

Global Trends and Perspectives in Chiropractic Treatments of Musculoskeletal Conditions: A Bibliometric Analysis

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Published: 2026

Journal of the International Academy of Neuromusculoskeletal Medicine

Volume 23, Issue 2

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ABSTRACT

Objective: To analyze global research trends in chiropractic treatment for musculoskeletal conditions using bibliometric methods.

Methods: A total of 2,508 articles published between 1978 and 2025 were retrieved from Web of Science, PubMed, and the Index to Chiropractic Literature and analyzed for publication output, countries, authors, institutions, journals, and keywords.

Results: Publication output increased steadily after 1995 and peaked in 2021–2022. The United States and Canada were the leading contributors, followed by Australia, China, and Denmark. Eric Chun-Pu Chu had the highest publication volume, while Jan Hartvigsen demonstrated the greatest citation impact. Core journals included the *Journal of Manipulative and Physiological Therapeutics* and *Chiropractic and Manual Therapies*. Keyword analysis showed sustained emphasis on low-back pain and spinal manipulation, with growing attention to integrative care and quality improvement.

Conclusion: Chiropractic research has expanded substantially, with increasing international collaboration and evolving research priorities.

Keywords: Chiropractic; Bibliometric analysis; Musculoskeletal condition; Trends

List of abbreviations: Web of Science: WoS; Index to Chiropractic Literature: ICL; Emerging Sources Citation Index: ESCI; Science Citation Index Expanded: SCIE

INTRODUCTION

Musculoskeletal conditions are among the leading causes of chronic pain and disability, affecting a broad spectrum of individuals, from working-age adults to the elderly.¹ A global epidemiological analysis of data from the Global Burden of Disease database reported that, in 2017, approximately 1.3 billion people worldwide were affected by these conditions, with 121,300 deaths attributed to musculoskeletal disorders in the same year.² These findings highlight the significant socioeconomic burden that musculoskeletal conditions impose globally. The American College of Physicians recommends that chronic musculoskeletal pain be managed initially with nonpharmacologic treatments.³

Chiropractic has gained widespread acceptance globally as a predominantly manual therapy approach used in the management of musculoskeletal conditions.⁴ Its principles emphasize the body's intrinsic capacity for self-healing.⁵ In the United States, nearly one-quarter of adults seek chiropractic care as a first-line treatment for neck and back pain.⁶ As chiropractic care continues to gain recognition in health care, particularly in the management of musculoskeletal conditions, the demand for high-quality clinical evidence has grown. This demand has fueled a marked increase in chiropractic-related research, including randomized controlled trials, systematic reviews, and meta-analyses.^{7,8}

Bibliometric analysis is a rigorous method based on quantitative and qualitative statistical approaches used to evaluate the publication landscape within a specific field. By extracting information on authors, keywords, journals, countries, and citations, and performing further analysis and computation using specialized software, this approach enables the construction of relational networks, which can then be quantified and visualized.⁹ Bibliometric studies play a pivotal role in advancing research fields by revealing progress and identifying emerging directions.¹⁰ Although prior bibliometric research has provided an overview of chiropractic-related publications,¹¹⁻¹⁹ bibliometric studies focusing on specific systems or conditions within chiropractic remain limited. Such targeted analyses could provide valuable insights into the research landscape of these specialized areas. To address this gap, we conducted a bibliometric study to evaluate the global state and trends of chiropractic research on musculoskeletal conditions by analyzing data from multiple databases using tools such as VOSviewer (version 1.6.20, Centre for Science and Technology Studies, Leiden University, Leiden, The Netherlands)²⁰ and CiteSpace (version 6.4.R, Dr. Chaomei Chen, Drexel University, Philadelphia, PA).²¹ This approach allowed us to identify emerging research directions and themes, providing guidance for future investigations.

METHODS

Data Source and Search Strategy

A comprehensive systematic literature search was performed using the Web of Science (WoS), PubMed, and the Index to Chiropractic Literature (ICL) databases to ensure thorough coverage of chiropractic-related research. The final search was completed on August 1st, 2025, with the search period spanning from the establishment of each database up to August 1st, 2025, ensuring that the data is both current and accurate. Detailed search parameters for PubMed and WoS are provided in **Table 1** and **Table 2**. Given that a few

influential journals in the chiropractic field are indexed in the Emerging Sources Citation Index (ESCI) rather than the Science Citation Index Expanded (SCIE), both indexes were included in the data retrieval process to obtain a more representative and comprehensive dataset. Because the ICL database does not support advanced search options, "musculoskeletal disease" was used as the primary search keyword. Nevertheless, given ICL's focus on chiropractic literature, this approach remains well-aligned with our research objectives.

Table 1. Search strategy implementation for PubMed.

Rank	Search phrases	results
#1	("Manipulation, Chiropractic"[Mesh] OR chiropractic[Title/Abstract] OR chiropract*[Title/Abstract] OR chiropraxis[Title/Abstract])	11075
#2	("Musculoskeletal Diseases"[Mesh] OR spinal disease*[Title/Abstract] OR muscle injur*[Title/Abstract] OR soft tissue injur*[Title/Abstract] OR orthopedics[Title/Abstract] OR orthopaedics[Title/Abstract] OR musculoskeletal disease*[Title/Abstract])	1950350
#3	#1 AND #2	2713

Table 2. Search strategy implementation for Web of Science.

Rank	Search phrases	results
#1	TS=("Chiropractic" OR "Chiropract*" OR "Chiropraxis")	5802
#2	TS=(Spinal Disease OR Muscle Injury OR Soft Tissue Injury OR Orthopedics OR Orthopaedics OR Musculoskeletal Disease)	226648
#3	#1 AND #2	323

Literature Screening and Data Extraction

This study primarily focused on original articles and reviews related to chiropractic treatment or management of musculoskeletal conditions. For the WoS and PubMed databases, built-in filters were applied to retain original research articles and reviews before importing the records into EndNote (version X9, Clarivate Analytics, London, UK) for further management. Because the ICL database lacks equivalent filtering functions, non-eligible publication types were manually excluded after importation into EndNote. Across the three databases, meeting abstracts, clinical guidelines, records with incomplete data, books, letters, notes, proceedings papers, editorial materials, corrections, and retracted publications were excluded. Duplicate records were then removed using EndNote's deduplication function. Subsequently, titles, abstracts, and full texts were manually screened to exclude records that did not directly address chiropractic treatment or management of musculoskeletal conditions. Studies primarily focused on policy, education, professional issues, basic science, or other non-treatment-focused topics were excluded from the final analysis. The literature screening and selection process is summarized in **Figure 1**.

