

Stroke Rehabilitation Trends: A Bibliometric Analysis

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ABSTRACT

Background: Stroke is one of the leading causes of irreversible brain damage and functional disability.

Purpose: Explore stroke rehabilitation research trends through bibliometric analysis.

Methods: Publication searches from 1997 to 2024 were conducted using the Scopus database. Furthermore, the data obtained was analyzed bibliometrically using VOSviewer version 1.6.20. This analysis includes visualization analysis, co-occurrence analysis, and stroke rehabilitation publication trend analysis.

Results: The results of the bibliometric analysis identified 247 publications that met the search criteria in the field of stroke rehabilitation trends. The distribution of publications by country shows that the United States dominates with 83 publications (33.6%), followed by China with 29 publications (11.74%), and Canada with 19 publications (7.69%). This distribution pattern indicates that research on stroke rehabilitation trends remains concentrated in developed countries with high research capacity. These findings confirm that stroke rehabilitation is a topic receiving significant academic attention and continues to evolve globally; therefore, further studies on research trends in this field are considered important to provide direction for the development of more effective stroke rehabilitation interventions in the future.

Conclusion: this article provides a comprehensive overview of stroke rehabilitation trends.

Keywords: Bibliometric Analysis, Rehabilitation, Stroke

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BACKGROUND

Stroke caused by brain damage due to lack of blood supply to the brain due to rupture or blockage of blood vessels in the brain (Cui et al., 2023). One of the serious effects of stroke is the varied movement problems, ranging from slight difficulty to a complete loss of the ability to control muscles and perform movements (Matys-Popielska et al., 2024). To lower the chances of developing avoidable disabilities for stroke patients, it is essential to implement a customized and efficient treatment plan to prevent and aid long-term recovery for stroke patients (Petersson et al., 2024).

One of the most effective ways to reduce the level of disability and improve the ability of patients affected by stroke is rehabilitation; some studies suggest that rehabilitation begins sooner after a stroke, which can speed up recovery and lead to better health outcomes (Yin et al., 2024). Systematic and thorough rehabilitation methods not only improve physical abilities and reduce the level of disability but also lower the risk of complications and strokes (Zeng et al., 2024).

The World Health Organization (WHO) states that 15 million people worldwide each year suffer from stroke, five million of them are permanently disabled, and another five million die (Hawati et al., 2024). Based on data from Indonesian Basic Health Research 2018, the prevalence of stroke in Indonesia increased from 7/1000 population in 2013 to 10.9/1000 population in 2018 (Setyopranoto et al., 2022).

Bibliometrics is a concept that was first introduced by Pritchard in 1969 and further developed with infographics by Van Raan in 2004. Using sophisticated software, researchers can easily analyze and know the various patterns and developments occurring in a particular field, especially in the medical sector (Chen et al, 2006). Therefore, this study aims to analyze the research pattern on stroke rehabilitation trends using bibliometric research. We anticipate that this research will enhance our comprehension of the advancements in this field, identifying the most significant papers. In addition, these findings will also provide an outline for future policy and research development.

OBJECTIVE

Bibliometrics is a concept that was first introduced by Pritchard in 1969 and further developed with infographics by Van Raan in 2004. Using sophisticated software, researchers can easily analyze and know the various patterns and developments occurring in a particular field, especially in the medical sector (Chen et al, 2006). Therefore, this study aims to analyze the research pattern on stroke rehabilitation trends using bibliometric research. We anticipate that this research will enhance our comprehension of the advancements in this field, identifying the most significant papers. In addition, these findings will also provide an outline for future policy and research development.

METHODS

This study uses bibliometric mapping analysis. This article describes all the steps used to perform this analysis, including data collection, screening, extraction, and synthesis.

Data sources

The Scopus database served as the publication source for this article. Scopus is a database that provides abstracts and indexes that have links to full text, created by Elsevier Co (Burnham, 2006). Scopus includes publications from Medline and offers a variety of advantages when compared to Google Scholar and Web of Science. The platform covers the fields of social sciences and humanities and has a larger database of bibliometric analysis. Following and assessing the impact of academics on a particular theme is aided by

characteristics such as author identification. Scopus makes it easier to find relevant research by offering sorting and filtering options (Al-Jabi, 2023).

Search strategy

The first step in this article is to search the Scopus database for relevant documents. We use the Scopus Engine to generate relevant words associated with stroke and rehabilitation. The search strategy consists of a combination of keywords that are assembled with AND and OR operators. Sign symbol ("") to narrow the search for the term. The following is the formula of the search set: (TITLE-ABS-KEY (*stroke AND rehabilitation*) AND TITLE-ABS-KEY (*stroke AND recovery*) AND TITLE-ABS-KEY(*therapeutic AND exercise*)) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "J")) AND (LIMIT-TO (LANGUAGE, "English")). The search is focused on the title, abstract and keywords of the article to ensure that the research is relevant to the main topic used. The discovery process was completed on December 10, 2024 to prevent inconsistent results as a result of database updates.

