

# Knowledge Mapping and Keyword Hotspot Analysis of International Research on Sports Intangible Cultural Heritage

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## Abstract

To explore the research hotspots and evolutionary trends in international intangible cultural heritage (ICH) related to sports, this study uses the Web of Science (WOS) Core Collection as its data source and employs VOSviewer to construct a keyword cooccurrence knowledge map for quantitative analysis. The results show: (1) Core topics remain stable. Terms such as “intangible cultural heritage”, “heritage”, and “protection” rank among the most frequent keywords, indicating that scholars continue to focus on defining the cultural essence of ICH and its mechanisms of continuity. (2) The research paradigm exhibits a clear trend of digital transformation. The emergence of technological terms such as “motion capture” and “video annotation” reveals a new direction in using digital technologies to document embodied tacit knowledge. (3) The industrialization pathway has become increasingly explicit. The high frequency of “tourism” confirms that the integration of culture and tourism has become a key approach to realizing the living transmission and value transformation of ICH. The findings suggest that international research on sports related ICH has transcended disciplinary boundaries and is forming a new interdisciplinary pattern characterized by “theoretical grounding, technological empowerment, and industrial driving”.

## Keywords

Sports intangible cultural heritage, WOS database, VOSviewer, Digital preservation, Culture-tourism integration

## Introduction

### *Cultural heritage crisis and the emerging consensus on protection in the context of globalization*

In the current era marked by rapid globalization and modernization, the diversity of human civilizations is facing unprecedented challenges [1]. As industrialization accelerates and modern lifestyles become increasingly dominant, many traditional cultural expressions are gradually losing their original foundations for survival and are at risk of marginalization or even extinction. In response to this crisis, the United Nations Educational, Scientific and Cultural Organization (UNESCO) adopted the *Convention for the Safeguarding of the Intangible Cultural Heritage* in 2003, formally establishing the concept of intangible cultural

heritage (ICH) [2]. The convention calls on the international community to take action to safeguard the various practices, performances, representations, knowledge systems, and skills that communities, groups, and in some cases, individuals recognize as part of their cultural heritage [3,4].

### *The unique value of sports intangible cultural heritage*

As an important component of intangible cultural heritage, sports intangible cultural heritage (hereafter “sports ICH”) embodies humanity’s distinctive bodily wisdom, survival skills, and collective memory [5]. It includes not only explicit forms of physical activity - such as traditional martial arts, folk games, and ethnic dances, but also rich ritual norms, moral values, and forms of social

cohesion. For example, China's Taijiquan, Brazil's Capoeira, and Japan's Judo are not merely means of physical exercise; they also serve as symbolic expressions of their respective national spirits [6]. However, compared with static material cultural heritage, sports ICH is characterized by "living fluidity" and "oral-bodily transmission". Under the impact of modern competitive sports and popular fitness culture, many traditional sports practices face challenges in continuity due to complex rules, spatial constraints, or limited commercial appeal. In some cases, once a practitioner passes away, the associated knowledge or skill disappears as well. Thus, how to scientifically assess the value of sports ICH and explore its space for survival in contemporary society has become an urgent issue in academic research [7].

#### ***The digital transformation of research paradigms***

In recent years, the rise of big data, artificial intelligence, and knowledge graph technologies has driven a shift in research paradigms within the humanities and social sciences - from qualitative description to quantitative analysis. Traditional studies on sports ICH have largely relied on fieldwork, case documentation, and historical textual research [8]. Although such approaches are detailed and insightful, they often fall short in capturing the overall trajectory and developmental logic of global research on the subject. The use of bibliometric methods to mine and visualize large bodies of academic literature enables scholars to objectively reveal the knowledge structure, shifting hotspots, and frontier trends in the field, thereby providing valuable data support for future safeguarding practices.

#### ***Research purpose***

This study aims to systematically review international academic research on sports intangible cultural heritage over the past decade using the Web of Science (WOS) Core Collection as the data source and VOSviewer as the primary visualization tool. By constructing a keyword cooccurrence network, the study seeks to address the following key questions:

What are the core topics and high frequency research hotspots in current international studies on sports ICH?

What roles do digital technologies (e.g., VR, machine learning) and modern industries (e.g., tourism) play in the safeguarding of intangible cultural heritage?

#### ***Research significance***

##### ***(1) Theoretical significance***

This study fills a gap in the field of sports ICH by providing a large sample and visual review. Statistical analysis of high frequency keywords - such as "intangible cultural heritage," "heritage," and "culture" - helps clarify the conceptual framework of the field. Meanwhile, the identification of emerging terms such as "virtual reality", "machine learning," and "serious games" reveals. At a theoretical level, the internal logic of technological empowerment in ICH preservation and highlights a broader trend toward interdisciplinary integration.

