

A bibliometric analysis of studies addressing rehabilitation in martial arts

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Abstract

Purpose. The scientific novelty of this study lies in the identification and structured interpretation of thematic clusters that characterize the contemporary research landscape of rehabilitation in martial arts. To conduct an analytical review of publications devoted to the problem of rehabilitation in martial arts using the VOSviewer software tool in the PubMed database.

Material & Methods. To create the study sample as of December 31, 2025, a bibliometric analysis of data from the PubMed database was performed. The search was conducted using the key phrase "rehabilitation in martial arts". Publications from 2001 to 2025 were analyzed. VOSviewer version 1.6.19 was used, applying keyword analysis and direct citation analysis with the construction of bibliometric maps, cluster density visualization, and citation weights.

Results. Using VOSviewer 1.6.19, a total of 1111 publications were identified. All publications were written in English. A substantial increase in the number of publications was observed in each five-year period, which can be explained by the growing interest in and popularization of research on rehabilitation in martial arts. Overall, 4713 researchers from 2943 organizations studied rehabilitation issues across various martial arts disciplines. The publication activity of 1049 authors with a link strength greater than zero was analyzed. These authors were grouped into 41 clusters, characterized by 5333 links with a total link strength of 6836. The most productive authors were Tsang W. (25 publications), Wayne P. (23), Li F. (21), Tao J. (19), Chen L. (17), Huang J. (15), Yen G. (14), Franchini E. (13), and Wang C. (13). For network visualization, 371 elements (keywords) were selected and grouped into 9 clusters. The network included 14701 links with a total strength of 67,750. The most prominent research topics were centered around the keywords "humans", "male", "martial arts", "adult", "female", "aged", "tai ji", "exercise", "treatment outcome" and "quality of life". Overlay visualization demonstrated a clear evolution of scientific research: from general assessment of functional status and risk prevention (early stage), through the implementation of specialized rehabilitation methods (transitional stage), to individualized physical rehabilitation programs with an emphasis on motor activity control and exercise tolerance (modern stage).

Conclusions. Using the VOSviewer software, a bibliometric analysis of publications indexed in the PubMed database was conducted, revealing a steady increase in scientific interest in rehabilitation in martial arts, as evidenced by a significant growth in the number of publications over the analyzed period. A high level of international scientific cooperation was identified, reflected in the wide range of authors, institutions, and interdisciplinary links. The analysis

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The online version available at
[https://doi.org/10.15391/prht.2026-11\(1\).04](https://doi.org/10.15391/prht.2026-11(1).04)

of bibliometric maps made it possible to identify nine key thematic clusters encompassing sports, clinical, psychosocial, and preventive aspects of rehabilitation. The leading research directions focus on recovery from sports injuries, improvement of the functional state of the musculoskeletal system, quality of life, and mental health. Overlay visualization confirmed the evolution of scientific approaches – from basic functional and clinical studies to contemporary individualized physical rehabilitation programs with load control. The obtained results confirm the need for further research aimed at integrating rehabilitation measures directly into the structure of the training process, as well as at developing scientifically grounded models of long-term athletic recovery.

Keywords: martial arts, rehabilitation, VOSviewer, bibliometric mapping, cluster, citation.

Introduction

The modern development of martial arts is characterized by an increase in the intensity of training and competitive loads, the growing complexity of technical and tactical actions, and higher demands on the functional and psychophysiological capacities of athletes [1, 2]. Under such conditions, the risk of acute and chronic musculoskeletal injuries, overstrain of functional systems, and the development of fatigue states significantly increases, which negatively affects athletic performance and the duration of sports careers [3].

Rehabilitation in martial arts becomes particularly important due to the contact nature of bouts, asymmetric loads, frequent impact actions, and high demands on speed-strength, coordination, and cognitive components of preparedness [4]. An effectively organized rehabilitation process not only restores lost functions after injuries but also optimizes the adaptive mechanisms of athletes' bodies, reduces the risk of recurrent injuries, and ensures the stability of sporting performance [5, 6].

Of particular relevance is the integration of rehabilitation measures into the long-term training system of martial arts athletes, which involves a combination of medical-biological, physiotherapeutic, pedagogical, and psychological recovery tools. At the same time, in practical training settings, rehabilitation is often addressed in a fragmented manner, without taking into account the specific characteristics of a given martial art, the stage of preparation, and the individual characteristics of the athlete. This determines the need for scientifically substantiated comprehensive rehabilitation programs.

An analysis of scientific research indicates that the problem of athlete rehabilitation is quite widely covered in studies devoted to sports medicine and the theory of sports training [7, 8], describing general principles of sports training and rehabilitation, stages of post-injury recovery, and the role of therapeutic physical exercise, massage, physiotherapy, and modern recovery technologies in athlete preparation [9].

