ARCHIVES OF BUDO
Journal of Innovative Agonology

e-ISSN: 1643-8698

Section: ***HEALTH THROUGH COMBAT SPORT & SURVIVAL EXERCISES*** *Original Paper*

The impact of hand-to-hand combat exercises on physical health: a bibliometric and visualization analysis

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Authors' Contribution:

A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

Received: date: 18.12.2024
Accepted: date 20.01.2025
Published: date 28.01.2025

Abstract:

Background and study Aim: Hand-to-hand combat exercises, as a combination of traditional and modern physical activities, have gained increasing academic attention for their impact on physical health. However, systematic research on this topic remains limited, necessitating the use of bibliometric methods to clarify the current research aspects and emerging trends. The aim of this review is the aspects of hand-to-hand combat exercises that dominate in scientific works in relation to broadly understood health.

Material and Methods: Data for this study were sourced from the Web of Science Core Collection database, including the Science Citation Index Expanded and the Social Sciences Citation Index, covering the period from January 1, 2014, to December 31, 2024. A search was conducted using keywords such as 'hand-to-hand combat exercises' (in fact 'combat sports' and 'martial arts') and 'physical health' resulting in 1,724 English-language articles, including 1,201 research articles and 523 review papers. CiteSpace 6.4.R1 was used for data analysis, providing an in-depth examination of publication volume, country and institution distribution, author contributions, references, and keywords.

Results: A lot of hand-to-hand combat exercises have a significant positive impact on cardiovascular health, muscle strength, flexibility, mental health, injury prevention and rehabilitation, and promoting healthy lifestyles. The study results also identifies research trends, major contributing countries and institutions, and current research hotspots in the field.

Conclusions: Future research should focus on deepening knowledge in areas such as cross-cultural comparisons, integration of modern technologies, personalized training program designs, comprehensive training methods, socioeconomic impact assessments, and mechanism exploration. This will enhance the scientific validity and practical value of health and humanities educations through hand-to-hand-combat systems.. Additionally, attention must be given to ethics and cultural adaptability to ensure the sustainable development and global application of hand-to-hand combat training and research. Through systematic and multidimensional studies, hand-to-hand combat exercises can play an increasingly important role in global health promotion and public health.

Keywords: martial arts, mental health, neo-gladiator, physical fitness

Dictionary:

Neo-gladiator – a person who trains mix martial arts (MMA) and similar forms of hand-to-hand fighting that do not meet the definition of sport according to the Olympic Charter [56-59].

Centrality indices – are answers to the question "What characterizes an important vertex?" The answer is given in terms of a real-valued function on the vertices of a graph, where the values produced are expected to provide a ranking which identifies the most important nodes [60,61].

1. Introduction

With increasing public awareness of physical health, hand-to-hand combat exercises have gained widespread attention as an effective intervention for both physical exercise and mental well-being [1-3]. These exercises, which include various forms of physical activity focused on coordination, strength, and endurance, are appreciated for their potential benefits to physical health [4-6]. Unlike the extreme aggressive practices associated with the term 'mixed martial arts', camouflaged as neogladiatorship (see dictionary) this study focuses on the positive health effects of non-violent, fitness-oriented combat training. Hand-to-hand combat exercises, often practiced alongside traditional philosophical principles like breath control, internal energy, and mental focus [7-10], contribute positively to cardiovascular, respiratory, musculoskeletal, and nervous systems, as well as mental health [11-16]. Therefore, exploring and systematically evaluating the role of hand-to-hand combat exercises in promoting physical health is essential for advancing public fitness while respecting the cultural heritage of these practices.

Physical health is a key indicator of quality of life, encompassing various dimensions such as physical functioning, and also influencing on mental state, and social adaptability [17-19]. hand-to-hand combat exercises, through systematic training in flexibility, endurance, speed, strength, balance, and coordination, continuously improve physical function and thus enhance overall health [20-24]. Additionally, hand-to-hand combat exercises emphasize the integration of mind and body, high-lighting the unity of movement, breath, and intention [25-27]. This dynamic balance training helps alleviate stress, improve focus, and enhance mental health. The positive effects of hand-to-hand combat exercises on physical health are evident in several areas: (1) promoting cardio-vascular health by improving blood pressure and heart rate; (2) increasing muscle strength and bone health, thereby reducing the risk of falls in the elderly; (3) boosting immune function and lowering the incidence of chronic diseases; (4) improving mental health by alleviating anxiety, depression, and other psychological issues. However, com-pared to other forms of exercise, the health benefits of hand-to-hand combat exercises are often overlooked, particularly in evidence-based frameworks where systematic research is still lacking. Therefore, it is essential to use bibliometric and visualization analysis to provide a com-prehensive overview of the research status, hotspots, and future trends regarding the health benefits of hand-to-hand combat exercises from a macro perspective (with a loose understanding of the word 'macro').

