太极拳干预高血压的研究图景：基于知识图谱的热点演化与前沿分析

孟梓，许佳楠，刘子寅，李翠含，张建伟，吕韶钧

北京师范大学体育与运动学院，北京 100875

摘要：目的：太极拳作为中华民族传统体育的瑰宝，是一种典型的身心运动，以其心静体松等特点在改善心血管功能及调控血压方面展现出独特优势，近年来围绕太极拳干预高血压的机制与效果的研究日益增多，相关文献数量迅速增长。基于科学知识图谱方法，对太极拳干预高血压领域的研究文献进行计量分析，旨在系统揭示该领域的研究热点主题，可视化展现其中的发展演化路径及前沿机制方向，呈现信息全景，为深入探索太极拳在高血压非药物干预中的作用机制与临床应用提供数据驱动的理论支持。以期推动太极拳在高血压防治领域的科学化发展与标准化推广，为践行“健康中国”和“太极拳健康工程”等战略贡献实证依据。**方法：**本研究以 Web of Science 核心合集及中国知网（CNKI）数据库中有关太极拳干预高血压的中英文文献为分析对象，通过系统检索初步获得文献 309 篇，依据预设的纳入与排除标准进行严格筛选，最终确定 144 篇有效文献构成研究样本。采用文献计量学方法，结合科学知识图谱技术，运用 CiteSpace 与 VOSviewer 等工具，对纳入文献的关键词、研究对象基本特征、研究设计类型、太极拳干预方案及主要实验结果等要素进行系统提取与可视化分析。通过构建关键词共现网络与聚类图谱，识别该领域的研究热点主题及其内在结构；结合时序演化视图与关键词突现检测，揭示研究主题的动态演变路径与前沿发展方向。进一步通过量化分析，系统归纳高血压人群的人口学特征、研究设计方法学特征、太极拳干预周期与频率等参数，以及关键生理指标的变化趋势，从而全面呈现太极拳干预高血压领域的研究图景与发展脉络。**结果：**基于研究现状，通过关键词共现与聚类分析发现，已形成以心血管功能改善、运动处方和针对不同人群为主的研究集群，其中随机对照试验、血压、生活质量、理化指标等核心关键词体现了以临床疗效验证为基础，逐步向作用机制探讨拓展的研究体系。时序演进分析则进一步表明，研究热点经历了从生理指标监测向机制研究深化的显著转变：在初步探索阶段，研究主题主要集中在基础性的疗效验证，学术关注点在于通过小样本临床观察与初步的随机对照试验，证明太极拳具备降压作用的相关核心问题；进入比较结果研究阶段，系统地将太极拳与有氧运动、其他传统养生功法等进行对比，以评估其在血压管理中的相对有效性与独特性，研究开始从单一的血压指标，向外周血管功能、自主神经系统调节等中间生理指标拓展；当前，太极拳干预高血压领域的研究正迈向机制探索与个性化干预的深水区，研究热点呈现出显著的多元化与微观化趋势。突现词检测分析证明了前沿主题突现为太极拳对高血压患者血管内皮功能、内分泌、炎症因子谱、肾素-血管紧张素系统以及肠道菌群-代谢轴等复杂生物学调控通路的影响，标志着对作用机理的阐释进入了多组学整

合的新阶段，向神经免疫调控机制、长期疗效维持及个体化方案优化等深度研究方向系统推进，呈现出从单一生理指标检测向生物标记物整合分析的重要转变，预示着未来研究将更加注重机制探索的深度与临床转化的广度。在研究特征量化分析方面，纳入文献中多数为随机对照试验，研究对象以中老年原发性高血压患者为主，干预方案普遍采用 12-24 周标准化训练模式，实验数据证实，太极拳干预不仅能显著降低收缩压与舒张压（$p<0.01$），同时还在改善自主神经平衡、提升生活质量等方面表现出多重效益。**结论：**通过可视化分析直观地揭示了太极拳干预高血压领域的研究图景，该领域已形成从临床效果验证到生物学机制探索的完整研究体系，并正处于向更精细化、跨学科化方向发展的阶段。但也存在一定的局限性，在机制研究层面，多数研究仍停留在单一指标或单一通路的验证，缺乏对多靶点、多层次调控网络的系统性探索；在临床研究设计方面，长期随访研究明显不足，干预方案缺乏标准化规范，且对高血压不同亚型人群的针对性研究较为欠缺；在方法学层面，对主观健康指标的评价体系尚不完善。基于当前研究现状与趋势，未来应着重深化太极拳对于高血压患者血压的调控机制研究，通过多组学整合分析和精准评估方法推进机制认识的系统化，建立标准化的运动处方干预方案报告规范和长期随访机制，加强不同人群分层研究和慢病管理模式探索，同时加强国际合作，探索太极拳在真实世界中的推广模式与成本效益，巩固太极拳在高血压综合防控体系中的科学地位。

关键词：太极拳；高血压；知识图谱；可视化

Research landscape of Taijiquan intervention for Hypertension: hot-spot evolution and frontier analysis based on Knowledge Graph

Zi Meng, Jianan Xu, Ziyin Liu, Cuihan Li, Jianwei Zhang, Shaojun Lyu

College of physical education and sports, Beijing Normal University, Beijing, 100875