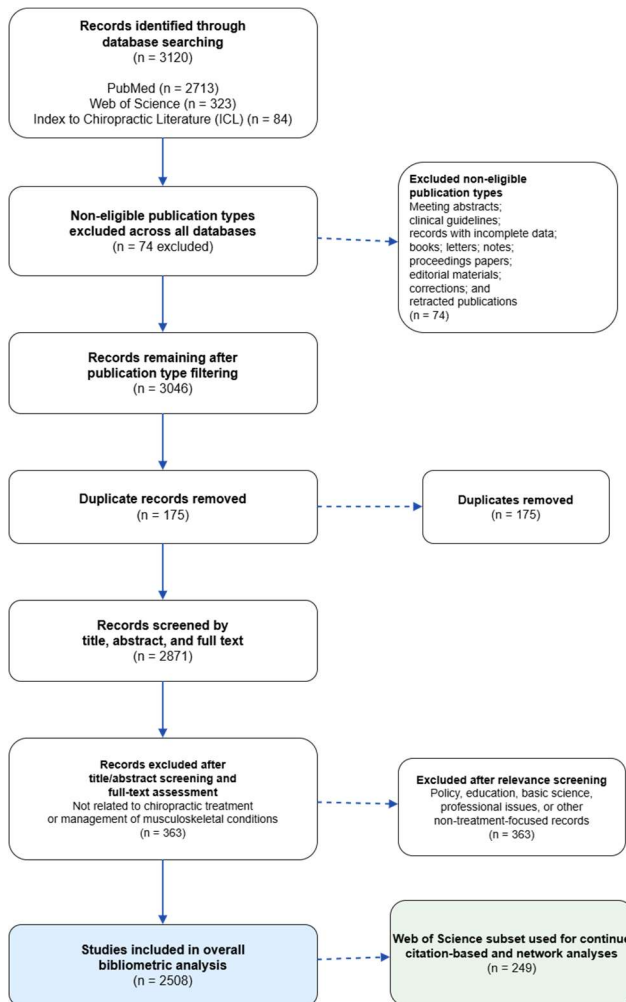


Figure 1. Flowchart of selecting the publications on chiropractic treatment in musculoskeletal conditions field.

Data Analysis and Visualization

Exponential trendlines were fitted to cumulative publication data to illustrate publication growth trends. Microsoft Excel was used for data organization and for generating color-coded bar charts of publication counts for the top 10 contributing authors and co-citation frequencies for the top 10 co-cited authors. VOSviewer facilitated bibliometric network visualizations, including analyses of geographical distributions, institutional affiliations, journals, co-citation patterns, co-occurrence networks, and keyword clustering. CiteSpace enabled citation-based visualizations, allowing the exploration of authorship networks, co-cited authors, institutional collaborations, co-cited journals, and temporal patterns such as timeline and time zone views. Citation bursts for keywords and references were identified to highlight research hotspots across authors, regions, institutions, and journals. Scimago Graphica (version 1.0.43, SCImago Lab, Granada, Spain) was used to map the global geographical distribution of publications and inter-country collaborations, providing insights into the spatial dimensions of research activity. These tools collectively supported a

comprehensive and multidimensional approach to analyzing bibliometric patterns and trends. The combined dataset from WoS, PubMed, and ICL was used to analyze overall publication trends, whereas the WoS dataset was primarily used for citation-based and network analyses.

RESULTS

Overall Publication Condition Based on WoS, PubMed, and ICL

A comprehensive aggregation and deduplication of articles from WoS, PubMed, and the ICL databases yielded a total of 2,508 articles. The publication volume in this field remained relatively low before 1985, with an average annual output of fewer than 10 articles. However, after 1995, the annual publication volume consistently exceeded 20 articles and showed a steady upward trend. A marked increase was observed after 2015, peaking between 2021 and 2022, followed by a slight decline in recent years, indicating an overall long-term growth in research output (**Figure 2**).

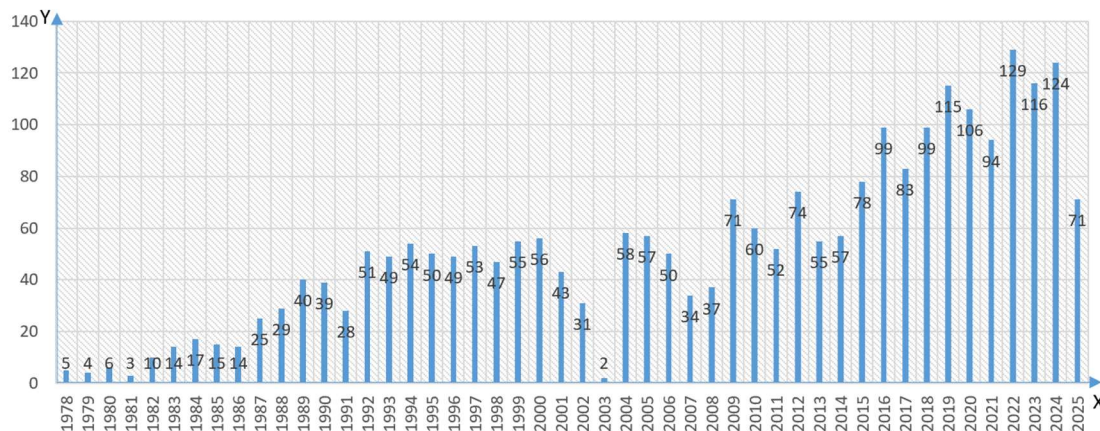


Figure 2. Time trend of the publications on chiropractic treatment in musculoskeletal conditions field based on 3 main databases (WoS, PubMed, ICL).

Annual Core Publication Trend Analysis

WoS is an academic core literature database provided by Clarivate Analytics, offering extensive citation information that aids researchers in tracking the impact of their work. To further analyze high-impact academic literature, we selected publications within WoS for an in-depth bibliometric analysis.

Following our screening, we identified 249 articles published between 1990 and 2025, written by 924 authors, encompassing 409 institutions, 40 countries, and 101 journals, with a total of 9,939 citations sourced from 3,313 different journals. **Figure 3** illustrates the distribution of publication dates for articles in the field of chiropractic treatment for musculoskeletal conditions within the WoS database. Overall, the publication volume shows a fluctuating upward trend, consistent with the general publication trend observed from the integration of multiple databases mentioned earlier. This indicates that research in this field has garnered increasing attention over time.