##### ***(2) Practical significance***

The findings offer valuable references for policymakers and practitioners. For example, the strong association between "tourism" and "sports ICH" identified in the analysis confirms that integrating culture and tourism is an effective pathway for addressing the survival challenges of ICH [9,10]. This can help guide local governments and organizations in safeguarding intangible heritage while appropriately developing its economic value, thereby achieving sustainable "living transmission".

#### ***Research methods***

##### ***Data source***

To ensure data authority and international comparability, this study selected the Web of Science (WOS) database as its source of literature. WOS indexes high quality academic journals worldwide and is widely recognized as representing mainstream academic viewpoints at the international level.

##### ***Analytical tool: VOSviewer***

This study employs VOSviewer to construct scienti-

fic knowledge maps. The software generates visualized network diagrams based on keyword frequencies and cooccurrence relationships. By analyzing how often keywords appear together in the same publication, it is possible to determine the degree of relatedness among different research topics. In the map, the size of each node represents the frequency of a keyword, while the thickness of the connecting lines indicates the strength of their association.

### Results and analysis

Drawing on the WOS Core Collection and using bibliometric methods, this study applies VOSviewer to conduct a keyword cooccurrence

network analysis of the retrieved literature. Through frequency statistics of high frequency keywords and cluster interpretation of network structures, the study objectively reveals the distribution of research hotspots, the composition of core themes, and the evolutionary trends at the frontier of international research on sports intangible cultural heritage.

#### ***Research hotspot distribution based on frequency statistics***

The occurrence frequency of keywords is a key indicator of the level of academic attention devoted to a particular research topic. By analyzing the top 10 high frequency keywords (see Table 1), we can outline the current research focus and the structure of hotspots in this field.

Table 1. Statistics of top 10 high frequency keywords.

Rank	Label	Occurrences	Avg. pub. year
1	Intangible cultural heritage	70	2018
2	Heritage	21	2016
3	Cultural heritage	14	2017
4	Dance	13	2017
5	Tourism	11	2017
6	Intangible heritage	10	2019
7	Culture	9	2016
8	Legacy	9	2014
9	Intangible cultural heritage (national investment unit)	9	2017
10	Protection	9	2015

Statistical results show that the top three keywords focus primarily on conceptual clarification. “Intangible cultural heritage” ranks first with an absolute high frequency of 70 occurrences, with an average publication year of 2018. It is followed by “heritage” (21 occurrences, 2016) and “cultural heritage” (14 occurrences, 2017).

This distribution has important academic implications:

First, it indicates that research in this field is still in a critical stage of theoretical refinement. Although applied explorations are becoming increasingly active, scholars continue to prioritize clarifying the conceptual boundaries of “sports ICH” and establishing its legitimacy as part of humanity’s shared cultural wealth.

Second, the concentration of average publication years (2016-2018) in recent years suggests sustained scholarly attention to this core issue. Discussions consistently center on the “heritage” attribute of traditional sports, emphasizing their cultural value rather than merely their competitive function.

#### ***Embodied perspectives made explicit: The blurred boundaries between dance and sport***

Notably, “dance” ranks fourth with 13 occurrences and an average publication year of 2017. Within the classificatory scope of sports ICH, many practices - such as dragon and lion dances, martial arts routines, and Capoeira - exhibit strong performative and codified characteristics, demonstrating a fusion of physical movement and artistic expression.

The high frequency of “dance” highlights an emerging academic trend: Researchers are increasingly moving beyond the modern sports paradigm of “higher, faster, stronger”, shifting instead toward interpretations rooted in body aesthetics and artistic performance. This shift provides new analytical entry points for understanding ritual and folkloric symbolism embedded in sports ICH, and underscores the importance of “embodied narratives” in this field of research.

#### ***Establishing the pathway to industrialization: The rise of tourism***

Among the top ten high frequency keywords, “tourism” (11 occurrences, 2017) is the only term directly pointing to industrial application and economic transformation.

Its prominence signals that the preservation model of sports ICH has shifted from earlier “museum style” conservation to “productive protection.” The data indicates growing scholarly interest in transforming sports ICH resources into tourism

experience products. Against the broader backdrop of cultural-tourism integration, developing folk sports performances and authentic cultural experiences not only helps alleviate the survival crisis of ICH practices but also enables economic returns that support cultural transmission.

The presence of “protection” (ranked 10th, 9 occurrences) further underscores that balancing commercialization with authenticity remains a persistent concern within academic discussions on tourism development and ICH safeguarding.