Time period

The study includes publications published from 1997–2024 to provide a complete picture of stroke rehabilitation trends. This time span, based on the initial research related to stroke rehabilitation, was published and then showed progress with each insight, along with the increasing need for self-management approaches and innovative health technology. The publication does not specify a date range because it is important to know the initial trends in this field and when the first discussions among academics began.

Eligibility criteria

Inclusion and exclusion criteria are used to ensure that the analysis is focused on relevant, quality, and focused publications of bibliometric research. This makes the results more valid and can provide a clear picture of research trends on the topic being studied. Inclusion criteria: articles that discuss stroke rehabilitation trends, written in English, all publication dates, articles in journals and exclusion criteria: articles with the publication stage "in press", publications in the form of books, book series, conference proceedings, and articles that are not in English.

Data Selection

First, we selected the appropriate database using Scopus. Then set the existing keywords and set the inclusion and exclusion criteria. Then for the search results, title and abstract screening were carried out to identify relevant articles in accordance with the inclusion criteria. This process removes irrelevant articles. Then, the important articles are exported in a format that can be used for bibliometric analysis, like CSV or RIS, so they can be processed with software like VOSviewer 1.6.20 and Excel. Data to be extracted includes the title, author, country, institution, number of citations, journals, keywords, and references.

Data Synthesis

VOSviewer is a free Java-based application developed by van Eck and Waltman and used to create network maps that show the relationships between terms in titles or abstracts as well as cooperation between countries (van Eck & Waltman, 2023). The software is often used to illustrate bibliographies, especially when analyzing complex co-citation networks, including frequently referenced references, linkages between collaborating authors, and keyword co-emergence analysis (Chen et al., 2020). The software used in this study is used to conduct journal co-citation analysis, keyword co-citation analysis, and visual analysis of the collaboration network of countries, authors, institutions, and journals. The size of the nodes indicates the number of publications, the thickness of the lines indicates the strength of the relationship, and the color of the nodes indicates the various clusters or times.

RESULTS

Evolution and growth of publications

Based on the flowchart of literature selection (Figure 1), the initial search according to the keywords in the Scopus database amounted to 310, and then screening was carried out according to the inclusion and exclusion criteria. The total number of articles, according to the inclusion criteria in this article, is 247 articles about stroke rehabilitation trends, the number is in accordance with the inclusion criteria: there are 207 articles and 40 reviews. The excluded articles totaled 63.