At the same time, a number of studies emphasize the specificity of injuries in martial arts, particularly the high incidence of injuries to the joint-ligament apparatus, muscles, spine, and traumatic brain injuries. In this context, the need for a differentiated approach to rehabilitation and monitoring is highlighted, taking into account movement biomechanics, dominant technical actions, and fighting style.

Some authors consider rehabilitation as a component of the system for managing training and competitive activities, emphasizing the feasibility of using functional and pedagogical monitoring to assess the effectiveness of recovery interventions [3]. In addition, there is a growing body of research focused on the application of innovative rehabilitation methods, including kinesiotaping, myofascial release, stabilization and proprioceptive exercises, as well as psychoregulatory techniques.

In the context of the increasing volume of scientific publications devoted to rehabilitation issues in martial arts, the application of modern bibliometric and scientometric analysis methods becomes particularly relevant. Traditional descriptive literature reviews do not always allow for a comprehensive identification of the structure of scientific knowledge, key research directions, relationships between thematic clusters, and the dynamics of scientific ideas in this field.

In this regard, the use of specialized bibliometric analysis software, such as VOSviewer, is promising. VOSviewer is a modern analytical tool widely used for the visualization and analysis of large volumes of bibliographic data. This software enables effective structuring of scientific information by identifying the most relevant topics, authors, institutions, and journals. The main advantage of VOSviewer lies in its ability to automatically cluster keywords, allowing researchers to identify meaningful relationships between publications and to form an understanding of the evolution of scientific interests within a specific field. This approach significantly facilitates literature reviews by enabling rapid identification of leading research directions and key researchers

in the selected topic [10, 11].

The scientific novelty of this study lies in the identification and structured interpretation of thematic clusters that characterize the contemporary research landscape of rehabilitation in martial arts. Unlike previous narrative or systematic reviews, this bibliometric analysis reveals the internal structure of research directions, their interconnections, and temporal evolution based on large-scale PubMed data. The obtained cluster structure complements existing bibliometric overviews by highlighting the integration of sports-specific, clinical, psychosocial, and preventive rehabilitation approaches within martial arts research.

The practical significance of the findings consists in providing specialists in physical rehabilitation and coaches with a structured overview of priority rehabilitation directions, allowing for evidence-informed selection of recovery strategies and integration of rehabilitation measures into the training process of martial arts athletes.

Purpose of the Study. To conduct an analytical review of publications devoted to the problem of rehabilitation in martial arts using the VOSviewer software tool in the PubMed database.

Material and Methods

Method of Study

The study employed a bibliometric method [12]. For this purpose, the software VOSviewer version 1.6.19 was used. VOSviewer is a software tool designed for constructing and visualizing bibliometric networks. These networks may include journals, researchers, or individual publications and are built on the basis of citation relationships, bibliographic coupling, co-citation, or co-authorship [13].

The co-occurrence method was selected as the main data analysis approach using VOSviewer. This method clusters keywords according to how frequently they appear together within the same publication. Keywords form thematic clusters that are represented by different colors. The size of each keyword is determined by the total link strength, which reflects the strength of its connections with other keywords, while the lines indicate the relationships between individual keyword pairs [14].

Data Extraction

After completing the selection of articles for visual and bibliometric analysis, the following data were extracted: author name, article title, journal of publication, keywords, affiliated organization, country of publication, and total number of citations.

Research Design

Using bibliometric analysis of the PubMed database, a publication sample was formed as of December 31, 2025. The query was based on the phrase "rehabilitation in martial arts" and included automatic PubMed term mapping, which incorporates Medical Subject Headings (MeSH). Logical operators were applied implicitly by the PubMed search engine. No restrictions were applied regarding study design; however, the search was limited to articles published between 2001 and 2025.

Based on the most frequently cited sources, promising research directions within this category were identified. The results of the analysis were presented in the form of bibliometric maps. Bibliometric mapping is a type of research based on the formal assessment of information flows. It enables researchers to navigate large information spaces and to structure extensive datasets for effective use. Data sources for mapping typically include information systems containing metadata of scientific publications, such as bibliographic information and citation data. Units of analysis in scientific mapping include journals, publications, references, authors, as well as terms and keywords used in the publications. Terms, as units of analysis, may be extracted from publication titles, abstracts, keyword lists, or full texts. In scientific mapping, relationships between units of analysis are established when at least two units co-occur within the same publication. These relationships can be represented as a graph or network, referred to as a map, where units of analysis (elements) serve as network nodes and the relationships between them form the edges. Thus, bibliometric maps represent networks describing relationships among units of analysis [15]. This methodology for calculating key indicators, identifying major research trends, and highlighting the most significant research directions has been applied in studies authors Piatysotska et al., Saltan et al., Al Husaeni & Nandiyanto, Li et al. [16–18, 13].