#### ***Keyword cooccurrence network and cluster analysis***

Using the keyword cooccurrence network generated by VOSviewer (as shown in Figure 1), the internal logic of knowledge flow within this field becomes visible. In the map, the size of each node represents the weight (frequency) of a keyword, the thickness of the connecting lines represents the strength of cooccurrence, and different color regions correspond to distinct research clusters. Visual interpretation of the map reveals four major thematic clusters in current international research on sports intangible cultural heritage.

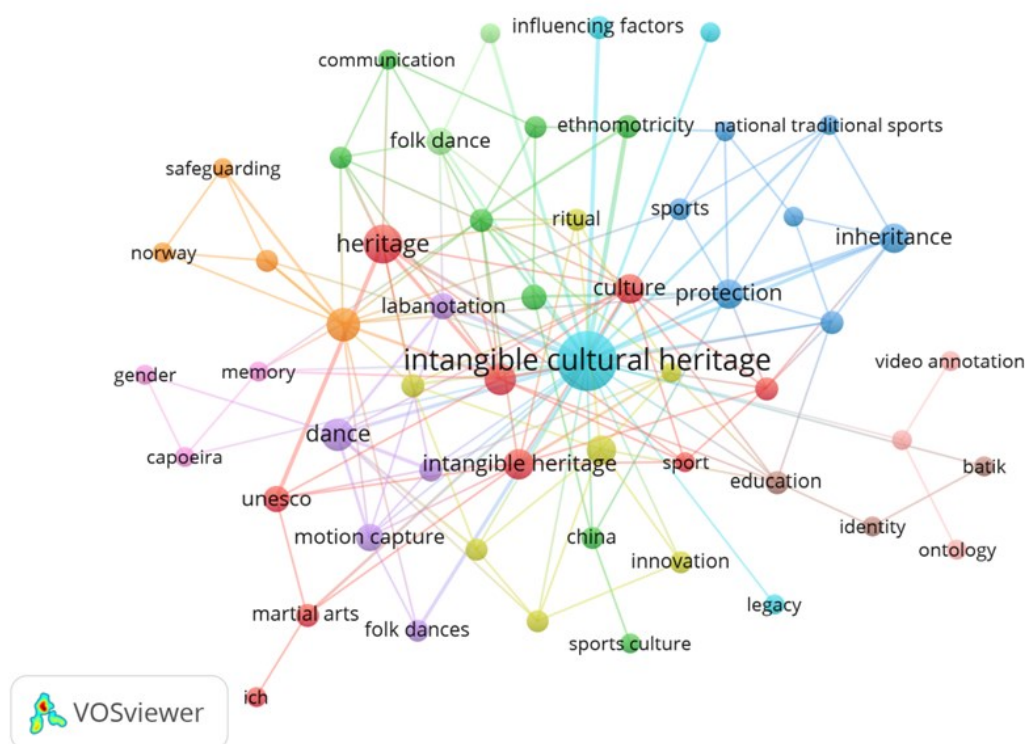


Figure 1. Keyword co-occurrence network.

### ***Cluster 1: Fundamental theory and safeguarding mechanisms (blue/cyan region)***

This cluster occupies the central and right areas of the map and is composed of nodes such as “intangible cultural heritage”, “protection”, “inheritance”, and “sports”.

#### **(1) Core position**

“Intangible cultural heritage,” the largest and most central node, links to all major branches of the network, indicating that all research radiates outward from this foundational concept.

#### **(2) Intergenerational transmission**

The strong connection between “inheritance” and “education” suggests that formal schooling is considered one of the most effective means to prevent intergenerational discontinuity. Research focuses on integrating local traditional sports into school curricula to ensure the passing on of cultural genes.

#### **(3) Sporting attributes**

Nodes such as “national traditional sports” and “sports” clarify the athletic nature of the research objects, highlighting their role in national fitness initiatives and the development of traditional sports.

### ***Cluster 2: Digital empowerment and technological applications (purple/pink region)***

Located primarily in the lower left portion of the map, this is the fastest growing and most innovative research branch. Its core nodes include “motion capture,” “video annotation,” “labanotation,” and “martial arts”.

#### **(1) Making tacit knowledge explicit**

The core of many sports ICH practices lies in embodied tacit knowledge - skills that are “felt but hard to verbalize”. The close connections among “motion capture”, “martial arts”, and “dance” indicate scholars’ efforts to use digital technologies to capture microlevel movement details. This facilitates transforming practitioners’ skills into storable and analyzable digital models (Digital Twins), enabling the long-term preservation of sophisticated techniques.

#### **(2) Interdisciplinary integration**

The presence of “video annotation” and “labanotation” reflects deep cross disciplinary integration among computer science, dance studies, and sports science. Combining traditional movement notation with modern video technology provides a dual system approach for scientifically recording sports ICH.