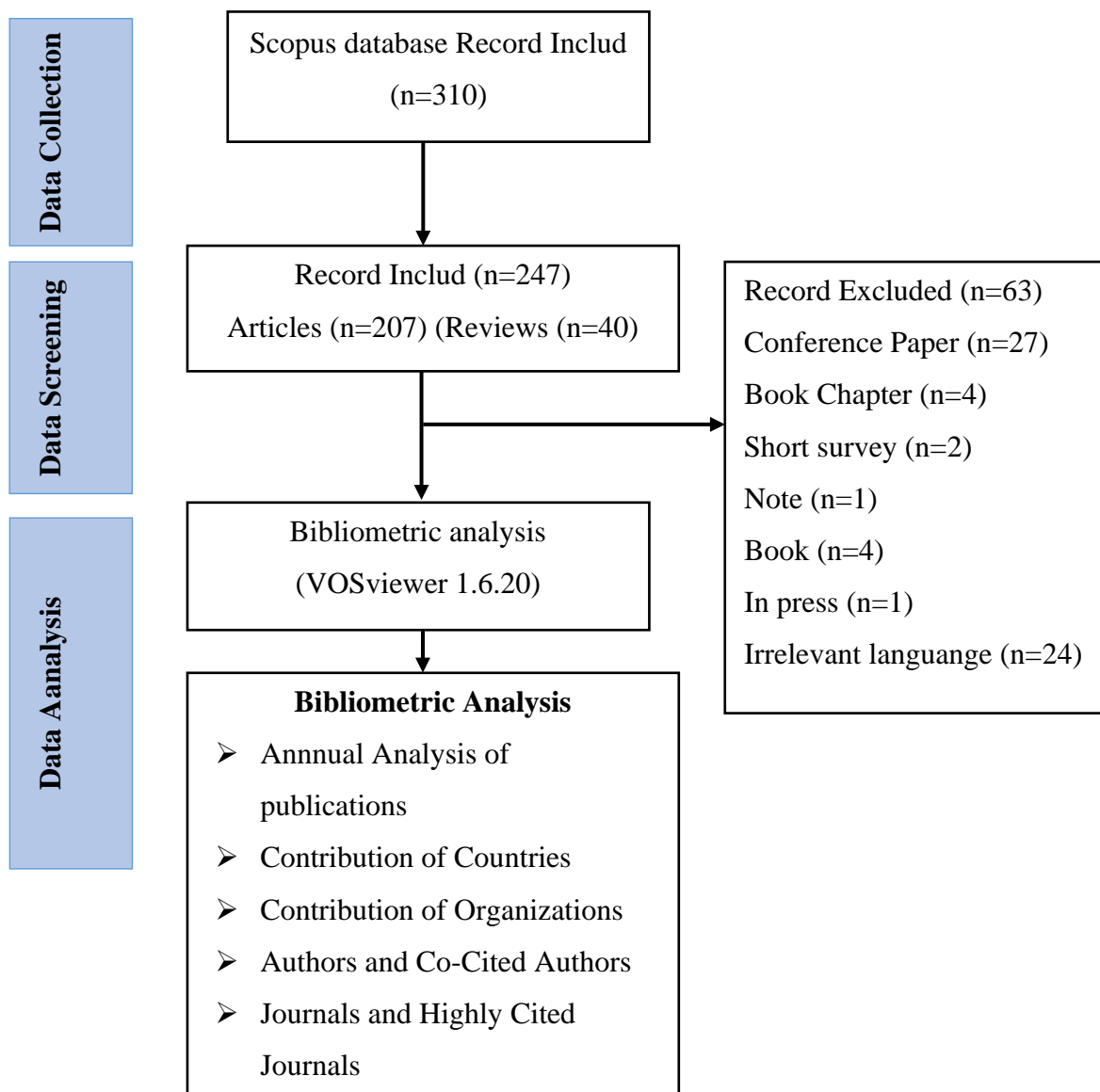


Figure 1. Flowchart of literature selection

Figures 2 and 3 present the annual publication. The publication of stroke rehabilitation trends starts in the first year, namely 1997; the last publication is in 2024. This trend illustrates a significant evolution in stroke rehabilitation trend research, from a phase of lack of attention to becoming an internationally important topic. Despite the continuous improvement, the condition remains fluctuating, reflecting advances in technology as well as the urgent demand

to provide support for the recovery of stroke patients. Figure 3 shows that the blue color of the article is 207, and the red color is 40.

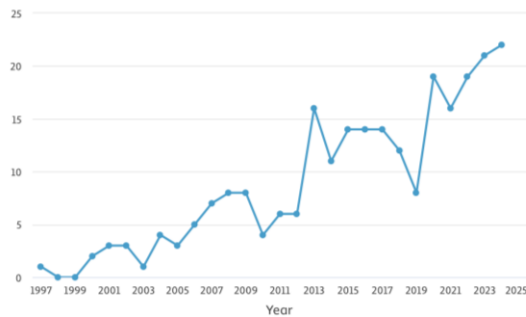


Figure 2. Document by year
Source: Scopus Data Analysis

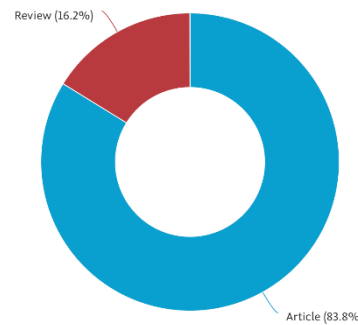


Figure 3. Document by Type
Source: Scopus Data Analysis

Top Active Countries

Table 1 shows the countries that produced 50 publications on stroke rehabilitation trends. The United States reflects its leading position in research and development in this area with a number of publications of 83 with a percentage (33.6%) on this study. Table 1 shows the countries that produced 50 publications on stroke rehabilitation trends. The United States reflects its leading position in research and development in this area with a number of publications of 83 with a percentage (33.6%) on this study. China ranks second with 29 publications (11.74%), while Canada has 19 publications (7.69%).