Inclusion and exclusion criteria

Inclusion criteria: publications indexed in PubMed; studies addressing rehabilitation, recovery, or therapeutic exercise in martial arts; articles published between 2001 and 2025; publications written in English.

Exclusion criteria: conference abstracts, editorials, letters; studies not related to rehabilitation or recovery; duplicate records.

Statistical analysis

Inferential statistical methods were not applied in this study, which is consistent with the methodological framework of bibliometric research. Bibliometric analysis focuses on the quan-

titative description, structural mapping, and visualization of scientific information rather than on hypothesis testing or population inference.

All analyses were conducted using descriptive bibliometric indicators, including the number of publications, citation counts, co-occurrence frequencies, total link strength, cluster composition, and average publication year. Network and overlay visualizations generated by VOSviewer were used to identify thematic structures, research trends, and temporal dynamics within the entire dataset of publications retrieved from the PubMed database.

Since the analysis covered the complete population of publications matching the search query, rather than a statistical sample, the use of inferential statistics was not methodologically justified.

Although absolute bibliometric indicators (number of publications, number of authors, total link strength) were used as primary descriptors, their interpretation was complemented by relative indicators to improve analytical robustness. In bibliometric mapping, absolute values reflect structural properties of scientific networks; however, normalization allows for more balanced comparison between authors, clusters, and time periods.

Results

A total of 1111 publications were identified in the PubMed scientometric database for the query "rehabilitation in martial arts" over the analyzed period. All retrieved publications were written in English. A marked increase in the number of publications was observed in each five-year interval (Fig. 1), which can be attributed to the growing interest in and popularization of research on rehabilitation in martial arts. Overall, 4713 researchers from 2943 institutions investigated rehabilitation issues across various martial arts disciplines.

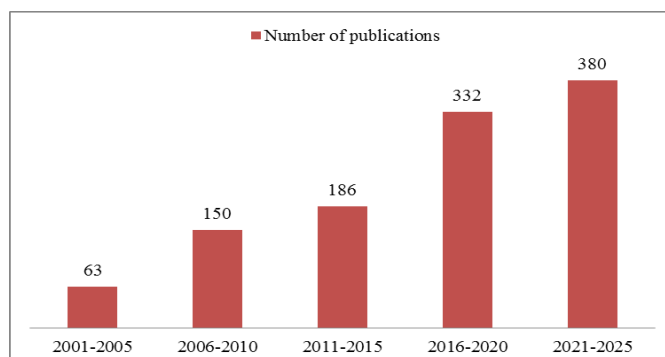


Figure 1. Dynamics of publications during the research period

Using VOSviewer 1.6.19 software, bibliometric maps were constructed. The analysis of these

maps was aimed at identifying trends in research on rehabilitation in martial arts, as well as determining priority research directions and leading authors. The results for the most prominent authors who investigated rehabilitation issues in martial arts are presented in Figure 2. The analysis included 1049 authors who had established links with one another. A distinctive feature of Figure 2 is its division into 41 clusters. These clusters are characterized by 5333 links with a total link strength of 6,836. The highest number of publications was recorded for the following authors: Tsang W. (25), Wayne P. (23), Li F. (21), Tao J. (19), Chen L. (17), Huang J. (15), Yen G. (14), Franchini E. (13), and Wang C. (13).

Figure 3 presents a bibliometric map of the main keywords in publications devoted to the study of rehabilitation issues in martial arts. The minimum keyword occurrence threshold was set at five in order to balance network interpretability and thematic representativeness. This threshold is commonly used in bibliometric studies to exclude sporadic terms while preserving stable conceptual structures. For network visualization, 371 elements (keywords) were selected and grouped into nine clusters. The network comprises 14701 links with a total link strength of 67750. The most prominent research topics are centered around the keywords "humans", "male", "martial arts", "adult", "female", "aged", "tai ji", "exercise", "treatment outcome" and "quality of life". Each keyword is represented by a circle, with larger circles indicating a higher number of links associated with that keyword. The proximity of the circles on the map reflects the strength of the correlation between the objects.

The first cluster is the largest on the bibliometric map and is highlighted in red. It includes 97 keywords. The central and most influential keyword in this cluster is "humans". It occurs 1102 times, has 370 links with other keywords on the map, and a total link strength of 10933, indicating its system-forming role in the research field. The core of this cluster also includes the keywords "male", "martial arts", "adult," "muscle strength", "athletic injuries", "movement", "reaction time", "motor skills" and "posture", which indicates that the research is focused on issues related to musculoskeletal injuries, recovery of motor qualities, and functional performance of athletes. The main research directions within this cluster are concentrated on the analysis of injury mechanisms in martial arts, assessment of the functional state of the musculoskeletal system, and the development of rehabilitation programs aimed at restoring athletic performance. This cluster can be provisionally defined as "Sports Injuries and Functional Rehabilitation in Martial Arts".

