

Trend in research and hotspot on exercise therapy at home for stroke patients: a bibliometric analysis



Review

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Abstract: **Objective:** This study aims to analyze research trends, co-authorship networks, and hotspots over the past decade regarding research on exercise therapy at home for stroke patients.

Methods: Articles on exercise therapy at home for stroke patients were routinely searched for in the SCOPUS database from 2013 to 2023. To evaluate and predict the most popular topics and trends in this field, the data collected from the reports are processed using the VOSviewer program.

Results: The final analysis covered 1943 articles. The number of publications has steadily increased over the past decade. The United States has made the most significant contributions in this field. The University of Toronto (Canada) and Cramer, S.C. were the most productive institutions and researchers. The journal Disability and Rehabilitation has the highest number of publications (Citescore 4.4; SJR 0.76). The research area in this field is predominantly dominated by medicine. The frequently occurring keywords include “stroke,” “rehabilitation,” and “telerehabilitation.” Innovations, such as telerehabilitation and virtual reality (VR), are emerging as key trends, enhancing patient engagement and accessibility in home-based therapy.

Conclusions: Using bibliometric analysis and network visualization, this study summarizes the latest research on home-based exercise therapy for stroke patients, highlighting the impact of innovative technologies, such as telerehabilitation and VR. This analysis identifies research gaps, trends, and popular subjects, providing a comprehensive framework for future studies on key topics, collaborative initiatives, and developmental patterns.

Keywords: *bibliometric analysis • exercise therapy • home • stroke • trend research*

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1. Introduction

Stroke, which has the highest disease burden among all neurological disorders, is a primary cause of disability in adults and a significant global health concern, with 15 million new cases occurring annually.^{1,2} Physical exercise therapy is one stroke rehabilitation strategy that has attracted a lot of interest because it

can help stroke patients live better lives and achieve better functional outcomes.³ Although clinical settings are usually used for rehabilitation programs, home-based exercise therapy is a promising alternative that provides accessibility, convenience, and possible cost savings.^{4,5}

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In recent years, there has been a growing interest in exploring the development of effectiveness and feasibility of home-based exercise therapy to promote exercise and physical activity in stroke patients. This trend reflects a broader shift towards patient-centered care and the integration of innovative technology into rehabilitation practice.^{6,7} However, a thorough and comprehensive analysis is needed to explore the existing literature, identify the main research focuses, and highlight areas that require further attention.

This study aims to conduct a bibliometric analysis of home-based exercise therapy for stroke patients. The primary objectives of this study are to:

- (1) Analyze publication trends in the literature related to home-based exercise therapy for stroke patients and to identify publication patterns and shifts in research focus over time.
- (2) Assess citation patterns to reveal the influence and relationships between key works in the field and to identify the most impactful and frequently cited studies.
- (3) Identify thematic clusters in the literature to understand the main topics and subthemes of focus in this research area.

Bibliometric analysis, as a quantitative method to assess the characteristics and patterns of scientific literature,⁸ offers valuable insights into the research landscape of home-based exercise therapy for stroke patients. By systematically analyzing publication trends, citation patterns, and thematic content, bibliometric studies can identify hotspots, emerging topics, and areas requiring further exploration.⁹

By defining the scope of this study, we provide valuable insights into the major trends, challenges, and opportunities in research, clinical practice, and policy related to home-based exercise therapy for stroke patients.^{10,11} These findings are expected to aid in the development of evidence-based strategies to improve rehabilitation outcomes and quality of life for stroke patients.

2. Methods

2.1. Data sources and search strategy

The information utilized in this study for the bibliometric analysis was obtained from SCOPUS database, given its status as the preeminent repository of such data. SCOPUS, owned by Elsevier BV Company in the USA, is the largest database of scientific peer-reviewed literature, with over 22,000 titles from international publishers.¹² This research was conducted between June 2013 and June 2023. The search strategy was as follows: “exercise therapy” OR “rehabilitation” OR “physical

exercise” OR “exercise” AND “home” OR “Home-based” OR “home-dwelling” AND “stroke” OR “Cerebrovascular Accidents” OR “CVA (Cerebrovascular Accident)” OR “Brain Vascular Accident” OR “Acute Cerebrovascular Accident” OR “Stroke patient.” Articles were the primary form of literature selected for this investigation. Select “English” as the language category; non-English publications were excluded. The documents that were chosen were downloaded on 5 March 2024.

