent directions and achievements for future research.

Author contributions: Conceptualization, A.B.; methodology, A.B, D.T., and G.G; analysis, A.B.; writing—original draft preparation, A.B., D.T, and G.G; writing—review and editing, A.B. and D.T.; visualization, A.B. and D.T.; supervision, A.B. All authors have read and agreed to the published version of the manuscript.

ACKNOWLEDGEMENT

This research received no external funding.

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