In recent years, research methods based on evidence-based medicine and scientific evaluation have been widely promoted in the fields of sports and health. By using visualization software CiteSpace to build knowledge maps from bibliometric data, analysis of co-occurring keywords, co-citation of papers, and author collaboration networks can help the academic community map the relationships and interactions between research units, revealing the dynamic evolution of research topics over time and providing a systematic and more accurate reference for future studies. Therefore, introducing bibliometric and visualization methods to the study of hand-to-hand combat exercises and physical health can not only uncover research hotspots and the knowledge structure of the field but also analyse the degree of international collaboration and the characteristics of interdisciplinary cooperation. Additionally, this approach can help identify key research institutions, funding bodies, and high-impact literature, thereby providing data support for future research.

Although research on hand-to-hand combat exercises and physical health has increased in recent years, several gaps remain. First, there is a lack of systematic reviews of global research out-comes. Second, there is a lack of horizontal comparison and relational analysis between different studies. Third, research topics are scattered and have not formed a clear academic framework. Therefore, this paper, based on bibliometric and visualization analysis, focuses on the impact of hand-to-hand combat exercises on physical health and systematically reviews the re-search status in this field from a global perspective.

The aim of this review is the aspects of hand-to-hand combat exercises that dominate in scientific works in relation to broadly understood health.

The decomposition of this aim into research tasks is the answer to the following questions: What is the current research status in the field of hand-to-hand combat exercises and physical health? What are the current research hotspots and emerging trends? Which academic institutions and scholars have made significant contributions? How is research distributed across different countries and regions? On a theoretical level, this study will support the development of the knowledge system regarding the health benefits of hand-to-hand combat exercises. On a practical level, it will provide a reference for the global promotion of hand-to-hand combat exercises and the scientific communication of its health value.

2. Materials and Methods

Data Source and Search Strategy

The literature data for this study were sourced from the Web of Science Core Collection, specifically the Science Citation Index Expanded and the Social Sciences Citation Index. The search strategy was set as follows: TS=("hand-to-hand combat exercises" OR "martial arts" OR "kung fu" OR "taekwondo" OR "karate" OR "judo" OR "wushu" OR "tai chi" OR "capoeira" OR "traditional martial arts" OR "combat sports") AND TS=("physical health" OR "health" OR "well-being" OR "fitness" OR "cardiovascular" OR "musculoskeletal" OR "mental health" OR "balance" OR "flexibility" OR "strength" OR "endurance" OR "mobility") AND TS=("impact" OR "effect" OR "influence" OR "benefit" OR "outcome" OR "role") AND TS=("exercise" OR "training" OR "activity" OR "movement" OR "sport" OR "physical activity"). The search period was from January 1, 2014, to December 31, 2024. A total of 1,724 English-language research articles were identified, including 1,201 research articles and 523 review articles.

Data Analysis

Data processing and analysis were conducted using CiteSpace 6.4.R1 visualization software. The analysis focused on several key areas, including: Analysis of Publications, Analysis of Country and Institution, Analysis of Authors, Analysis of References, and Analysis of Keywords. A multi-dimensional analysis of the data will provide valuable in-sights into the positive effects of hand-to-hand combat exercises on physical health.

On the graphical presentation of the results the size of the nodes reflects the academic output of each country regarding the impact of martial arts on physical health, while the colour of the nodes indicates the evolution of research trends over time. While centrality indices (see dictionary) are presented in Tables.

3. Results

Analysis of publications

The number of publications on the positive impact of martial arts (as this name is mainly used by the authors of the publication) on physical health showed a significant upward trend from 2014 to 2024. The total number of publications increased from 95 in 2014 to 231 in 2024, representing a 140% growth. The average annual growth rate was approximately 10.1%. The increase accelerated notably after 2018 (122 publications) and 2020 (182 publications), reflecting the growing research interest in the health benefits of martial arts. From 2016 to 2019, the number of publications rose from 85 to 138, indicating the growing recognition of the health benefits of martial arts (Figure 1).