To ensure the accuracy and reliability of the data, the dataset was cleaned before proceeding. This process involved removing duplicate records and verifying the relevancy of the articles. After this cleaning process, a final selection of 1493 articles was made. The process of screening is illustrated in Figure 1.

2.2. Bibliometric analysis and visualization

VOSviewer version 1.6.20, a software tool for constructing and visualizing bibliometric networks, was utilized for bibliometric and visual analysis in this study.¹³ Significant quantities of bibliographic data are transformed into visual representations by the software.¹⁴ VOSviewer uses a similarity visualization mapping technique to create more structured bibliometric maps than other typical multidimensional scaling methods. VOSviewer uses a similarity matrix to position things close together if they are very similar and far apart if they are dissimilar on a 2-dimensional map. VOSviewer stands out from other mapping programs by focusing on creating graphical representations of bibliometric maps that are easily understandable.¹⁵

We visualized the network using VOSviewer, which also performed co-occurrence analyses of researchers, institutions, countries, keywords, and journals. Co-occurrence and co-citation analysis are the 2 most prevalent methodologies. Co-occurrence analysis enables academics to find the prominent subjects and patterns in a field of study. If 2 words regularly appear together in an article, it suggests a stronger association between them compared to other word pairings.¹² Complete records and references were included in the exported literature from SCOPUS in CSV (Comma-Separated Values) format, which allows structured bibliographic data to be stored in a tabular form suitable for bibliometric analysis. Subsequently, the literature was imported into VOSviewer for the purpose of conducting bibliometric analysis. Additionally, the data were imported into Microsoft Excel and analyzed using both quantitative and qualitative analyses.

2.3. Research ethics

Bibliographic data were sought and obtained from SCOPUS. The data were publicly accessible. The data

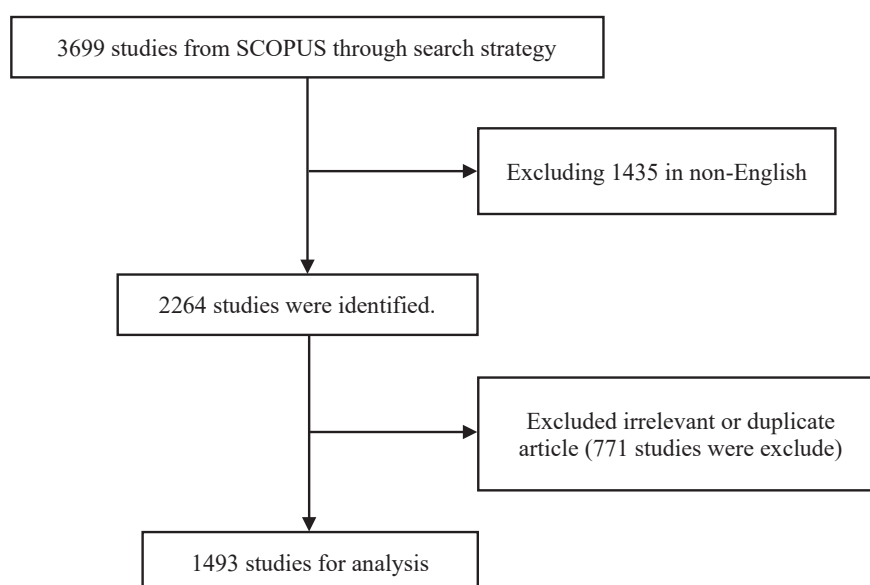


Figure 1. Flow chart of how the articles in this study were chosen.

extraction process did not require any interaction with human participants or animals. No ethical difficulties arose from using these data; therefore, no clearance from an ethics commission was necessary.