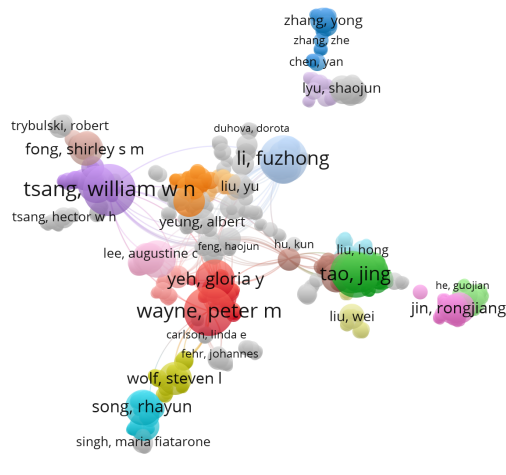


Figure 2. Bibliometric map of authors whose publications addressed rehabilitation issues in martial arts. Source: authors' own research based on data retrieved from PubMed and analyzed using VOSviewer (31.12.2025)

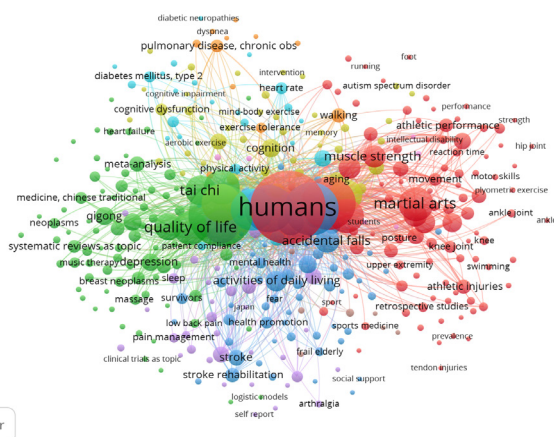


Figure 3. Bibliometric map of the main keywords in publications devoted to rehabilitation issues in martial arts (network visualization). Source: authors' own research based on data retrieved from PubMed and analyzed using VOSviewer (31.12.2025)

The second cluster, highlighted in green on the map, includes 87 keywords. The most influential keyword in this cluster is "tai ji", which occurs 807 times, has 347 links with other keywords on the map, and a total link strength of 8349. Other significant keywords in this cluster include "quality of life", "tai chi", "qigong", "mental health", "depression" and "sleep." The research themes within this cluster are related to the use of health-promoting and restorative practices, including elements of martial arts, to improve the physical and psychological condition of individuals during the rehabilitation process. This cluster can be conditionally defined as "Quality of Life and Psychosocial Aspects of Rehabilitation".

The third cluster consists of 61 keywords and is marked in blue on the map. It reflects stud-

ies focused on the restoration of functional independence and daily motor activity following injuries and diseases. The most significant keyword is "female", which occurs 581 times, has 365 links with other keywords, and a total link strength of 6822. Other relevant keywords include "activities of daily living", "accidental falls", "physical education and training", "health promotion", "stroke rehabilitation" and "mental health." In the context of martial arts, this cluster illustrates the application of general rehabilitation approaches aimed at developing basic motor stability and control. The conditional name of this cluster is "Functional Independence and Restoration of Daily Motor Activity".

The fourth cluster, marked in yellow, includes 41 keywords. The leading keyword is "exercise therapy", which occurs 316 times, has 325 links with other keywords, and a total link strength of 3351. This cluster also includes the keywords "cognition", "cognitive dysfunction", "cognitive impairment", "postural balance" and "mind-body exercise". The main focus is on the relationship between physical activity and cognitive recovery, which is particularly relevant for the comprehensive rehabilitation of athletes after injuries. This cluster is conditionally named "Cognitive Functions and Their Recovery Through Physical Exercise".

The fifth cluster consists of 33 keywords and is shown in purple on the map. It reflects studies devoted to functional recovery and the restoration of daily motor activity after injuries and periods of illness. The most significant keyword is "treatment outcome", which occurs 229 times, has 297 links with other keywords, and a total link strength of 2796. Other important keywords include "single-blind method", "pain", "physical therapy modalities" and "knee osteoarthritis". In the context of martial arts, this cluster provides a basis for developing individualized functional recovery programs after injuries and periods of hypodynamia, as well as for the safe return of athletes to training activities. The conditional name of this cluster is "Cardiorespiratory Rehabilitation and Exercise Tolerance".