Abstract: Objective: Taijiquan, as the treasure of Chinese traditional sports, is a typical physical and mental exercise. It has shown its unique advantages in improving cardiovascular function and regulating blood pressure with its characteristics of tranquility and relaxation. In recent years, the research on the mechanism and effect of Taijiquan intervention on hypertension is increasing, and the number of relevant literatures is growing rapidly. Based on the mapping method of scientific knowledge, this paper makes a quantitative analysis of the research literature in the field of Taijiquan intervention in hypertension, aiming to systematically reveal the research hot topics in this field, visually show the development and evolution path and cutting-edge mechanism direction, present the information panorama, and provide data-driven theoretical support for in-depth exploration of the mechanism and clinical application of Taijiquan in non drug intervention of hypertension. In order to promote the scientific development and standardized promotion of Taijiquan in the field of hypertension prevention and treatment, and provide empirical basis

for the implementation of "healthy China" and "Taijiquan health project" and other strategies. **Methods:** This study took the Chinese and English literatures on Taijiquan intervention in hypertension in the core collection of web of science and the database of China National Knowledge Infrastructure (CNKI) as the object of analysis. 309 literatures were initially obtained through systematic retrieval, and were strictly screened according to the preset inclusion and exclusion criteria. Finally, 144 effective literatures were determined to constitute the research sample. Using bibliometric methods, combined with the mapping technology of scientific knowledge, CiteSpace and VOSviewer and other tools, the key words, basic characteristics of research objects, research design types, Taijiquan intervention scheme and main experimental results were systematically extracted and visually analyzed. By constructing keyword co-occurrence network and clustering map, the hot topics and their internal structure in this field are identified; Combined with temporal evolution view and keyword emergence detection, the dynamic evolution path and frontier development direction of the research topic are revealed. Further, through quantitative analysis, the demographic characteristics, research design methodology characteristics, Taijiquan intervention cycle and frequency and other parameters of hypertension population were systematically summarized, as well as the change trend of key physiological indicators, so as to comprehensively present the research prospect and development context of Taijiquan intervention in hypertension. **Results:** Based on the current research situation, through keyword co-occurrence and cluster analysis, it was found that a research cluster focusing on cardiovascular function improvement, exercise prescription and different populations had been formed. The core keywords such as randomized controlled trials, blood pressure, quality of life, physical and chemical indicators embodied a research system based on clinical efficacy verification and gradually expanded to explore the mechanism of action. Time series evolution analysis further shows that the research focus has undergone a significant change from physiological index monitoring to Mechanism Research Deepening: in the preliminary exploration stage, the research theme is mainly focused on the basic efficacy verification, and the academic focus is to prove the core issues related to the anti-hypertensive effect of Taijiquan through small sample clinical observation and preliminary randomized controlled trials; At the stage of comparative results research, Taijiquan was systematically compared with aerobic exercise and other traditional health preserving exercises to evaluate its relative effectiveness and uniqueness in blood pressure management. The research began to expand from a single blood pressure index, peripheral vascular function, autonomic nervous system regulation and other intermediate physiological indicators; At present, the research in the field of Taijiquan intervention in hypertension is moving towards the deep-water area of mechanism exploration and personalized intervention, and the research hot-spots show a significant trend of diversification and microcosmization. The detection and analysis of emergent words proved that the frontier theme of Taijiquan was the impact of Taijiquan on vascular endothelial function, endocrine, inflammatory factor spectrum, renin-angiotensin system, intestinal flora metabolic axis and other complex biological regulatory pathways in patients with hypertension, marking that the interpretation of the mechanism of action entered a new stage of multi-omics integration, and was systematically promoted in the direction of in-depth

research such as neuroimmune regulation mechanism, long-term efficacy maintenance and individualized scheme optimization, showing an important change from single physiological index detection to biomarker integration analysis, indicating that future research will pay more attention to the depth of mechanism exploration and the breadth of clinical transformation. In terms of quantitative analysis of research characteristics, most of the included literatures are randomized controlled trials. The research objects are mainly middle-aged and elderly patients with primary hypertension. The 12-24 week standardized training mode is widely used in the intervention program. The experimental data confirm that Taijiquan intervention can not only significantly reduce systolic and diastolic blood pressure ($p<0.01$), but also improve autonomic nerve balance and quality of life. **Conclusion:** through visual analysis, the research picture of Taijiquan intervention in hypertension is revealed intuitively. This field has formed a complete research system from clinical effect verification to biological mechanism exploration, and is in the stage of more refined and interdisciplinary development. However, there are also some limitations. At the level of mechanism research, most studies still remain in the verification of a single index or a single channel, lacking systematic exploration of multi-target and multi-level regulatory networks; In terms of clinical research design, the long-term follow-up study is obviously insufficient, the intervention program is lack of standardization, and the targeted research on different subtypes of hypertension is relatively lacking; At the methodological level, the evaluation system of subjective health indicators is not perfect. Based on the current research status and trends, in the future, we should focus on deepening the research on the regulation mechanism of Taijiquan on blood pressure in patients with hypertension, promote the systematization of mechanism understanding through multi-omics integrated analysis and accurate evaluation methods, establish standardized exercise prescription intervention scheme reporting norms and long-term follow-up mechanism, strengthen the hierarchical research of different populations and the exploration of chronic disease management mode, at the same time, strengthen international cooperation, explore the promotion mode and cost-effectiveness of Taijiquan in the real world, and consolidate the scientific position of Taijiquan in the comprehensive prevention and control system of hypertension.

Keywords: Taijiquan; Hypertension; Knowledge Graph; visualization