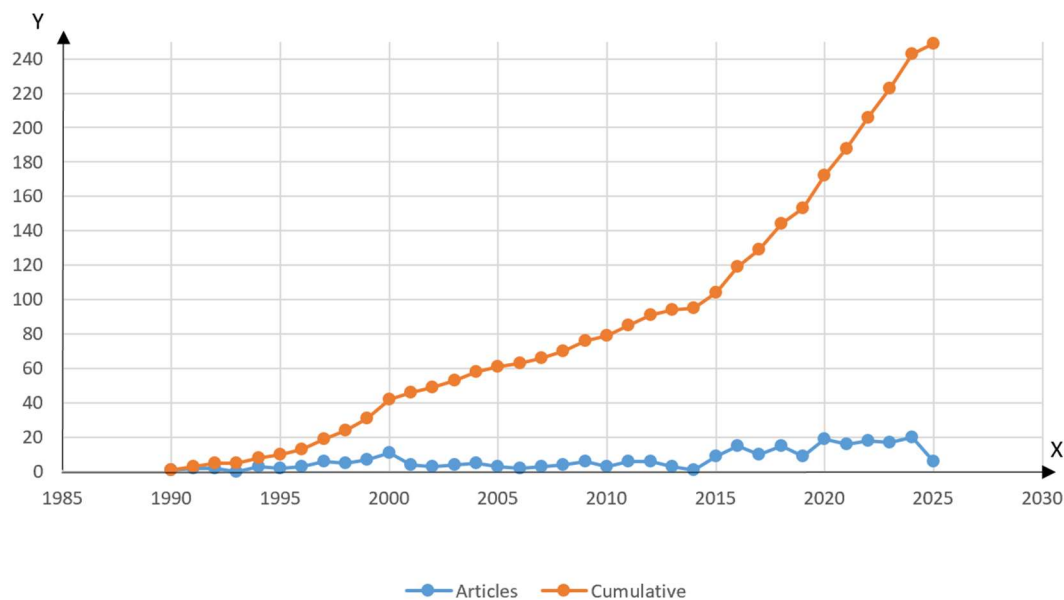


Figure 3. Time trend of the publications on chiropractic treatment in musculoskeletal conditions field based on WoS.

Nations and Regions Analysis of Core Publication

To understand which countries are leading in the field of chiropractic treatment of musculoskeletal conditions, we analyzed the publication volume from all contributing countries. A total of 40 countries has participated in research in this field. Using VOSviewer, we visualized the countries with more than two publications. **Figure 4(A)** shows the network between countries, where each node represents a country. The larger the node, the greater the publication volume. The lines between nodes indicate the degree of collaboration between countries, the thicker the line, the closer the collaboration. The United States and Canada, as the two major contributors, have collaborations with countries in Oceania, Europe, and South America. This collaborative relationship is also depicted in the world map in **Figure 4(C)**. **Figure 4(B)** shows the density visualization of active countries, where higher publication volumes are indicated in bright yellow, and lower volumes in blue. The figure shows an uneven distribution in publication volumes, with the United States, Canada, and Australia being the major contributors. Notably, Asian countries have fewer publications and less collaboration with other Western countries.

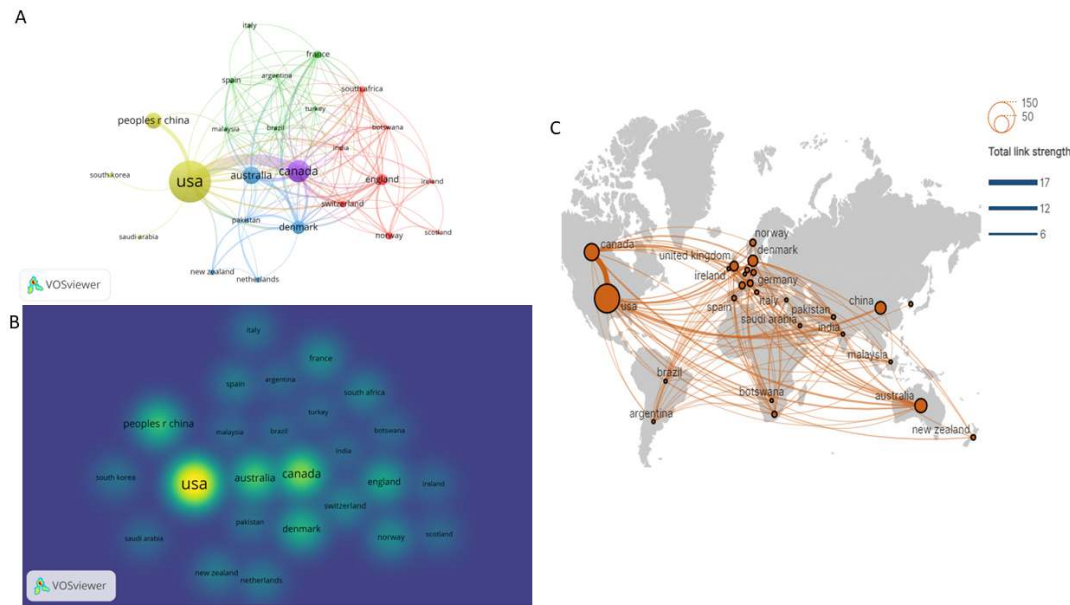


Figure 4. Co-occurrence of countries for chiropractic treatment in musculoskeletal conditions. (A) Network visualization of countries. (B) Density visualization for countries. (C) World map of active countries.

Further analysis of high-productivity countries in this field is presented in **Table 3**, showing the top five countries by publication volume. The United States has the highest citation count of 1,689. Canada has the highest average citations per paper at 19.71, with a publication volume second only to the United States. Despite having the smallest publication volume among the top contributors, Denmark has an average citation count of 16.39 per paper.

Table 3. Top 5 countries in chiropractic treatments in musculoskeletal conditions field.

Rank	Country	Documents	Citations	Average Citation
1	USA	121	1689	13.96
2	Canada	42	828	19.71
3	Australia	28	580	20.71
4	China	23	123	5.35
5	Denmark	18	295	16.39

Analysis of Authors, Institutions, and Journals of Core Publication

Top ten authors by publication volume

Analyzing the authors of the literature helps identify the leading scholars and core research strengths within a field. According to Price's Law,²² within a given research domain, a small group of prolific authors typically contributes a substantial portion of the total publications, and the number of these core authors is approximately the square root of all contributing authors. Based on VOSviewer statistics, the most productive author in this field published 12 papers. Author productivity was assessed based on all authors indexed in the retrieved

records using the default full-counting method. With a total of 924 contributing authors, the threshold for core authors was determined as three or more publications according to Price's Law. A total of 24 authors met this criterion, collectively producing 109 papers, which closely follows the distribution pattern described by Price's Law. This finding suggests that chiropractic research in the field of musculoskeletal disease treatment has developed a relatively stable and collaborative group of core authors. **Table 4** and **Figures 5(A) and 5(B)** show the highly productive authors in this field. In terms of publication volume, Eric Chun-Pu Chu ranks first with 12 publications, followed by Robert J. Trager with 9 and Jan Hartvigsen with 8. Jason W. Haas, Deed E. Harrison, and Clinton J. Daniels each published six papers, while Paul A. Oakley, Christine M. Goertz, Stacie A. Salsbury, and Robert D. Vining each contributed five papers.