The sixth cluster, marked in turquoise, contains 26 keywords. The most influential keyword in this cluster is "middle aged", which occurs 358 times, has 336 links with other keywords, and a total link strength of 4442. Other significant keywords include "physical fitness", "follow-up studies", "blood pressure", "physical activity" and "heart rate". These terms reflect interdisciplinary studies analyzing the role of physical activity in the prevention of health disorders and in the restoration of functional status in middle-aged individuals. In the context of rehabilitation in martial

arts, this cluster serves as a methodological foundation for designing recovery-oriented training programs aimed at both injury treatment and the long-term maintenance of athletic performance. The conditional name of this cluster is "Physical Activity as a Universal Means of Rehabilitation and Prevention".

The seventh cluster includes 11 keywords and is marked in orange on the map. The most significant keyword is "walking", which occurs 45 times, has 122 links with other keywords, and a total link strength of 504. Other relevant keywords include "exercise tolerance" and "exercise movement techniques". These terms indicate the clinical orientation of studies related to recovery after pulmonary diseases through moderate-intensity exercise. The conditional name of this cluster is "Restoration of Functional Motor Activity After Pulmonary Diseases".

The eighth cluster, marked in brown, includes eight keywords. The most important keyword in this cluster is "bone density", which occurs 14 times, has 68 links with other keywords, and a total link strength of 172. Other significant keywords include "biomarkers", "osteoporosis" and "falls", reflecting research related to age-related changes in motor function and bone tissue density. These results are relevant for the development of safe rehabilitation programs for older athletes and veteran martial arts practitioners, as well as for prolonging active sports longevity. The conditional name of this cluster is "Age-Related and Motor Aspects of Rehabilitation".

The ninth cluster includes seven keywords and is highlighted in pink on the map. The most significant keyword is "physical exercise", which occurs nine times, has 58 links with other keywords, and a total link strength of 106. Other relevant keywords include "physical function", "students" and "universities," indicating the integration of rehabilitation and training approaches. This cluster reflects the integration of rehabilitation into the training process of students practicing martial arts and includes studies analyzing the relationships between physical fitness, motor skills, and performance outcomes. The conditional name of this cluster is "Physical Fitness and Sports Performance in the Rehabilitation of Martial Arts Students".

To enhance the analytical value of the results, several relative bibliometric indicators were calculated. On average, one author accounted for approximately 1.06 publications, indicating a high level of collaborative research. The mean number of links per keyword cluster ranged from 58 to 1634, reflecting differences in thematic density and maturity of research directions. In relative terms, the number of publications increased by more than

200 % between 2010 and 2025, confirming a pronounced positive growth dynamics in research on rehabilitation in martial arts. Such normalization allows comparison of bibliometric structures independent of dataset size and reduces potential bias associated with absolute indicators.

The overlay visualization function of VOSviewer 1.6.19 allows researchers to assign scores to elements and to sort them according to a selected parameter, thereby identifying the most relevant research topics. In this study, the publication year was assigned as the scoring parameter for each analyzed item. Using VOSviewer 1.6.19, a map was generated that visualized the average publication year of the most frequently occurring keywords (Fig. 4). For a more detailed analysis, the period with the highest number of publications (2010-2025) was selected. On the map, colors range from blue (representing the earliest average publication year) through green to yellow (indicating the most recent and currently relevant keywords).

The analysis of the keyword bibliometric map constructed using VOSviewer 1.6.19 with the Average publication year indicator revealed the temporal evolution of scientific research – from foundational approaches to modern interdisciplinary perspectives. The earliest thematic directions are represented by keywords with an average publication year of 2011-2013. These reflect basic clinical and functional studies focused on restoring daily activity and preventing injuries. Such studies primarily addressed the assessment of patients' functional status, fall risks, and general consequences of impaired motor activity, which is typical of the early stage of rehabilitation research development.

The subsequent stage is represented by studies with an average publication year of 2016-2018, reflecting an expansion of the methodological toolkit of rehabilitation. During this period, interest in alternative and complementary intervention methods increased. Research from this stage demonstrates a shift from general functional recovery toward the search for specific means of optimizing the rehabilitation process, including non-pharmacological approaches.

The most recent keywords (average publication year 2021-2024) reflect current trends in rehabilitation science associated with the targeted use of physical exercise and the analysis of exercise tolerance. Studies from this period are characterized by a focus on dosed physical activity, restoration of walking ability, control of exercise intensity, and enhancement of functional endurance, which are particularly relevant for modern rehabilitation programs following diseases and injuries.

Thus, the bibliometric analysis demonstrates a clear evolution of scientific research: from general assessment of functional status and risk prevention

their recovery through physical exercise”) is consistent with research demonstrating a close relationship between motor activity and cognitive functioning. Scientific evidence indicates that combining physical exercises with cognitive tasks promotes the recovery of attention, reaction speed, and executive functions, which are critically important for martial arts athletes [4, 2].