Figure 1. Publication trends on the impact of martial arts on physical health (2014–2024).

The global outbreak of the COVID-19 pandemic made home-based exercise a significant focus. Martial arts became a research priority due to their minimal equipment requirements and adaptability to various health conditions. Some authors of published works draw attention to role of hand-to-hand combat exercises role in boosting immunity, improving cardiovascular health, and alleviating psychological stress. This led to a sharp increase in publications from 182 in 2020 to 224 in 2021. From 2022 to 2024, the number of publications increased slightly from 229 to 231. During this period, the research topics became more diverse, addressing the health benefits of martial arts for different populations, including the elderly, women, and adolescents, as well as the impact of cross-cultural dissemination on health promotion.

China's node is the largest and located at the centre of the network greatest contribution in global research on the impact of hand-to-hand combat exercises (combat sports, martial arts, health exercises with elements of hand-to-hand combat techniques). As a significant part of traditional Chinese culture and these specific psychophysical activities (especially: tai chi, qigong, and martial arts rehabilitation) provide abundant resources for research, which puts China experts in a privileged position. The United States' node is positioned slightly above the centre of the network, indicating its key role of American experts in research activity and international collaboration. Research in the U.S. mainly focuses on scientific validation, such as the physiological effects of martial arts and psychological health intervention mechanisms, with an emphasis on experimental and data-driven evidence of martial arts' impact on physical health. Additionally, the U.S. stands out

in cross-cultural promotion and innovative applications, such as introducing tai chi to Western communities and integrating elements of martial arts into fitness and therapeutic practices. Australia, as an emerging powerhouse in this field, has a larger node and high research activity. In recent years, Australian studies have focused on the role of martial arts (of course some elements) in preventing falls among the elderly, martial arts in community health programs, and exploring martial arts as a psychological intervention. European countries, including the United Kingdom, Germany, Spain, and Italy, have formed a close-knit collaboration network, with Germany and the U.K. playing a crucial bridging role. Research primarily focuses on the effects of certain elements of martial arts on individuals with neurological disorders, the impact of martial arts on adolescents' psychological and social adaptation, and cross-cultural comparison studies (Figure 2).

Country of analysis

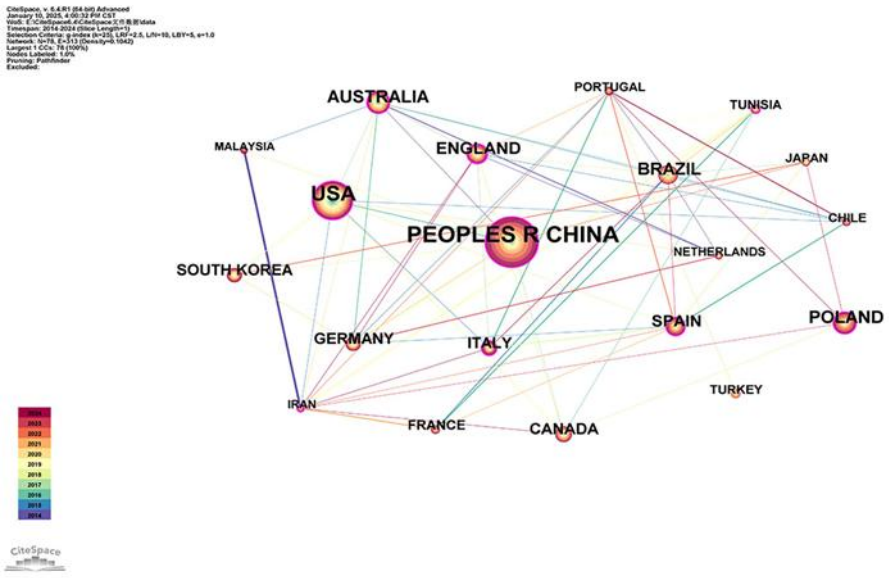

Figure 2. Top 20 Countries/regions by number of publications.