Among the top three most cited high-productivity authors, Professor Jan Hartvigsen from the University of Southern Denmark leads with eight publications in the field of chiropractic treatment of musculoskeletal conditions, receiving 110 citations with an average of 13.75 citations per paper. He is followed by Professor Christine M. Goertz from Duke University, who has published five papers with 58 citations and an average of 11.6 citations per paper, and Professor Stacie A. Salsbury from the Palmer College of Chiropractic, who has published five papers with 55 citations and an average of 11 citations per paper. In addition, Robert D. Vining and Clinton J. Daniels, both from the United States, also demonstrated strong research influence with 50 and 44 citations respectively.

According to the statistics, among the top ten highly productive authors, seven are from the United States, two from Denmark, and one from Hong Kong. Notably, four scholars are affiliated with specialized chiropractic institutions including the Palmer College of Chiropractic and the CBP Nonprofit Organization in the United States as well as the New Zealand College of Chiropractic. One scholar is from the Veterans Affairs chiropractic system in the United States, while the remaining authors are affiliated with comprehensive universities. From the collaboration network shown in **Figure 5(A)**, several distinct clusters can be observed, indicating that highly productive authors tend to have their own stable collaborative teams. The relative independence of these clusters suggests that there remains room for stronger cooperation among different research groups in future studies.

Table 4. Most productive authors in the chiropractic treatment of musculoskeletal conditions field.

Rank	Author	Documents	Citations	Average Citation
1	Eric Chun-Pu Chu	12	78	6.5
2	Robert J. Trager	9	69	7.67
3	Jan Hartvigsen	8	110	13.75
4	Jason W. Haas	6	3	0.5
5	Deed E. Harrison	6	3	0.5
6	Clinton J. Daniels	6	44	7.33
7	Paul A. Oakley	5	3	0.6
8	Christine M. Goertz	5	58	11.6
9	Stacie A. Salsbury	5	55	11
10	Robert D. Vining	5	50	10

Top ten authors by co-citation

Figures 5(C) and **5(D)** show the most frequently co-cited authors in the field of chiropractic treatment for musculoskeletal conditions. The citation frequencies reported in this co-citation analysis represent occurrences within the analyzed dataset. Eric Chun-Pu Chu had 51 citations, making him the most frequently co-cited author, followed by Cheryl Hawk with 42 and Scott Haldeman with 34. Other highly co-cited authors also demonstrated considerable academic influence, reflecting the breadth of scholarly contribution within this field.

The top co-cited author, Professor Eric Chun-Pu Chu, is a Hong Kong-based clinician-scientist whose work has advanced the integration of chiropractic care into musculoskeletal rehabilitation and interdisciplinary clinical research. The second most co-cited author, Professor Cheryl Hawk, is affiliated with Texas Chiropractic College and has made extensive contributions to evidence-based chiropractic and public-health research. Third, Professor Scott Haldeman, serves as a clinical professor in the Department of Neurology at the University of California, Irvine, and is internationally recognized as a leading figure in global spine-care research. From the co-citation network visualization in **Figure 5(C)**, several interconnected clusters can be observed, reflecting shared citation patterns and intellectual relationships among influential authors in this field. These co-citation patterns suggest that certain authors and publications have contributed substantially to the development of the evidence base in chiropractic research related to musculoskeletal conditions.

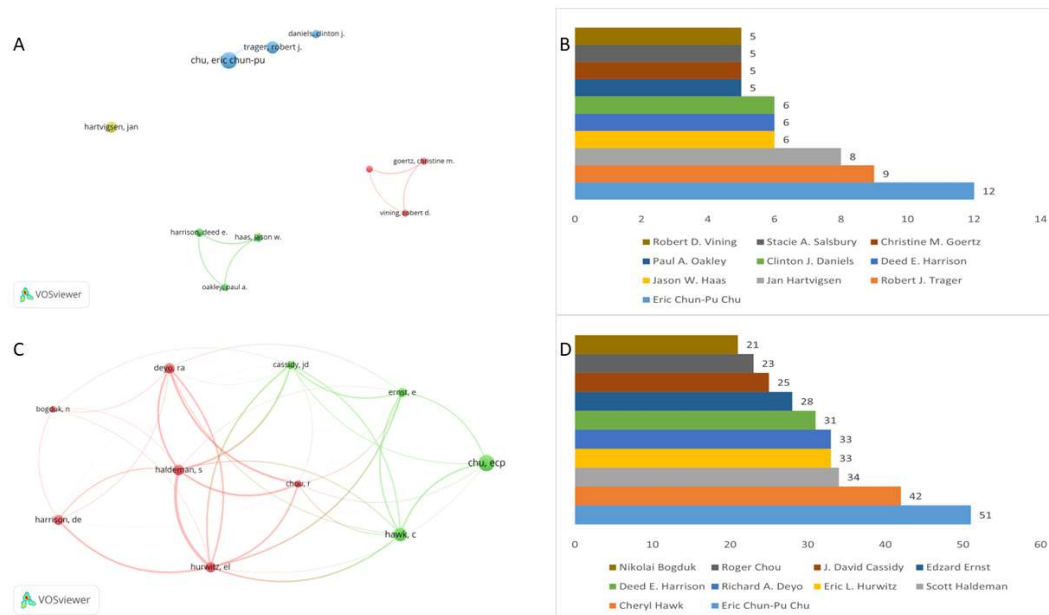


Figure 5. Analysis of co-authors and co-cited authors in the field of chiropractic. (A) Network visualization of authors. (B) Bar chart showing the publication volume of the top 10 authors by publication count. (C) Network visualization of co-cited authors. (D) Bar chart showing the citation volume of the top 10 most frequently co-cited authors.