The fifth cluster (“Cardiorespiratory rehabilitation and exercise tolerance”) corresponds to previous studies emphasizing the importance of pain management, cardiovascular functional status, and the effectiveness of rehabilitation interventions. Literature data suggest that load individualization and outcome assessment are key factors for the successful return of athletes to full physical activity [3, 9].

The sixth cluster (“Physical activity as a universal means of rehabilitation and prevention”) aligns with studies in which regular physical activity is regarded as a fundamental component of preventing functional disorders and maintaining work capacity. Previous research has demonstrated that appropriately dosed physical exercise positively affects cardiorespiratory parameters, blood pressure, and overall physical fitness levels [26, 27].

The seventh cluster (“Restoration of functional motor activity after pulmonary diseases”) correlates with clinical studies confirming the effectiveness of walking programs and moderate-intensity exercises in improving exercise tolerance. The obtained results indicate the integration of these approaches into the rehabilitation of athletes, particularly following systemic or respiratory diseases [28, 29].

The eighth cluster (“Age-related and motor aspects of rehabilitation”) corresponds to studies addressing age-related changes in bone tissue and motor function. Scientific evidence confirms that systematic physical exercise contributes to maintaining bone mineral density and reducing the risk of falls, which is particularly important for older athletes and veterans of martial arts [30, 31].

The ninth cluster (“Physical fitness and sports performance in the rehabilitation process of students practicing martial arts”) aligns with studies highlighting the feasibility of integrating rehabilitation measures into the educational and training process. Previous research demonstrates that combining rehabilitation with specialized physical training contributes to improved motor efficiency and stability of sports performance in young athletes [32, 33].

Although clusters 7-9 contain a limited number of keywords, they represent emerging and highly specialized research directions. Their pres-

ence reflects niche rehabilitation topics that are gaining relevance, particularly in the context of individualized recovery strategies and long-term athlete health. Even clusters with predominantly clinical terminology were interpreted through the lens of sports rehabilitation, emphasizing their applicability to martial arts athletes during post-injury recovery, return-to-training phases, and long-term performance maintenance.

The analysis of the temporal dynamics of keywords revealed an evolution of scientific approaches – from early studies focused on general functional assessment and risk prevention to contemporary research emphasizing individualized physical rehabilitation programs, dosed physical activity, and control of exercise tolerance (Fig. 4). This shift reflects a transition from universal recovery schemes to personalized strategies that take into account the type of martial art, level of preparedness, age, and health status of athletes.

In summary, rehabilitation in martial arts is currently emerging as a comprehensive system that integrates medical, physical, cognitive, and psychosocial components. These findings are supported by earlier studies [24, 28].

This study has several limitations that should be considered when interpreting the results. First, the bibliometric analysis was based solely on the PubMed database, which may not fully capture publications indexed exclusively in other scientific databases such as Scopus or Web of Science. Second, the analysis relied on author-provided keywords and indexing practices, which may introduce thematic bias. Third, the descriptive nature of bibliometric indicators does not allow for causal inference or direct evaluation of the effectiveness of specific rehabilitation interventions. Therefore, the findings should be interpreted as a structured overview of research trends rather than as evidence-based clinical recommendations.

Conclusions

Using VOSviewer software, a bibliometric analysis of publications indexed in the PubMed database was conducted, revealing a steady increase in scientific interest in rehabilitation in martial arts, as evidenced by a significant growth in the number of publications over the analyzed period. A high level of international scientific cooperation was identified, reflected in the wide range of authors, institutions, and interdisciplinary links. The analysis of bibliometric maps made it possible to identify nine key thematic clusters encompassing sports, clinical, psychosocial, and preventive aspects of rehabilitation. The leading research directions focus on recovery from sports injuries, improvement of the functional state of

the musculoskeletal system, quality of life, and mental health. Overlay visualization confirmed the evolution of scientific approaches – from basic functional and clinical studies to contemporary individualized physical rehabilitation programs with load control. The obtained results confirm the need for further research aimed at integrating rehabilitation measures directly into the structure of the training process, as well as at developing scientifically grounded models of long-term athletic recovery.

Author's contribution

Yuri Tropin: Conceptualization, Methodology, Data Curation; **Victor Shandrygos:** Writing – Review and Editing; **Volodymyr Shatskykh:** Visualization, Investigation; **Vale-rii Dzherelii:** Supervision; **Oleksandr Mozoliuk:** Writing – Original draft preparation. All authors have read and agreed with the published version of the manuscript.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

Funding Statement

This article did not receive financial support from state, public, or commercial organizations.

Editorial Independence Disclosure

Yuriy Tropin is affiliated with the same institution as the Editor-in-Chief of Physical Rehabilitation and Recreational Health Technologies. To ensure a transparent and unbiased review process, the Editor-in-Chief was completely excluded from the editorial handling, peer review coordination, and the final decision-making regarding this manuscript. The manuscript underwent independent double-blind peer review by external experts.