Institution of analysis

Shanghai University of Sport is the central node in the network, highlighting its significant contribution to research on the impact of martial arts on physical health and its close collaborations with various institutions. Harvard University, Harvard Medical School, and Brigham & Women's Hospital are also major contributors to this field, forming a small collaborative sub-network among them. The involvement of these institutions indicates that the academic community in Europe and the U.S. is increasingly focused on the scientific mechanisms between martial arts and health, with research primarily concentrated on martial arts' effects on chronic diseases, mental health, and rehabilitation. Beijing University of Chinese Medicine and the China Academy of Chinese Medical Sciences, as core institutions in traditional Chinese medicine, highlight the integration of martial arts and traditional Chinese medicine in promoting physical health.

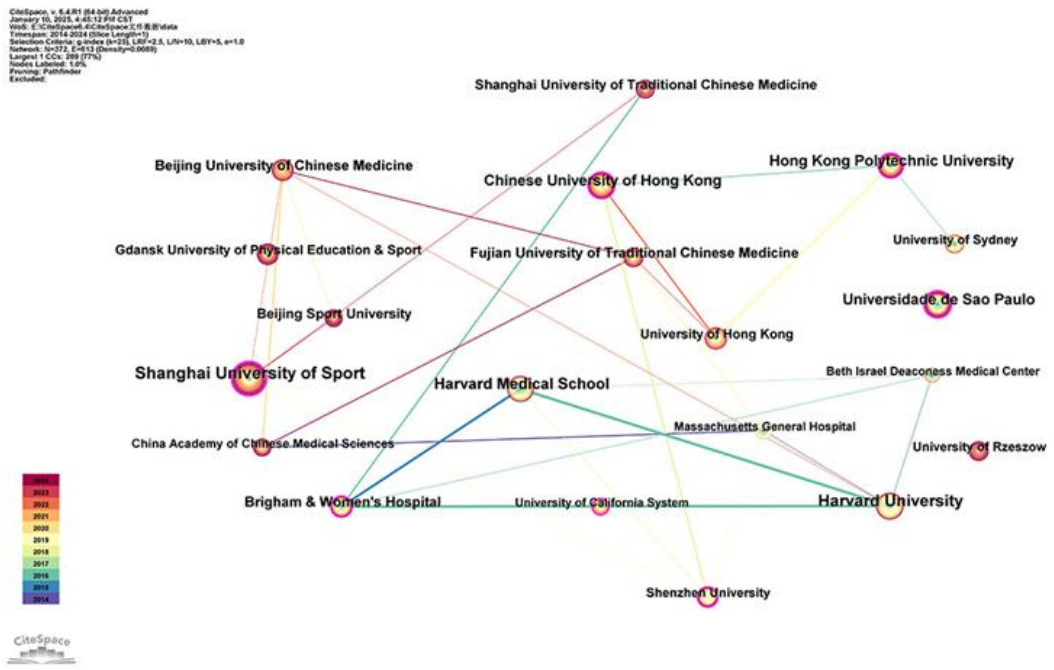

Figure 3. Top 20 institutions by number of publications.

The Chinese University of Hong Kong and Hong Kong Polytechnic University have numerous international connections, reflecting the important role of Hong Kong institutions in bridging the academic communities of mainland China and the global stage. Martial arts health research is primarily led by China but has gradually attracted international participation, forming a research network with cross-regional and multidisciplinary collaborations.

Most of these institutions are located in East Asia, particularly in China, Japan, and South Korea. These countries have a long-standing martial arts tradition, and their re-search institutions have invested significant resources in preserving and innovating martial arts culture. Additionally, several top universities and research institutions in Europe and North America have made notable contributions to this field, demonstrating global interest in the health benefits of martial arts.

Author of analysis

The top two authors, Emerson Franchini, and Peter M Wayne, have published 27 and 24 papers respectively, making them the primary contributors in this field. Authors Liye Zou and Jing Tao ranking third and fourth, have each published 19 papers, indicating their significant research contributions and core status in the field. Authors Tadeusz Ambrozy, Lukasz Rydzik, and Jia Huang, ranked fifth through seventh, have published between 11 and 13 papers, representing a high level of academic output. The seven authors ranked ninth to fifteenth have each published 7 papers, indicating a large number of researchers with moderate contributions (Table 1).

Table 1. Top 15 Authors by number of publications on the impact of martial arts on physical health.