Table 1. 10 active countries ranked by article on stroke rehabilitation from 1997 to 2024

Rank	Country	Total publication	Percentage (%)
1	United States	83	33,6
2	China	29	11,74
3	Canada	19	7,69
4	Italy	18	7,29
5	Japan	14	5,67
6	United Kingdom	14	5,67
7	United Kingdom	13	5,26
8	Australia	12	4,86
9	Germany	11	4,45
10	Netherland	10	4,05

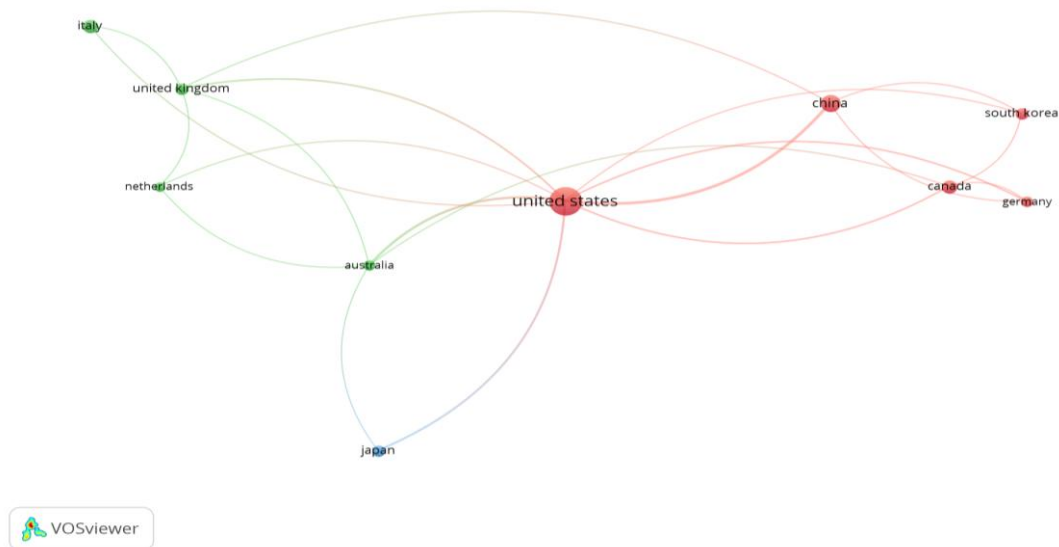


Figure 4. Evaluation of international research networks on stroke rehabilitation between 50 countries with a minimum of 1 research product

Top Contributing Affiliations/institutions

Table 2 analyzes the contribution of various educational institutions and research in the publication of articles related to stroke rehabilitation trend research. VA Medical Center, United States, ranked first with a total of 11 publications (4.45%), followed by the University of Toronto with 8 publications (3.24%). The University of California, Irvine, and the University of Maryland School of Medicine ranked third and fourth, respectively, with a contribution of 7 publications (2.83%). Furthermore, Northwestern University and Northwestern University Feinberg School of Medicine each contributed 6 publications (2.43%). Other institutions, such as the University of Kansas Medical Center, the University of British Columbia, and Columbia University, each have 5 publications (2.02%). Last from the University of Calgary with 4 publications (1.62%). This contribution reflects the important role of these institutions in the development of research in the field of stroke rehabilitation.

Table 2. The 10 Affiliations/institutions with the highest number of articles published on stroke rehabilitation, sorted by performance.

Rank	Affiliations/institutions	Country	Total Publication	Percentage (%)
1	VA Medical Center	United States	11	4,45
2	University of Toronto	Canada	8	3,24
3	University of California, Irvine	United States	7	2,83
4	University of Maryland School of Medicine	United States	7	2,83
5	Northwestern University	United States	6	2,43
6	Northwestern University Feinberg School of Medicine	United States	6	2,43
7	University of Kansas Medical Center	United States	5	2,02

8	The University of British Columbia	Canada	5	2,02
9	Columbia University	United States	5	2,02
10	University of Calgary	Canada	4	1,62

Top Contributed Funding sponsor

Table 3 shows the 10 sponsors that contributed the most to publications related to stroke rehabilitation trends from 1997 to 2024. The National Institutes of Health of the United States ranked first with 22 publications (8.91%), followed by the U.S. Department of Health and Human Services with 15 publications (6.07%). The third, fourth, and fifth rankings are occupied by the National Institutes of Child Health and Human Development, the National Institute of Neurological Disorders and Stroke, and the National Natural Science Foundation of China, with 8 publications each (3.24%). Meanwhile, the Eunice Kennedy Shriver National Institute of Child Health and Human Development and the Japan Society for the Promotion of Science each contributed 6 publications (2.43%). The Heart and Stroke Foundation of Canada and the National Science Foundation complete this list with 5 publications each (2.02%). The last is from the Canadian Institutes of Health Research with 4 publications (1.62%). Global health institutions have significantly contributed to advancing research on stroke rehabilitation trends, as evidenced by this data.