**Received: January 04, 2026; Accepted: February 15, 2026
Published: February 28, 2026**

References

- Curby D, Dokmanac M, Kerimov F, Tropin Y, Latyshev M, Bezkorovainyi D, Korobeynikov G. Performance of wrestlers at the Olympic Games: gender aspect. *Pedagogy Phys Cult Sports*. 2023;27(6):487-493. <https://doi.org/10.15561/26649837.2023.0607>
- Guan X, Lan M, Ge L, Zhu Q, Chen Y, Tang L, Zhong Y. Effect of Tai Chi combined with visual-action-sensory rehabilitation therapies on cognitive function in acute ischemic stroke: a study protocol for a randomized controlled trial. *Ann Med*. 2025;57(1):2566877. <https://doi.org/10.1080/07853890.2025.2566877>
- Humphrey R. Tai chi in cardiac rehabilitation. *J Cardiopulm Rehabil*. 2003;23(2):97-99. <https://doi.org/10.1097/00008483-200303000-00005>
- Chang CL, Lin TK, Pan CY, Wang TC, Tseng YT, Chien CY, Tsai CL. Distinct effects of long-term Tai Chi Chuan and aerobic exercise interventions on motor and neurocognitive performance in early-stage Parkinson's disease: a randomized controlled trial. *Eur J Phys Rehabil Med*. 2024;60(4):621-633. <https://doi.org/10.23736/S1973-9087.24.08166-8>
- Moreira SR, Ii ACO, Armstrong A. Capoeira: hypothesis on health rehabilitation and quality-of-life maintenance. *Rev Assoc Med Bras*. 2022;68(11):1530-1536. <https://doi.org/10.1590/1806-9282.20220360>
- Weerdesteyn V, Groen BE, van Swigchem R, Duysens J. Martial arts fall techniques reduce hip impact forces in naive subjects after a brief period of training. *J Electromyogr Kinesiol*. 2008;18(2):235-242. <https://doi.org/10.1016/j.jelekin.2007.06.010>
- Su AW, Johns WL, Bansal S. Martial arts: orthopaedic injuries and related biomechanics. *J Am Acad Orthop Surg*. 2024;32(1):e1-e12. <https://doi.org/10.5435/JAAOS-D-23-00261>
- Terry CM. The martial arts. *Phys Med Rehabil Clin N Am*. 2006;17(3):645-676. <https://doi.org/10.1016/j.pmr.2006.05.001>
- Woodward TW. A review of the effects of martial arts practice on health. *WMJ*. 2009;108(1):40-43. <https://bit.ly/4c0a8YC>
- Podrihalo O, Xiaohong G, Mulyk V, Podrigalo L, Galashko M, Sokol K, Jagiello W. Priority scientific areas in sports dances research: the analysis of the scientific resources of Web of Science Core Collection. *Phys Educ Stud*. 2022;26(5):207-223. <https://doi.org/10.15561/20755279.2022.0501>
- Tropin Y, Podrigalo L, Boychenko N, Podrihalo O, Volodchenko O, Volskyi D, Roztorhui M. Analyzing predictive approaches in martial arts research. *Pedagogy Phys Cult Sports*. 2023;27(4):321-330. <https://doi.org/10.15561/26649837.2023.0408>
- Sofyan D, Abdullah KH. College sport publication trends over 15 decades: a bibliometric analysis. *Khazanah Al-Hikmah J Ilmu Perpust Informasi Kearsipan*. 2022;10(1):69-82. <https://doi.org/10.24252/kah.v10i1a7>
- Li WH, Hadizadeh M, Yusof A, Naharudin MN. Analysis of research trends on elbow pain in overhead sports: a bibliometric study based on Web of Science database and VOSviewer. *Healthcare*. 2022;10(11):2242. <https://doi.org/10.3390/healthcare10112242>
- van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*. 2010;84:523-538. <https://doi.org/10.1007/s11192-009-0146-3>
- Diem A, Wolter SC. The use of bibliometrics to measure research performance in education sciences. *Res High Educ*. 2013;54(1):86-114. <https://doi.org/10.1007/s11162-012-9264-5>
- Piatyotska S, Podrigalo L, Olkhovyi O, Yefremenko A, Ashanin V. Priority areas of scientific research in the field of esports: an analytical review based on publications in the scientometric database. *Sport Tour Cent Eur J*. 2023;6(4):109-136. <https://doi.org/10.16926/sit.2023.04.06>
- Saltan N, Olkhovyi O, Fishchuk I, Saltan O, Semenova Y, Orlenko O. Priority modern scientific trends and approaches in physical education research: bibliometric analysis of scientometric databases. *Slobozhanskyi Herald Sci Sport*. 2025;29(1):14-27. <https://doi.org/10.15391/sns.v.2025-1.02>
- Al Husaeni DN, Nandiyanto ABD. Bibliometric analysis of high school keyword using VOSviewer indexed by Google Scholar. *Indones J Educ Res Technol*. 2023;3(1):1-12. <https://doi.org/10.17509/ijert.v3i1.43112>
- Podrigalo L, Tymchenko K, Perevoznyk V, Semeniv B, Paievskyi V, Halashko O. Scientific support for strength sports: anal-