Institutions of authors

An institutional collaboration network analysis was performed using CiteSpace (version 6.4.R, Dr. Chaomei Chen, Drexel University, Philadelphia, PA) to identify organizations or institutions with relatively mature research in this field. **Table 5** lists the top ten institutions in terms of publication count and centrality in chiropractic research. The higher the centrality of an institution, the more frequently it collaborates with other authors or institutions. In **Figure 6**, the nodes represent institutions, with larger nodes indicating a greater number of publications, and the links between nodes signifying inter-institutional collaborations. The thickness of the connecting lines reflects the strength of these collaborations. Leading the field in publication volume are the University of Southern Denmark and the US Department of Veterans Affairs, each with 12 publications, followed by the Veterans Health Administration with 11 and the University of Toronto with 10. Murdoch University and Case Western Reserve University also show notable research activity, each contributing ten and eight publications, respectively. In terms of centrality, the US Department of Veterans Affairs ranks first with a value of 0.07, followed by the Veterans Health Administration and Murdoch University, both at 0.06, and the University of Southern Denmark at 0.05. Institutional names are reported according to their original indexing in the WoS Core Collection. These results suggest that institutions such as the University of Southern Denmark, the Veterans Health Administration, and Murdoch University not only demonstrate strong research productivity but also occupy pivotal positions in the global collaboration network. Their high centrality and frequent cooperation with other research entities indicate that these institutions play an important role in promoting academic exchange, driving innovation, and shaping research directions in the

chiropractic field.

Table 5. Top 10 institutions in chiropractic treatment in musculoskeletal conditions field by publication count and centrality ranking.

Rank	Institutions	Count	Rank	Institutions	Centrality
1	University of Southern Denmark	12	1	US Department of Veterans Affairs	0.07
2	US Department of Veterans Affairs	12	2	Veterans Health Administration (VHA)	0.06
3	Veterans Health Administration (VHA)	11	3	Murdoch University	0.06
4	University of Toronto	10	4	University of Southern Denmark	0.05
5	Murdoch University	10	5	Case Western Reserve University	0.04
6	Case Western Reserve University	8	6	Institute for Work & Health	0.04
7	University Hospitals of Cleveland	8	7	University of Toronto	0.03
8	McGill University	7	8	McGill University	0.03
9	University of Quebec	6	9	Pennsylvania Commonwealth System of Higher Education (PCSHE)	0.03
10	Macquarie University	6	10	Rush University	0.02

CiteSpace v. 5.8.R1 (64-bit) Advanced
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 Network: 1996-2023 (since largest)
 Selection Criteria: g-index (p=0.25), LRF=2.5, LN=10, LBY=5, w=1.0
 Modularity Q=0.95, Silhouette S=0.93
 Labels: 132 (67%)
 Nodes Labeled: 7.5%
 Pruning: None
 Included:

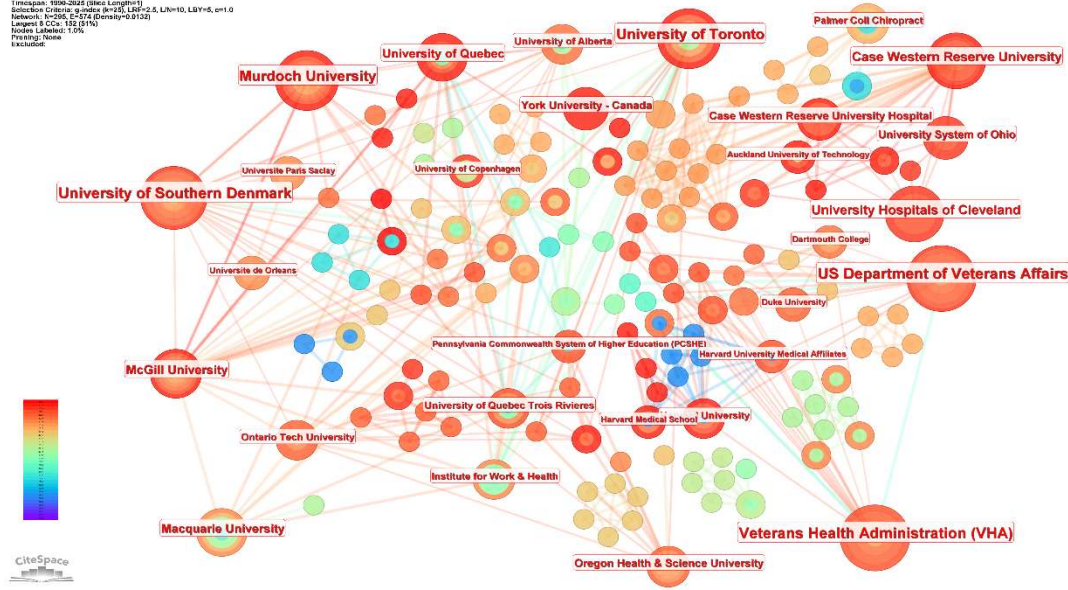


Figure 6. Display of institutions engaged in chiropractic treatment in musculoskeletal conditions.

Journals analysis of core publications

Since 1978, publications in the field of chiropractic treatment for musculoskeletal conditions have been primarily concentrated in specialized journals. **Table 6** and **Figure 7(A)** present the top ten journals ranked by publication volume in this field. Among them, the *Journal of Manipulative and Physiological Therapeutics* ranks first with 58 publications and 1,092 citations, averaging 18.83 citations per paper. *Chiropractic and Manual Therapies* follow with 24 publications and 379 citations, averaging 15.79 citations per paper, while the *Cureus Journal of Medical Science* ranks third with 16 publications and 22 citations. Other active journals in this field include the *Journal of Chiropractic Medicine* with 12 publications, the *Journal of Sports Chiropractic and Rehabilitation* with 9, and *Spine* with 7 publications, the latter achieving a notably high average of 28.29 citations per paper, reflecting its strong academic influence. The *American Journal of Case Reports*, *Military Medicine*, *BMC Musculoskeletal Disorders*, and the *Journal of Chiropractic Education* also contribute to the dissemination of chiropractic research. Overall, the *Journal of Manipulative and Physiological Therapeutics* and *Chiropractic and Manual Therapies* remain the primary publication platforms for chiropractic research related to musculoskeletal disorders. Their high publication volume and citation counts demonstrate their pivotal roles in promoting scholarly communication and advancing evidence-based practice in this field.

Table 6. Top 10 journals in chiropractic treatments in musculoskeletal conditions field.