Table 3. 10 The top ten funding sponsor that have the most publications in research related stroke rehabilitation 1997 to 2024

Rank	Affiliations/institutions	Country	Total Publication	Percentage (%)
1	National Institutes of Health	United States	22	8,91
2	U.S Department of Health and Human Services	United States	15	6,07
3	National Institutes of Child Health and Human Development	United States	8	3,24
4	National Institute of Neurological Disorders and Stroke	United States	8	3,24
5	National Natural Science Foundation of China	China	8	3,24
6	Eunice Kennedy Shriver National Institute of Child Health and Human Development	United States	6	2,43
7	Japan Society for the Promotion of Science	Japan	6	2,43
8	Heart and Stroke Foundation of Canada	Canada	5	2,02
9	National Science Foundation	United States	5	2,02
10	Canadian Institutes of Health Research	Canada	4	1,62

Top Document per year by source

Figure 5 and Table 4 show a large increase in publications addressing stroke rehabilitation trends. This graph illustrates how the trend of stroke rehabilitation-related publications developed over the period analyzed (1997–2024). The most publications related

to stroke rehabilitation occurred in 2016. Journals that have a high IF play an important role in disseminating relevant and high-impact research results.

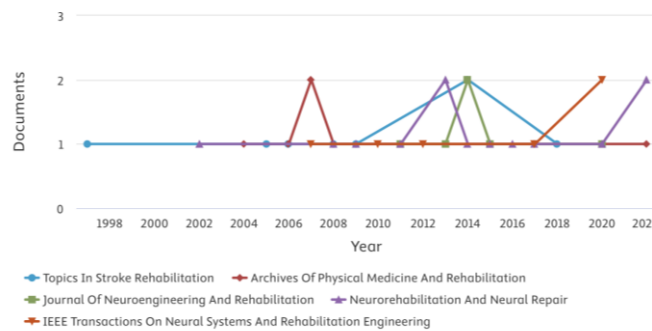


Figure 5. Document per year by source/journal
Source: Scopus Data Analysis

Table 4. The top 10 journals in research related to stroke rehabilitation

Rank	Source/Journal	Total Publication	Percentage (%)	IF	Publisher
1	Neurorehabilitation And neural repair	13	5,26	3,7	SAGE
2	Tipics in Stroke Rehabilitation	8	3,24	2,2	Taylor & Francis
3	Archives of Physical Medicine and Rehabilitation	6	2,43	3,6	Elsevier
4	IEEE Transactions on Neural Systems and Rehabilitation Engineering	6	2,43	4,8	IEEE
5	Journal of Neuroengineering and rehabilitation	6	2,43	5,2	Springer Nature
6	Stroke	6	2,43	7,8	Wolters Kluwer Health
7	Trials	6	2,43	1,93	Springer Nature
8	Brain Sciences	5	2,02	2,7	Multidisciplinary Digital Publishing Institute (MDPI)
9	European Journal of Physical and Rehabilitation Medicene	5	2,02	3,3	Edizioni Minerva Medica
10	Journal of Stroke and Cerebrovascular Disease	5	2,02	2,677	Elsevier

Top Document by authors

Table 5 shows the contributions of the top 10 authors in stroke rehabilitation-related publications. The authors with the highest contributions are Cramer, S.C from David Geffen School of Medicine at UCLA, United States and Reinkensmeyer, D.J from the University of

California, United States with 5 publications (2.02%), followed by Duncan, P.W. from Wake Forest University School of Medicine, United States with 4 publications (1.62%). Other contributors include Al Shoyaib, A. of the Food and Drug Administration, Bayley, M.T. of the Toronto Rehabilitation Institute, Dukelow, S.P of the Hotchkiss Brain Institute, Eng, J.J. of The University of British Columbia, Forrester, L.W of Baltimore VA Medical Center, Hanley, D.F of Johns Hopkins University School of Medicine, Hill, M.D of the The University of Calgary, each with 3 publications (1.21%) also has a significant contribution. This data reflects the global distribution of research in this area.

Table 5. Top 10 productive authors in research related to stroke rehabilitation

Rank	Author	Institution	Country	Total Publication	Percentage (%)
1	Cramer, S.C	David Geffen School of Medicine at UCLA	United States	5	2.02
2	Reinkensmeyer, D.J.	University of California	United States	5	2.02
3	Duncan, P.W.	Wake Forest University School of Medicine	United States	4	1,62
4	Al Shoyaib, A.	Food and Drug Administration	United States	3	1,21
5	Bayley, M.T.	Toronto Rehabilitation Institute	Canada	3	1,21
6	Dukelow, S.P	Hotchkiss Brain Institute	Canada	3	1,21
7	Eng, J.J.	The University of British Columbia	Canada	3	1,21
8	Forrester, L.W	Baltimore VA Medical Center	United States	3	1,21
9	Hanley, D.F	Johns Hopkins University School of Medicine	United States	3	1,21
10	Hill, M.D	University of Calgary	Canada	3	1,21

Top Citation Analysis

Table 6 shows the 10 most frequently cited publications in stroke rehabilitation-related research in the period from 1997 to 2024. The article with the highest citation is the work of Burgar et al., (2000), entitled "Development of robots for rehabilitation therapy: The Palo Alto VA/Stanford experience", published in the Journal of Rehabilitation Research and Development, with 622 citations and an impact index per article of 6.72. The second most cited article is the work of Volpe et al., (2000) with 497 citations and an impact index per article of 7.96 and other publications such as Luft et al., (2004) and Duncan et al., (2003) which focus on stroke rehabilitation and selection. Overall, these publications cover a wide range of important topics such as stroke rehabilitation, interventions and the global burden that stroke patients experience, providing a broad insight into the field of stroke rehabilitation.