- ysis of scientific resources from the Web of Science Core Collection. *Pedagogy Phys Cult Sports*. 2025;29(1):44-61. <https://doi.org/10.15561/26649837.2025.0106>
20. Makaruk H, Starzak M, Płaszewski M, Winchester J. Internal validity in resistance training research: a systematic review. *J Sports Sci Med*. 2022;21:308-331. <https://doi.org/10.52082/jssm.2022.308>
21. Deshmukh NV, Shah MS. Bilateral radial head fractures in a martial arts athlete. *Br J Sports Med*. 2003;37(3):270-271. <https://doi.org/10.1136/bjsm.37.3.270>
22. Wayne PM, Ahn A, Clark J, Irwin MR, Kong J, Lavretsky H, et al. The science of Tai Chi and Qigong as whole person health - part I: rationale and state of the science. *J Integr Complement Med*. 2025;31(6):499-520. <https://doi.org/10.1089/jicm.2024.0957>
23. Park M, Lee H, Li Y, Song R. Effects of Tai Chi and Qigong on physical function and psychiatric symptoms among individuals with mental illness: a systematic review and meta-analysis of randomized controlled trials. *Ann Behav Med*. 2025;59(1):kaaf019. <https://doi.org/10.1093/abm/kaaf019>
24. Burke DT, Al-Adawi S, Lee YT, Audette J. Martial arts as sport and therapy. *J Sports Med Phys Fitness*. 2007;47(1):96-102. <https://bit.ly/4sdW4Mr>
25. Thornton JS, Caneiro JP, Hartvigsen J, Ardern CL, Vinther A, Wilkie K, et al. Treating low back pain in athletes: a systematic review with meta-analysis. *Br J Sports Med*. 2021;55(12):656-662. <https://doi.org/10.1136/bjsports-2020-102723>
26. Bu B, Haijun H, Yong L, Chaohui Z, Xiaoyuan Y, Singh MF. Effects of martial arts on health status: a systematic review. *J Evid Based Med*. 2010;3(4):205-219. <https://doi.org/10.1111/j.1756-5391.2010.01107.x>
27. Yu Y, Wu T, Wu M, Liu S, Chen X, Wu J, et al. Evidence map of traditional Chinese exercises. *Front Public Health*. 2024;12:1347201. <https://doi.org/10.3389/fpubh.2024.1347201>
28. Andrianopoulos V, Klijn P, Franssen FM, Spruit MA. Exercise training in pulmonary rehabilitation. *Clin Chest Med*. 2014;35(2):313-322. <https://doi.org/10.1016/j.ccm.2014.02.013>
29. Carvajal Tello N, Segura Ordoñez A, Arias Balanta AJ. Rehabilitación pulmonar en fase hospitalaria y ambulatoria. *Rehabilitacion*. 2020;54(3):191-199. <https://doi.org/10.1016/j.rh.2020.02.008>
30. Li F, Harmer P, Fitzgerald K, Eckstrom E, Akers L, Chou LS, et al. Effectiveness of a therapeutic Tai Ji Quan intervention vs a multimodal exercise intervention to prevent falls among older adults at high risk of falling: a randomized clinical trial. *JAMA Intern Med*. 2018;178(10):1301-1310. <https://doi.org/10.1001/jamainternmed.2018.3915>
31. Sun M, Min L, Xu N, Huang L, Li X. The effect of exercise intervention on reducing the fall risk in older adults: a meta-analysis of randomized controlled trials. *Int J Environ Res Public Health*. 2021;18(23):12562. <https://doi.org/10.3390/ijerph182312562>
32. Aandahl HS, Von Heimburg E, Van den Tillaar R. Effect of Postactivation Potentiation Induced by Elastic Resistance on Kinematics and Performance in a Roundhouse Kick of Trained Martial Arts Practitioners. *J Strength Cond Res*. 2018;32(4):990-996. <https://doi.org/10.1519/JSC.0000000000001947>
33. Weerdesteyn V, Groen BE, van Swigchem R, Duysens J. Martial arts fall techniques reduce hip impact forces in naive subjects after a brief period of training. *J Electromyogr Kinesiol*. 2008;18(2):235-242. <https://doi.org/10.1016/j.jelekin.2007.06.010>