Ranking	Count	Centrality	Year	Author
1	27	0.01	2015	Emerson Franchini,
2	24	0	2014	Peter M Wayne
3	19	0.01	2017	Liye Zou
4	19	0	2015	Jing Tao
5	13	0.01	2017	Tadeusz Ambrozy
6	12	0.01	2022	Lukasz Rydzik
7	11	0	2019	Jia Huang
8	10	0	2015	Lidian Chen
9	7	0	2021	Tomas Herrera-valenzuela
10	7	0	2014	Ruth E Taylor-piliae
11	7	0	2021	Pablo Valdes-badilla
12	7	0.01	2022	Jozef Simenko
13	7	0	2019	Tao Xiao
14	7	0	2024	Robert Trybulski
15	7	0	2016	Li Li

This long-tail effect further illustrates the varying levels of contribution among researchers in this field. Most authors have a Centrality value of 0, indicating weak connectivity with-in the academic network, with their research primarily focused on individual or independent projects, and a lack of broad collaboration across institutions and scholars. This also reflects that research on the impact of martial arts on physical health is still in a de-centralized stage, with no highly interconnected or collaboration-intensive academic community yet formed.

These scholars have advanced theoretical development and practical applications in the field through diverse research topics and innovative methodologies. Their research has enriched the knowledge system of sports science and public health and provided a scientific foundation for policy-making and the implementation of health promotion strategies. In the future, with ongoing technological advancements and deeper research, the role of martial arts in promoting physical health will be widely promoted, and its ap-plication prospects will expand further.

Analysis of cited reference

Among 25 selected references, the citation impact ranges from 5.62 to 18.21, with higher-impact references reflecting greater academic value. The top 25 highly cited references on the impact of martial arts on physical health indicate that martial arts have a significant effect not only on cardiovascular health, muscle strength, flexibility, and balance but also on other areas of health (Table 2).

Table 2. Top 25 references with the strongest citation bursts – ordinal variable: from the highest impact ranks.

Publication author(s) [references]	year	impact ranks	Strongest citation bursts period begin	end	model
Page et al. [28]	2021	18.21	2022	2024	
Li et al. [29]	2012	15.3	2022	2024	
Wayne et al. [30]	2014	9.48	2017	2019	
Cumpston et al. [31]	2019	9.01	2022	2024	
Huston, McFarlane [32]	2016	8.92	2020	2021	
Taylor-Piliae et al. [33]	2014	8.36	2015	2019	
Wang et al. [34]	2014	8.18	2015	2018	
Yeh et al. [35]	2011	7.76	2014	2016	
Chan et al [36]	2018	7.42	2020	2022	
Song et al. [37]	2017	7.4	2021	2022	
Chen et al. [38]	2016	6.92	2020	2021	
Jahnke [39]	2010	6.66	2014	2015	
Wang et al. [40]	2010	6.66	2014	2015	
Zou et al. [41]	2017	6.64	2018	2021	
Huang [42]	2015	6.44	2017	2020	
Wang et al. [43]	2018	6.47	2021	2022	
Leung et al. [44]	2011	6.4	2014	2016	
Gillespie et al. [45]	2012	6.32	2014	2017	
Bull et al. [46]	2020	6.32	2022	2024	
Kim et al. [47]	2015	6.18	2018	2020	
Zeng et al. [48]	2014	6	2015	2019	
Francini [49]	2011	5.81	2014	2016	
Gao et al. [50]	2014	5.67	2015	2019	
Zou et al. [51]	2019	5.62	2019	2020	
Sungkarat et al. [52]	2018	5.62	2019	2021	

Martial arts also play a key role in improving mental health, preventing injuries, and promoting a healthy lifestyle. These findings not only validate the scientific basis and effectiveness of martial arts as a comprehensive health promotion tool but also provide strong theoretical support for its application in public health, clinical rehabilitation, and personal fitness. Future research can further explore the health effects of different martial arts styles, conduct larger-scale longitudinal studies to assess long-term health benefits, and integrate modern technologies, such as wearable devices and biofeedback, to deepen the understanding of the health mechanisms of martial arts.

Keyword of analysis

'Tai chi' plays an important role in enhancing physical health, preventing risks, and improving fitness. Other frequently occurring keywords include 'quality of life', 'older adults', 'exercise', and 'systematic review', indicating that the research focus is on 'elderly health', 'exercise outcomes', and 'scientific evaluation'. 'Tai chi' is strongly associated with keywords like 'balance', 'falls', 'strength', and 'physical activity', demonstrating that research is cantered on the role of tai chi in improving fitness, strength, and fall prevention (Figure 4).