Table 6. Top 10 most cited publications in research related to stroke rehabilitation

Rank	Author	Title	Source Title	Country	Cited by	Impact Index per Article
1	(Burgar et al., 2000)	Development of robots for rehabilitation therapy: The Palo Alto VA/Stanford experience	Journal of Rehabilitation Research and Development	United States	622	6,72
2	(Volpe et al., 2000)	A novel approach to stroke rehabilitation: Robot-aided sensorimotor stimulation	Neurology	United States	497	7,96
3	(Luft et al., 2004)	Repetitive bilateral arm training and motor cortex activation in chronic stroke: A randomized controlled trial	JAMA	United States	488	16,15
4	(Duncan et al., 2003)	Randomized clinical trial of therapeutic exercise in subacute stroke	Stroke	United States	446	6,87
5	(Masiero et al., 2007)	Robotic-Assisted Rehabilitation of the Upper Limb After Acute Stroke	Archives of Physical Medicine and Rehabilitation,	United States	330	12,30
6	(Basteris et al., 2014)	Training modalities in robot-mediated upper limb rehabilitation in stroke: A framework for classification based on a systematic review	Journal Neuro Engineering and Rehabilitation	English	302	4,37
7	(Rosati et al., 2007)	Design, implementation and clinical tests of a wire-based	IEEE Transactions on Neural Systems and	United States	224	3,14

		robot for neurorehabilitation	Rehabilitation Engineering			
8	(Kahn et al., 2006)	Robot-assisted movement training for the stroke- impaired arm: Does it matter what the robot does?	Journal of Rehabilitation Research and Development	United States	209	17,93
9	(Woldag & Hummelsheim, 2002)	Evidence-based physiotherapeutic concepts for improving arm and hand function in stroke patients: A review	Journal of Neurology	Germany	203	2,93
10	(Duncan et al., 2007)	Protocol for the locomotor experience applied post-stroke (LEAPS) trial: A randomized controlled trial	BMC Neurology	United States	180	2,49

Source: The Impact Index Per Article is presented based on Reference Citation Analysis

Research themes in the literature on stroke rehabilitation

Figure 6 presents information on stroke rehabilitation trends based on bibliometric analysis. The visualization describes the relationships between various terms, themes, or topics that often appear in the related scientific literature. Using a color cluster approach, this map shows how the research field is divided into several main themes. The red color focuses on physical rehabilitation and stroke therapy; the topics that arise are "cerebrovascular accident," "rehabilitation," "physical therapy," "balance," "motor control," and "physiotherapy." The green color focuses on stroke pathophysiology and rehabilitation; the topics that emerge are "stroke," "neuroplasticity," "motor impairment," "upper extremity," "hemiparesis," and "cerebral blood flow." The blue color focuses on the topic of neurological mechanisms and clinical studies; the topics that emerge are "pathophysiology," "stroke rehabilitation," "nerve," "kinesiotherapy," "combined therapy," and "brain plasticity."

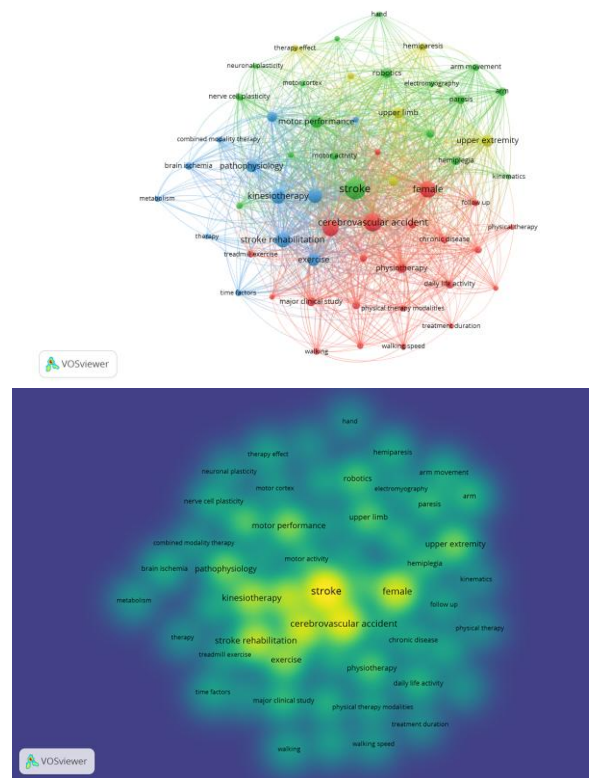


Figure 6. VOSviewer density visualization map and overlay of keywords in the reshuffle ventricle field. (A) VOSviewer keyword density visualization map. (B) VOSviewer keyword overlay visualization