Rank	Journal	Publications	Citations	Average Citations
1	<i>Journal of Manipulative and Physiological Therapeutics</i>	58	1092	18.83
2	<i>Chiropractic and Manual Therapies</i>	24	379	15.79
3	<i>Cureus Journal of Medical Science</i>	16	22	1.38
4	<i>Journal of Chiropractic Medicine</i>	12	38	3.17
5	<i>Journal of Sports Chiropractic and Rehabilitation</i>	9	6	0.67
6	<i>Spine</i>	7	198	28.29
7	<i>American Journal of Case Reports</i>	5	37	7.4
8	<i>Military Medicine</i>	4	47	11.75
9	<i>BMC Musculoskeletal Disorders</i>	3	37	12.33
10	<i>Journal of Chiropractic Education</i>	3	2	0.67

Table 7 and **Figure 7(B)** highlight the top ten co-cited journals in the field of chiropractic treatments for musculoskeletal conditions. The JCR (Journal Citation Reports) classification ranks journals into quartiles from Q1 to Q4 according to their impact factors within their respective research areas. Q1 represents the top 25% of journals, indicating the highest academic influence and prestige, while Q3 represents the 50%-75% range, reflecting a moderate level of impact within the field. *The Journal of Manipulative and Physiological Therapeutics* ranks first with 132 co-citations and is categorized under Q3 with an impact factor of 1.4. *Spine* follows with 114 co-citations and belongs to Q1 with an impact factor of 3.5. Other highly co-cited journals include *Chiropractic and Manual Therapies* with 63 co-citations and an impact factor of 2.3, *Annals of Internal Medicine* with 61 and an impact factor of 15.2, and *BMC Musculoskeletal Disorders* with 55 and an impact factor of 2.4. *JAMA*, *the Spine Journal*, *the Lancet*, *BMJ*, and *the European Spine Journal* also appear prominently among the top ten, all belonging to Q1 or Q2 quartiles and representing leading medical and multidisciplinary research platforms. **Figure 7(B)** illustrates the network visualization of these co-cited journals, where each node represents a journal. The size of the nodes corresponds to the number of co-citations, and the links between nodes indicate the strength of co-citation relationships. Larger nodes and denser clusters associated with high-impact journals such as *the Lancet*, *JAMA*, and *BMJ* highlight their pivotal role in connecting chiropractic research with mainstream medical science. This visualization underscores the interdisciplinary nature of chiropractic research, reflecting how both specialized chiropractic journals and leading international medical journals contribute to

advancing the study and clinical application of musculoskeletal disease treatments.

Table 7. Top 10 co-cited journals in chiropractic treatments in musculoskeletal conditions field.

Rank	Journal	Co-citation counts	JCR Partitions	Impact Factor (2025)
1	<i>Journal of Manipulative and Physiological Therapeutics</i>	132	Q3	1.4
2	<i>Spine</i>	114	Q1	3.5
3	<i>Chiropractic and Manual Therapies</i>	63	Q1	2.3
4	<i>Annals of Internal Medicine</i>	61	Q1	15.2
5	<i>BMC Musculoskeletal Disorders</i>	55	Q1	2.4
6	<i>JAMA</i>	46	Q1	55
7	<i>Spine Journal</i>	45	Q1	4.7
8	<i>Lancet</i>	43	Q1	88.5
9	<i>BMJ</i>	43	Q2	42.7
10	<i>European Spine Journal</i>	42	Q1	2.6

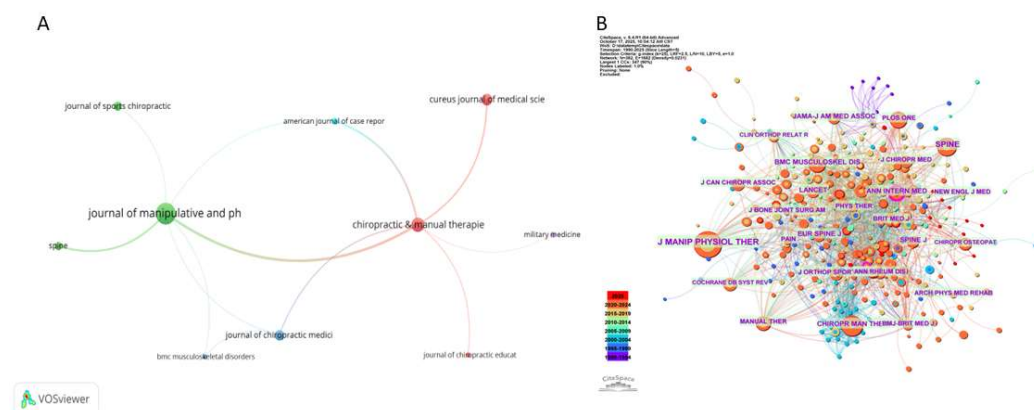


Figure 7. Depiction of originating journal and co-cited journal in chiropractic treatment in musculoskeletal conditions field. (A) Cartographic representation of the originating journals pertaining to chiropractic treatment in musculoskeletal conditions. (B) Graphic representation of co-cited journals pertaining to chiropractic treatment in musculoskeletal conditions.

Co-cited Literature

Co-cited references emerge when two articles are simultaneously listed in the reference section of a third article, thereby forming a co-citation relationship. This relationship often signifies contextual relevance and high-quality content with considerable influence within a specific research domain. In this study, VOSviewer was employed to identify the top five most frequently co-cited articles. **Table 8** presents the top five most-cited references in chiropractic treatment for musculoskeletal conditions. The citation counts reported in this section reflect citation occurrences within the analyzed dataset rather than total global citation counts indexed in Web of Science. Leading the list is The chiropractic profession: a scoping review of utilization rates, reasons for seeking care, patient profiles, and care provided by Peter J.H. Beliveau,⁴ published in *Chiropractic and Manual Therapies* in 2017, with 14 citations. This is followed by Patients using chiropractors in North America: who are they, and why are they in chiropractic care? by Ian D. Coulter,²³ published in *Spine* in 2008, cited 9 times. Two clinical practice guidelines published in *Annals of Internal Medicine* also rank among the most co-cited papers: Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society by Roger Chou,²⁴ and Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians by Amir Qaseem,²³ each cited 9 times. The fifth most co-cited paper is Use of chiropractic services from 1985 through 1991 in the United States and Canada by E.L. Hurwitz,²⁵ published in *American Journal of Public Health* in 1998, with 8 citations. **Figure 8** illustrates the co-citation network and density visualization of these references. In **Figure 8(A)**, larger circles represent more frequently co-cited articles, and thicker lines denote stronger co-citation relationships, highlighting the significant influence of these foundational studies. **Figure 8(B)** provides a density visualization, where warmer colors indicate clusters of highly influential articles. Together, these visualizations underscore the interconnected nature of high-impact research in chiropractic treatment, highlighting how foundational works are frequently referenced together, shaping the evidence base and clinical understanding in the management of musculoskeletal conditions.

Table 8. Top 5 most-cited references in the literature related to the field of chiropractic treatment in musculoskeletal conditions.