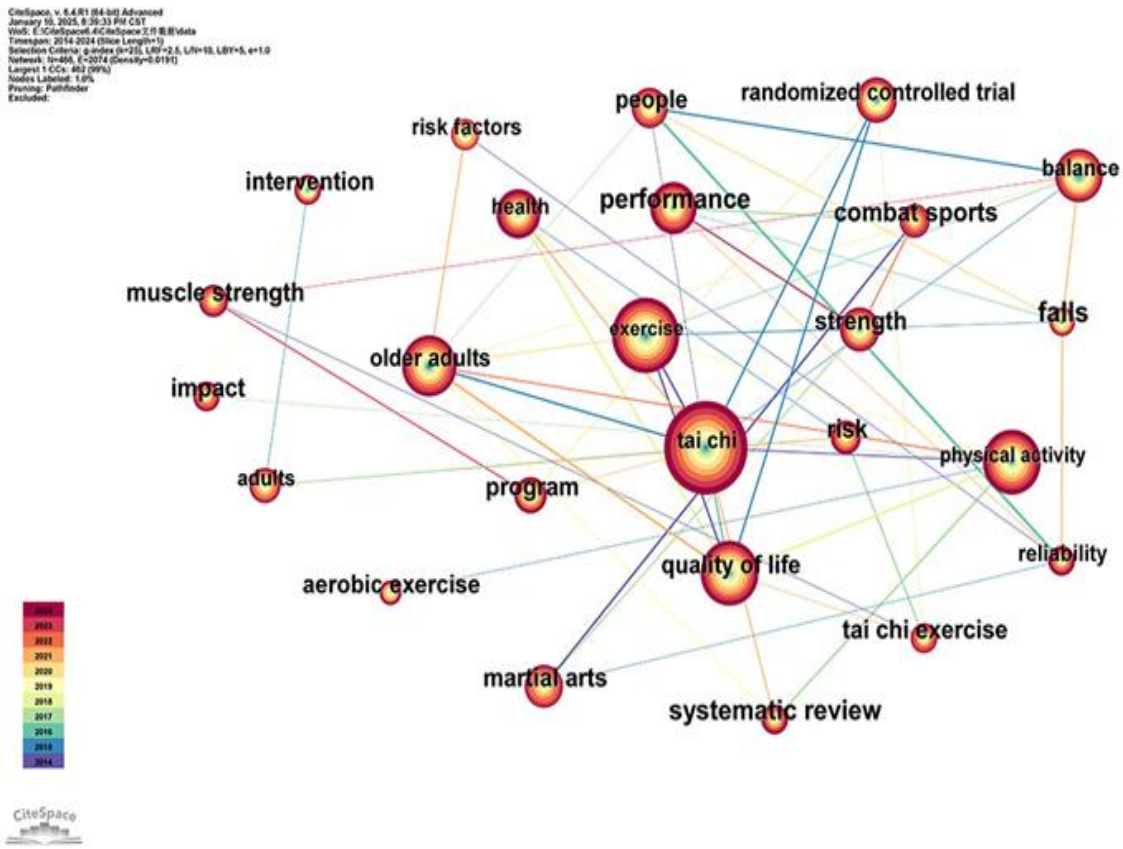

Figure 4. Co-occurrence map of keywords on the impact of martial arts on physical health.

The keyword martial arts is linked with terms such as 'program' and 'aerobic exercise', suggesting that studies are also exploring the integration of martial arts with other forms of exercise for health intervention. Randomized controlled trial acts as a connecting node, indicating that research in this area adopts rigorous scientific methods to ensure the reliability of findings. The red nodes represent the latest research, showing a growing focus on tai chi exercise and quality of life in recent years. Earlier studies were more focused on muscle strength and systematic review, indicating a shift from basic research to more comprehensive evaluations in this field. Research on tai chi and martial arts as intervention methods primarily addresses how they can improve balance, muscle strength, and reduce fall risks in the elderly. Associated keywords like risk and falls highlight that fall prevention and risk management are key topics in this area. The close connection between tai chi and quality of life suggests that its health benefits extend beyond physiological effects to potentially impact mental health and social participation.