3. Results

3.1. Analysis of publications based on bibliometrics in the timeline

Using our search method, we discovered and included 1493 publications on exercise therapy at home for stroke patients from SCOPUS. These articles originated from a total of 517 distinct sources, with an average publication rate of 8.75 articles per year and an average citation count of 15.13 (h-index 62). According to the data, 2786 keywords attributed to 26 distinct authors have been cited. This demonstrates that how strong the exercise therapy at home for stroke patients' field of study is and how it connects with other disciplines. Furthermore, these demonstrate that how this study is a developing discipline and how it maintains or fosters interactions with other subjects.

The annual number of publications on home-based exercise therapy for stroke patients increased from 83 in 2013 to 192 in 2023, as seen in Figure 2. Since 2013, the average number of citations per year per published item peaked at 3.14 for the 109 articles published in 2017, 2.91 for the 114 articles published in 2015, and 2.73 for the 140 articles published in 2019. The citation peaks

were a result of 3 articles that were widely referenced; Dodakian, McKenzie, Le, See, Pearson-Fuhrhop, Burke Quinlan, Zhou, Augsburg, Tran, Friedman, Reinkensmeyer and Cramer¹⁶ entitle "A Home-Based Telerehabilitation Program for Patients With Stroke"; Hammel, Magasi, Heinemann, Gray, Stark, Kisala, Carlozzi, Tulskey, Garcia and Hahn¹⁷ entitle "Environmental barriers and supports to everyday participation: A qualitative insider perspective from people with disabilities"; and Cramer, Dodakian, Le, See, Augsburg, McKenzie, Zhou, Chiu, Heckhausen, Cassidy, Scacchi, Smith, Barrett, Knutson, Edwards, Putrino, Agrawal, Ngo, Roth, Tirschwell, Woodbury, Zafonte, Zhao, Spilker, Wolf, Broderick and Janis¹⁸ entitle "Efficacy of Home-Based Telerehabilitation vs In-Clinic Therapy for Adults after Stroke: A Randomized Clinical Trial."

3.2. Analysis of countries, institutions, and international collaboration based on bibliometrics

The search results indicated that 1493 publications originated from 83 countries/regions and 160 institutions. The country with the most published articles was United States (454, or 23.8%) (see Table 1), followed by the United Kingdom (181, or 9.5%), Australia (118, or 6.2%), Canada (114, or 6%), and Netherland (87, or 4.6%). Despite it ranks eighth in terms of total articles, Italy attains the highest average citation per item (ACI) at 19.5. This demonstrates the exceptional caliber of Italian research concerning at-home exercise therapy

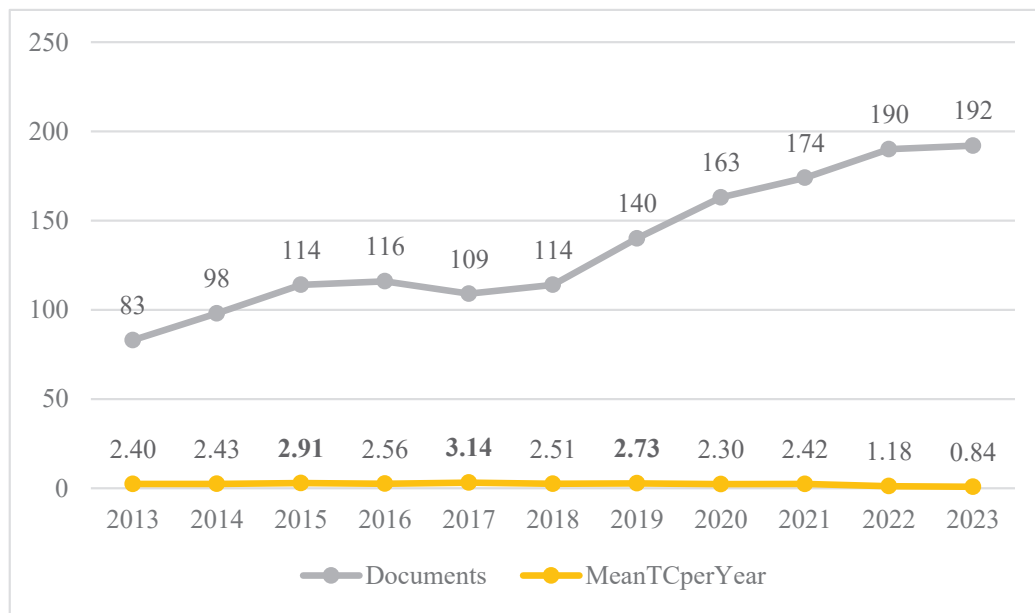


Figure 2. The annual publication output between 2013 and 2023.