### ***Cluster 3: Cultural ecology and regional practices (green/yellow region)***

This cluster includes nodes such as “China”, “folk dance”, “ritual”, and “ethno motricity”.

#### **(1) China’s contribution to global scholarship**

The prominent node “China”, connected to terms like “innovation” and “sports culture”, suggests that China’s abundant ICH resources - especially martial arts and Taijiquan - provide rich empirical cases for global research. China’s innovative practices in ICH safeguarding have also begun to attract international attention.

#### **(2) Symbiosis of ritual and culture**

The linkage between “ritual” and “folk dance” indicates that sports ICH often exists within specific festivals, rituals, or folk events. This cluster underscores the importance of “cultural ecological protection”: Safeguarding sports ICH requires not only preserving the movements themselves but also protecting the cultural environments that nourish them.

### ***Cluster 4: International policy and collective memory (orange region)***

On the left side of the map, nodes such as “safeguarding”, “heritage”, “memory”, and “UNESCO” form a closely interconnected group (at the edge of the red region).

This cluster focuses on the social function of intangible heritage as a form of “collective memory” and examines how UNESCO’s Convention for the Safeguarding of the intangible cultural heritage is implemented and localized in different countries (e.g., the node “Norway”).

## Conclusion

### *Research conclusions*

Using VOSviewer, this study conducted a visualization analysis of literature on sports intangible cultural heritage indexed in the Web of Science Core Collection over the past decade. Through high frequency keyword statistics and cooccurrence network analysis, several key conclusions were reached:

(1) The research paradigm demonstrates a dual pattern of “ontological stability and methodological innovation”.

Statistical results show that “intangible cultural heritage” and “protection” remain the most central high frequency terms, indicating a strong scholarly consensus regarding the foundational nature of sports ICH as a form of cultural asset. Meanwhile, the emergence of nodes such as “motion capture” and “video annotation” signals a methodological shift - from traditional fieldwork and textual documentation toward a “digital humanities” paradigm driven by computer vision and data analytics. This transformation enables the digital storage and analysis of embodied tacit knowledge that is otherwise difficult to transmit verbally.

(2) Culture-tourism integration has become the primary pathway for living heritage transmission. “Tourism”, as the only industry related term among the top five high frequency keywords, confirms that industrial development has become an internationally recognized safeguarding strategy. Research trends indicate that the preservation of sports ICH is moving beyond static museum style approaches toward “productive protection” embedded within modern service industries. By converting folk sports resources into tourism experience products, both the survival challenges of heritage practices and the cocreation of economic and cultural value can be addressed.

(3) Interdisciplinary collaboration and the convergence of sport and art are increasingly salient. The keyword cooccurrence network reveals the highly interdisciplinary nature of sports ICH

research. The field has expanded beyond the confines of sports science, integrating theories and methods from the arts (e.g., dance), computer science (e.g., machine learning), education, and other fields. The high frequency of “dance” highlights growing scholarly attention to the aesthetic value and embodied narratives of sports ICH, emphasizing its cultural significance as a unique form of performative art.

### *Research limitations*

Despite providing an objective overview of research hotspots and trends in the international field of sports ICH, this study has several limitations:

(1) Limited data sources

This study relies solely on the Web of Science Core Collection. Although this ensures high quality and internationally recognized literature, it inevitably excludes many valuable studies published in non-English national journals (such as China’s CNKI), potentially leading to an incomplete understanding of regional characteristics.

(2) Lag in technological analysis

Scientific knowledge maps reflect characteristics of published literature and may fail to capture cutting edge practices still in development or not yet widely published - such as the latest applications of generative AI in heritage innovation.

### *Future prospects*

Based on the above findings, future research on sports intangible cultural heritage may deepen along several dimensions:

(1) Advancing research on the integration of AI and ICH

As artificial intelligence continues to evolve, research should move beyond simple “digital documentation” toward “intelligent transmission”. Examples include using machine learning to analyze motion capture data and developing intelligent teaching systems capable of real time correction to address instructor shortages or applying AIGC to assist in designing cultural and creative products based on ICH.

(2) Strengthening research on the balance between authenticity and commercialization

With the increasing penetration of the tourism industry, finding a balance between market appeal and cultural authenticity will remain a long-term research topic. More empirical case studies are needed to develop scientific evaluation systems capable of monitoring the risk of cultural distortion caused by excessive commercialization.

(3) Constructing a Chinese discourse system with a global vision

The prominence of the “China” node indicates China’s importance as a key site of practice in this field. Future research should aim to elevate China’s rich experience in sports ICH safeguarding - such as the national ICH list system and heritage in school programs into internationally influential theoretical frameworks, promoting the global dissemination of Chinese sports culture and enhancing its international impact.

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#### Conflicts of Interest

The authors declare no conflict of interest.

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