Rank	Title	First Author	Journal	Year	Citations
1	The chiropractic profession: a scoping review of utilization rates, reasons for seeking care, patient profiles, and care provided	Peter J.H. Beliveau [4]	<i>Chiropractic and Manual Therapies</i>	2017	14
2	Patients using chiropractors in North America: who are they, and why are they in chiropractic care?	Ian D Coulter [23]	<i>Spine</i>	2002	9
3	Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society	Roger Chou [24]	<i>Ann Intern Med</i>	2007	9
4	Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians	Amir Qaseem [3]	<i>Ann Intern Med</i>	2017	9
5	Use of chiropractic services from 1985 through 1991 in the United States and Canada	E L Hurwitz [25]	<i>American Journal of Public Health</i>	1998	8

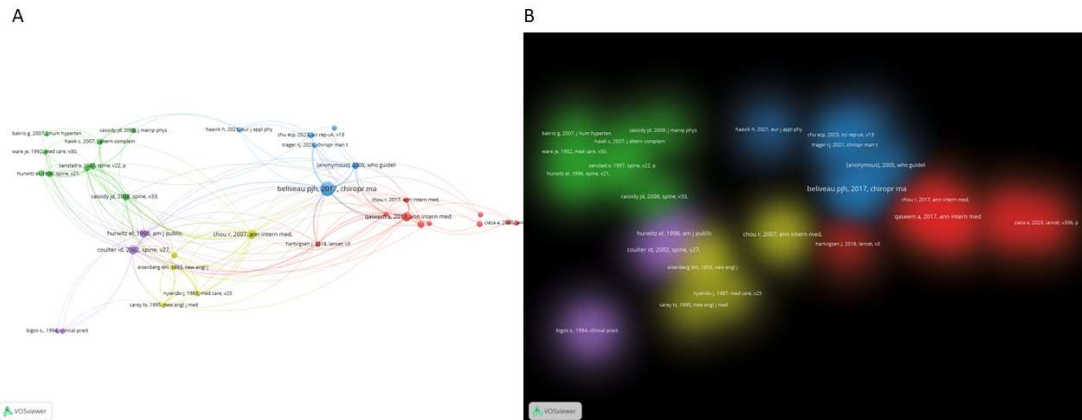


Figure 8. Demonstration of co-cited literature related to chiropractic treatment in musculoskeletal conditions. (A) Co-citation network of references, which circles denoting co-cited literature. (B) Density visualization of co-cited references.

Keywords Analysis

Keywords condense the core and essence of a paper, and analyzing keyword co-occurrence can reveal research hotspots in a scientific field. Using VOSviewer, a co-occurrence network map of keywords was drawn, and the results are shown in **Figure 9(A)**. In this figure, larger circle nodes indicate higher frequency keywords, representing major research hotspots in the field. The lines between nodes indicate the strength of association, with thicker lines showing more frequent co-occurrence within documents. The node colors represent different clusters. We did not select "chiropractic" as a keyword because our research field itself focuses on chiropractic. From **Table 9** and **Figure 9(A)**, the high-frequency keywords identified in this field include "low-back pain" (53 occurrences), "management" (27), "neck pain" (26), "disease" (23), and "spinal manipulation" (22). These terms represent the primary research foci in chiropractic studies related to musculoskeletal conditions. **Figure 9(A)** shows that "low-back pain" serves as the central and most dominant node, indicating its enduring importance as a core topic in chiropractic research. Closely associated terms such as "management," "neck pain," and "spinal manipulation" form interconnected clusters, reflecting the discipline's strong emphasis on pain management, spinal interventions, and musculoskeletal rehabilitation. **Figure 9(B)**, generated using CiteSpace, visualizes the co-occurrence network of keywords and reveals a pattern consistent with that observed in the VOSviewer network. The main clusters can be categorized into research on disease epidemiology and prevalence (red cluster), chiropractic techniques and manual therapies (green cluster), and clinical management and rehabilitation of spinal pain (blue cluster). The tight interconnections among these clusters highlight the interdisciplinary nature of chiropractic research, bridging public health, rehabilitation, and evidence-based clinical care. The temporal evolution of research hotspots is illustrated in the timeline visualization in **Figure 9(C)**. Early studies primarily focused on "chiropractic manipulation," "low-back pain," and "management," while more recent years have seen the emergence of keywords such as "risk," "prevalence," and "ankylosing spondylitis," indicating a gradual shift toward risk assessment, epidemiological evaluation, and disease-specific investigations. Furthermore, the burst detection analysis **Figure 9(D)** reveals that the most recent keywords with strong citation bursts include "neck pain," "medicine," and

“therapy,” suggesting a growing research emphasis on multimodal treatment approaches, integrative medicine, and therapeutic optimization. This overall trend demonstrates that the field of chiropractic research is evolving toward a more holistic, patient-centered, and preventive paradigm, integrating manual therapy, physical rehabilitation, and interdisciplinary care for musculoskeletal health.

Table 9. The top 5 most frequently appearing keywords in chiropractic treatment in musculoskeletal conditions.

Rank	Keywords	Occurrences
1	low-back pain	53
2	management	27
3	neck pain	26
4	disease	23
5	spinal manipulation	22

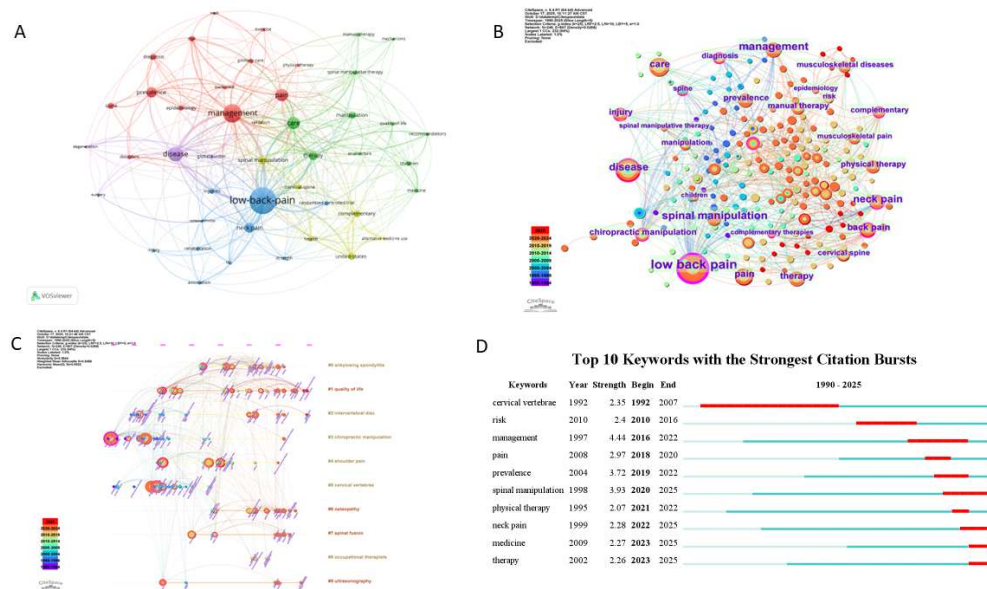


Figure 9. Keyword mapping in chiropractic research. (A) A network diagram illustrates the interaction of high-frequency keywords. (B) A CiteSpace visualization depicting keyword interconnections. (C) A CiteSpace timeline visualization of keyword evolution. (D) A visualization of burst keywords over time, highlighting significant trends.