4. Discussion

The co-occurrence map of keywords reveals the significant value of martial arts research in the health domain, particularly in its core role in elderly health, quality of life improvement, and fall prevention.

China, not only the birthplace of martial arts, also possesses a rich variety of traditional martial arts styles, such as tai chi, Shaolin kung fu, and wing chun. These cultural heritages provide extensive material and unique perspectives for academic research. Japan's martial arts, such as judo and karate, have achieved remarkable

success in competitive arenas and have also been deeply researched for their benefits in promoting physical and mental health. South Korea, as the birthplace of Taekwondo, holds a significant advantage in research on taekwondo and its impact on physical health. In Brazil, martial arts research primarily focuses on the impact of unique forms like capoeira on physical coordination, cardiovascular health, and social interactions. Overall, the research in this field exhibit a clear international trend, with a complex and extensive collaboration net-work, reflecting the globalization of studies on the impact of martial arts on physical health.

Research hotspots and frontiers

From 2014 to 2024, research on the impact of martial arts on physical health demonstrates both continuity and distinct phases of development. With the integration of aca-demic resources, advances in technology, and the deepening of cross-cultural studies, the scope of research in this field has become increasingly diverse and refined. Looking for-ward, martial arts research can to evolve toward a more mechanistic, globalized, and technology-driven approach, emerging as a multidisciplinary focus in health intervention studies.

Globally, academic research on the health impacts of martial arts exhibits a notable regional concentration and diversification trend. Asian countries with strong traditional martial arts heritage maintain their leading position in research output, while studies from Western developed nations and emerging economies are rapidly growing. Interdisciplinary collaboration and international exchanges have enriched the depth and breadth of research, while policy support and funding have provided necessary backing. Although challenges like standardization and long-term evaluation remain, the future of martial arts and health research is promising and poised to uncover additional health benefits.

Significant progress has been made globally in understanding the possibilities positive impact of martial arts on physical health (a threat to such perception is the promotion of interpersonal aggression under the attractive name of 'mixed martial arts' [53-55]). Research institutions in East Asia, particularly in China, Japan, and South Korea, excel in both the quantity and quality of research output. These institutions leverage a rich martial arts heritage and robust research capabilities to drive cut-ting-edge studies, covering diverse topics such as physiology, mental health, geriatric health, and injury prevention. With deeper research and stronger international cooperation, the role of martial arts in health promotion will undergo comprehensive and systematic scientific validation.

Only positive forms of martial arts demonstrate substantial benefits not only in enhancing physical fitness and mental health but also in cardiovascular health, weight management, and immune function. Many innovative training methods and diverse exercise routines make it a highly appealing and versatile activity suitable for people of different ages and health statuses [56-59]. Future research should explore its long-term health effects and specific mechanisms, providing a more solid scientific foundation for the promotion and application of martial arts in health.

Study Limitations

This study has certain limitations. The reliance on a single data source may have resulted in the omission of important literature from other databases, potentially limiting the comprehensiveness of the study in capturing research hotspots and trends. Further-more, the selection of English-language literature exclusively may have

introduced a bias, as relevant research published in other languages was not considered.

5. Conclusions

Future research should focus on deepening knowledge in areas such as cross-cultural comparisons, integration of modern technologies, personalized training program designs, comprehensive training methods, socioeconomic impact assessments, and mechanism exploration. This will enhance the scientific validity and practical value of health and humanities educations through hand-to-hand-combat systems.. Additionally, attention must be given to ethics and cultural adaptability to ensure the sustainable development and global application of hand-to-hand combat training and research. Through systematic and multidimensional studies, hand-to-hand combat exercises can play an increasingly important role in global health promotion and public health.

Acknowledgment

The author expresses gratitude to the Editors for pointing out that an overly enthusiastic (devoid of a critical approach from the perspective of the social mission of science) use of the term 'marital arts' may prove counter-prodictive. The scale of promoting interpersonal aggression under the attractive name of 'mixed martial arts' is so large that competent use of the terms exercises and/or systems of hand-to-hand combat may to some extent compensate for the negative impact of MMA pathology on broadly understood public health.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Conflicts of Interest: The author declare no conflicts of interest.

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Citation: Dou Liang. The impact of martial arts on physical health: a bibliometric and visualization analysis. Arch Budo J Inn Agon 2025, 21: 1-14