Future research direction analysis

Figure 7 is a visualization of a bibliometric network that illustrates the relationship between various concepts or keywords that often appear in research related to stroke rehabilitation. The node size indicates the frequency with which the keyword appears. The keywords "stroke" and "stroke rehabilitation" have the largest size, indicating the highest frequency. The color indicates the temporal distribution by year of publication. Color scale (blue to yellow). Dark blue indicates the topics that were more discussed in 2013, light green indicates topics that were popular in 2015 and yellow indicates the research theme of 2018. The line connects the keywords that often appear together in the "Stroke rehabilitation" study "Cerebrovascular accident." "Physiotherapy." Blue (2013) More fundamental research on pathophysiology and neuronal plasticity. Green (2014-2016) Focus on physiotherapy techniques, motor performance, and upper limb rehabilitation. Yellow (2017-2018) Focusing on the latest rehabilitation methods such as: robotics, walking speed, treatment duration. The early years focused on basic topics such as stroke pathophysiology and neuroplasticity. The following years showed developments in clinical applications, such as physical therapy and motor rehabilitation. The modern theme (2017–2018) highlights new technologies such as robotics and performance measurement such as walking speed.

This figure reflects the development of stroke and rehabilitation research during the period 2013–2018. Early research focused on the fundamentals of biology and physiology, while recent research turned to the application of advanced technology in rehabilitation. This visualization is very useful for understanding the evolution of themes in this field.

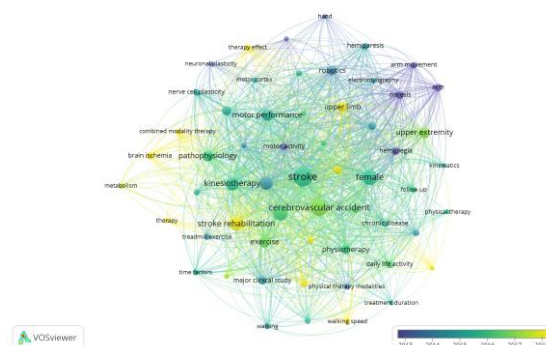


Figure 7. Map of overlay visualization analysis of terms in titles and abstracts based on frequency of appearance

DISCUSSION

Bibliometrics is an innovative technique that is practical and efficient for qualitative studies as well as quantitative analysis of publications. This method looks at the measurement part of literature and also finds things like countries, institutions, journals, authors, and keywords that show up in a lot of publications in a certain area over a certain amount of time. This lets researchers sum up the current state and progress patterns of a certain disease or research field and gives them ideas and direction for future research (Zhu et al., 2023). This study comprehensively analyzed the current research conditions related to stroke rehabilitation trends using bibliometric analysis, with the help of VOSviewer 1.6.20 software to evaluate collaboration between authors, institutions, and countries. The study graphically analyzed data trends from 1997 to 2024. The data appears to have improved overall, although there have been some fluctuations. An overall rise in trends in stroke rehabilitation is due to the high prevalence of stroke disease, which makes rehabilitation programs for stroke patients much more effective (Sauerzopf et al., 2024). Good rehabilitation can reduce the physical, emotional, cognitive, and social effects on stroke-affected individuals and their caregivers and also provide significant cost savings for the community (Tang et al., 2024).

In this bibliometric study, the country that contributed the most to the publication of stroke rehabilitation trends was the United States. This finding is in line with the most cited publications in research related to the publication of stroke rehabilitation trends, namely ((Duncan et al., 2007; Kahn et al., 2006; Rosati et al., 2007; Masiero et al., 2007; Duncan et al., 2003; Luft et al., 2004; Volpe et al., 2000; Burgar et al., 2000). Moreover The United States is the country that contributes the most publications because this country is the largest sponsor in this study, namely eight of the top ten funding sponsors who have research publications related to stroke rehabilitation trends from 1997 to 2024. The affiliations/institutions are the National Institutes of Health, U.S. Department of Health and Human Services, National Institutes of Child Health and Human Development, National Institute of Neurological Disorders and Stroke, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Science Foundation. The United States has contributed a lot to research on stroke rehabilitation, which can be attributed to a number of reasons. One of the main factors is the large financial support from government agencies like the United States, where most of the research was conducted in high-income countries (Bin Suliman et al., 2023). This study is also mostly published in reputable journals, such as 3 top journals, namely Neurorehabilitation and Neural Repair, Topics in Stroke Rehabilitation, and Archives of Physical Medicine and Rehabilitation.