DISCUSSION

This bibliometric analysis shows a significant upward trajectory in chiropractic research related to musculoskeletal conditions over the past few decades. The surge in publications, particularly noticeable after 1995 and peaking around 2022, underscores the growing recognition of chiropractic care as a vital component in managing musculoskeletal health. This trend aligns with broader healthcare movements favoring non-pharmacological and conservative interventions for pain management, especially considering global efforts to reduce opioid dependence.²⁶ With the increasing number of randomized controlled trials (RCTs) and systematic reviews, the efficacy of chiropractic care is gaining stronger scientific validation. Studies on interventions for lower back pain,²⁷ neck pain,²⁸ and migraines²⁹ have expanded, further solidifying its role within the framework of non-pharmacological treatment. This trend not only enhances the clinical credibility of chiropractic care but also encourages its inclusion in standardized pain management guidelines, offering patients more evidence-based, non-drug treatment options.

From a geographical perspective, the United States and Canada have been at the forefront of chiropractic research, contributing most of the publications. This dominance is consistent with previous analyses highlighting North America's central role in the field, largely due to its historical origins, well-established educational institutions, and strong policy support for chiropractic care.³⁰ Countries such as Denmark and Australia also exhibit substantial research output, reflecting their established chiropractic educational frameworks and professional integration. This can be attributed to their early adoption of chiropractic education, largely influenced by North America, as well as their shared linguistic and cultural similarities with the U.S. and Canada, which have facilitated academic exchange and collaboration. While Denmark differs in being a non-English-speaking country, its high English proficiency has enabled seamless access to international research and education, contributing to its strong chiropractic research presence.³¹ However, there remains a notable paucity of research from regions like Asia, South America, and Africa, indicating disparities in the global dissemination and adoption of chiropractic care. Within Asia, China ranks among the leading countries in publication volume, though most of its studies originate from Hong Kong, where chiropractic practice was established relatively early. This trend reflects Hong Kong's longstanding exposure to Western healthcare systems and its pivotal role in fostering chiropractic development and research in the region. Addressing these gaps through international collaboration could enhance the integration of chiropractic practices worldwide.

The analysis of leading authors in chiropractic research on musculoskeletal conditions highlights key contributors and their scholarly impact. Eric Chun-Pu Chu ranks first with twelve publications, followed by Robert J. Trager and Jan Hartvigsen. As the most frequently co-cited author, Eric Chun-Pu Chu is widely recognized as a trailblazer in chiropractic development across Asia. Through pioneering research and clinical leadership, he has advanced global understanding of spinal manipulation and musculoskeletal rehabilitation, bridging chiropractic practice with multidisciplinary medicine. The strong co-citation network reflects a mature and well-established research foundation, underscoring the importance of continued international collaboration and clinical investigation to further

advance chiropractic care.

Prominent institutions and researchers have significantly influenced the field's advancement. The University of Southern Denmark, the University of Toronto, and the U.S. Department of Veterans Affairs have been pivotal in producing high-impact studies and fostering international collaboration. Journals such as *Journal of Manipulative and Physiological Therapeutics* and *Chiropractic and Manual Therapies* have served as key platforms for disseminating chiropractic research, underscoring the interdisciplinary nature of the field and its intersection with mainstream musculoskeletal and rehabilitation sciences.

The analysis of co-cited literature underscores the foundational studies that have shaped chiropractic research on musculoskeletal conditions. Notably, Beliveau et al.⁴ conducted a comprehensive scoping review of the chiropractic profession, summarizing utilization rates, patient profiles, and the scope of care, which remains one of the most influential references in this field. Similarly, Coulter et al.²³ explored the demographic and clinical characteristics of chiropractic patients in North America, offering valuable insights into patterns of healthcare utilization and public perceptions of chiropractic services. Chou et al.²⁴ established evidence-based clinical practice guidelines for the diagnosis and treatment of low back pain, highlighting the importance of standardized protocols in advancing musculoskeletal care. The strong clustering of these influential works suggests a mature and well-established knowledge base that continues to guide contemporary chiropractic research. These findings highlight evolving research interest in multidisciplinary approaches to musculoskeletal care, suggesting that future studies may further explore the role of chiropractic interventions within integrated care models. Keyword co-occurrence analysis reveals a dynamic evolution in the thematic focus of chiropractic research. While traditional topics such as “low-back pain,” “spinal manipulation,” and “management” remain central, recent trends indicate a growing emphasis on integrative care models, therapeutic optimization, and preventive strategies. Emerging keywords related to “neck pain,” “medicine,” and “therapy” reflect an increasing interest in multidisciplinary collaboration and holistic patient management. This shift underscores the progression of chiropractic research from a focus on specific spinal conditions toward a broader framework encompassing comprehensive musculoskeletal health, evidence-based rehabilitation, and patient-centered care within multidisciplinary healthcare systems.

Limitations

Despite these advancements, several limitations warrant consideration. Bibliometric analyses, while providing valuable quantitative insights, do not assess the quality or clinical relevance of individual studies. Citation-based metrics may also inherently favor older publications, potentially underrepresenting recent impactful research. Additionally, disparities in database indexing may have influenced the comprehensiveness of this study, particularly in regions where chiropractic research is less frequently documented. Additionally, publication trends, particularly in earlier decades, should be interpreted with caution because chiropractic literature published prior to widespread electronic indexing may not have been comprehensively retrievable. Furthermore, Web of Science and PubMed provide limited coverage of some chiropractic journals, which may have influenced the completeness of the dataset and the observed publication trends.

CONCLUSION

This bibliometric analysis underscores the significant growth of chiropractic research on musculoskeletal conditions, with publication trends peaking in recent years. The dominance of North America, particularly the United States and Canada, reflects strong institutional and academic support, while other regions such as Denmark, China, and Australia continue to contribute substantially. Key authors and co-cited researchers have shaped the field, with studies on spinal manipulation and low-back pain remaining central. The findings highlight the need for greater international collaboration and expanded research efforts in underrepresented regions to further advance chiropractic care and its integration into multidisciplinary healthcare frameworks.

COMPETING INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Dr. Stephanie Sullivan, Ms. Karen Preston, Dr. Brent Russell, and the Life University CHARLI team. Additionally, we sincerely appreciate Ms. Zhaowen Shen for her guidance in creating the Excel charts.

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