VA Medical Center in the United States was ranked first in Top Contributing Affiliations/Institutions in the publication of related articles, while the top author in rehabilitation-related publications was Cramer, S.C from the David Geffen School of Medicine at UCLA, United States. In this study, it can be seen that developing countries have a significant role in stroke rehabilitation. This is due to the fact that stroke rehabilitation is more widely carried out in developed countries. Some of the factors that support this include a better health care system, wider access to resources, and a higher level of public awareness about health. These countries usually have well-funded research institutions and strong health policies to support various educational programs. In addition, they also focus on improving understanding of health services and disease prevention so that stroke treatment and prevention become more attention-grabbing (Li et al., 2022).

One method of treating stroke is through rehabilitation, which aims to repair nerve tissue that has been damaged. The red color focuses on physical rehabilitation and stroke therapy. Based on previous research, combining CnvT and VR as a rehabilitation process can improve the mobility of the arm, where this technique has the potential to reduce the level of disability and improve neuroplasticity (Potcovaru et al., 2024). The green color focuses on stroke pathophysiology and rehabilitation. Rehabilitation aims to improve the recovery pathway and improve adaptability to loss of nerve function, with the goal of improving performance and avoiding recurrence of stroke. Combining understanding of post-stroke recovery, biomarkers, and movement outcomes is a key challenge in providing information for tailored treatments and designing specific interventions (Okusanya et al., 2023). Color blue focuses on the topic that neurological mechanisms and clinical studies are essential in order to deal with the problem of the increasing number of stroke cases to create and test more effective treatment and prevention methods for stroke (Zhou et al., 2024). Therefore, seeing the development of trends in stroke rehabilitation greatly affects the health of patients in disease management.

Based on an analysis of keyword density maps using VOSviewer, several research gaps in the field of stroke rehabilitation can be identified. The dominance of keywords such as stroke, cerebrovascular accident, female, physiotherapy, and upper extremity indicates that research remains focused on physical and motor rehabilitation. Conversely, the presence of keywords in peripheral areas with low density, such as neuronal plasticity, motor cortex, robotics, and electromyography, indicates that neuroscience-based approaches and the integration of advanced technology in stroke rehabilitation have not yet been extensively explored. Furthermore, the low density of keywords such as daily life activities, walking, and treatment duration suggests a lack of research highlighting the long-term impact of rehabilitation and the recovery of patients' daily functional abilities. Additionally, the absence of keywords related to psychological, social, and family involvement indicates that holistic rehabilitation approaches remain underrepresented in the literature. Therefore, future research should focus on developing more comprehensive approaches through the integration of neuroscience-based technologies, the optimization of chronic-phase rehabilitation, and the strengthening of functional and psychosocial dimensions in the stroke patient recovery process.

LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, the analysis was limited to the Scopus database, which may have excluded relevant publications indexed in other databases such as Web of Science, PubMed, or Google Scholar. This may introduce database selection bias and limit the comprehensiveness of the results. In addition, only English-language articles were included, which may lead to language bias and the underrepresentation of research from non-English-speaking countries.

Second, the search strategy and keyword combinations used in this study may not have captured all relevant publications on stroke rehabilitation, potentially resulting in selection bias. The exclusion of conference papers, books, and articles “in press” may also have omitted emerging or recent research developments. Furthermore, the data were collected at a single time point, and given the dynamic nature of databases, the results may change over time as new publications are indexed.

Finally, as a bibliometric study, this research focuses on publication patterns, collaboration networks, and keyword trends, but does not assess the methodological quality or clinical effectiveness of the included studies. Therefore, the findings should be interpreted with caution, as a higher number of publications or citations does not necessarily reflect higher research quality or clinical impact

CONCLUSION

This study identified international patterns in the stroke rehabilitation area using bibliometric analysis. From the data that has been analyzed, the main theme of this study is stroke rehabilitation that lasted from 1997 to 2024, and it was found that the number of publications reached 247, which indicates a change in stroke rehabilitation trends over time. This shows the increasing attention to rehabilitation for stroke patients. In addition, this document suggests a direction for future research; it is important to explore and find the most effective stroke rehabilitation methods for stroke patients.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest relevant to this study. This research was conducted independently with no involvement of parties that could influence the results or interpretation of the data. There are no sources of funding for this research.

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