No.	Country	Articles (%)	Citations	ACI	TLS	Top country institution	Top institution author
1	United States	454 (23.8)	8050	17.73	142	Massachusetts General Hospital	Schwamm, L.H.
2	United Kingdom	181 (9.5)	3237	17.88	128	University of Nottingham	Walker, M.
3	Australia	118 (6.2)	1546	13.10	81	The University of Sydney	Ada, L.
4	Canada	114 (6.0)	1701	14.92	47	University of Toronto	Bayley, M. & Fang, J.
5	Netherlands	87 (4.6)	1541	17.71	68	Universiteit Maastricht	Schols, J.M.G.A., Van Heugten, C.M. Visser-Meily, J.M.A. & van Heugten, C.M.
6	Japan	83 (4.4)	1001	12.06	14	Nagasaki Rehabilitation Hospital	Nishioka, S.
7	China	78 (4.1)	1025	13.14	37	Fudan University	Chen, J.
8	Italy	64 (3.4)	1248	19.50	46	Università degli Studi di Milano	Borghese, N.A.
9	Sweden	60 (3.1)	811	13.52	33	Karolinska Institutet	Ytterberg, C.
10	Spain	44 (2.3)	680	15.45	36	Universitat Autònoma de Barcelona	Tormos, J.M.

Note: ACI, average citation per item; TLS, total link strength.

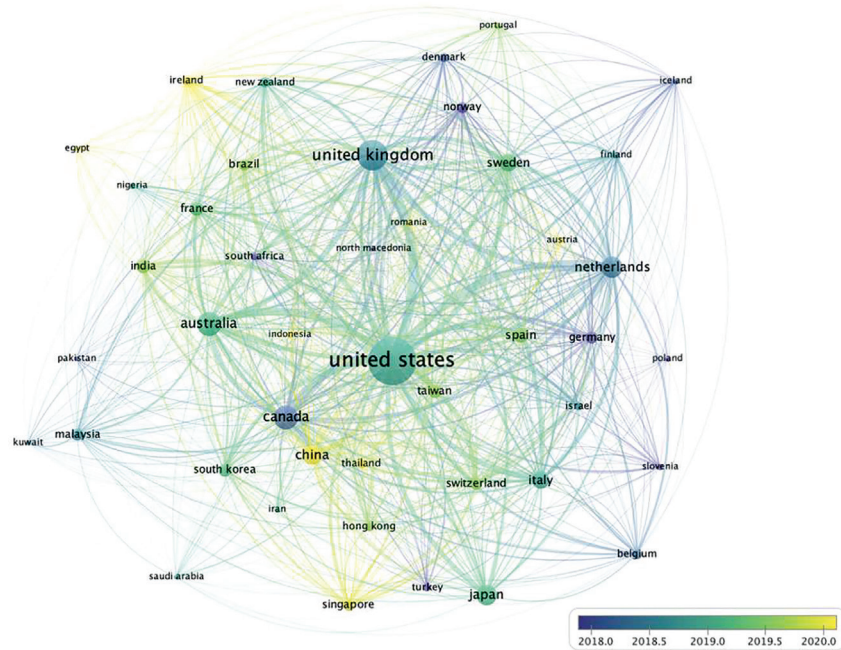
Table 1. The 10 nations that have produced the most research findings regarding at-home exercise therapy for stroke patients.

for stroke patients and its extensive acclaim among scholars.

The VOSviewer analysis presents Figure 3A, which illustrates a time overlay map showcasing the cooperation networks of various countries. The lines connecting nodes depict country connections, with node size

indicating the number of publications from various countries. Node color reflects time changes. Early research on home exercise therapy for stroke patients saw significant publications, led by Germany, Norway, Slovenia, and Turkey. As shown in Figure 3B, the United States exhibited the highest total link strength (TLS) (142),

(A) The country cooperation networks' time overlay map.



(B) Countries' collaboration world map.

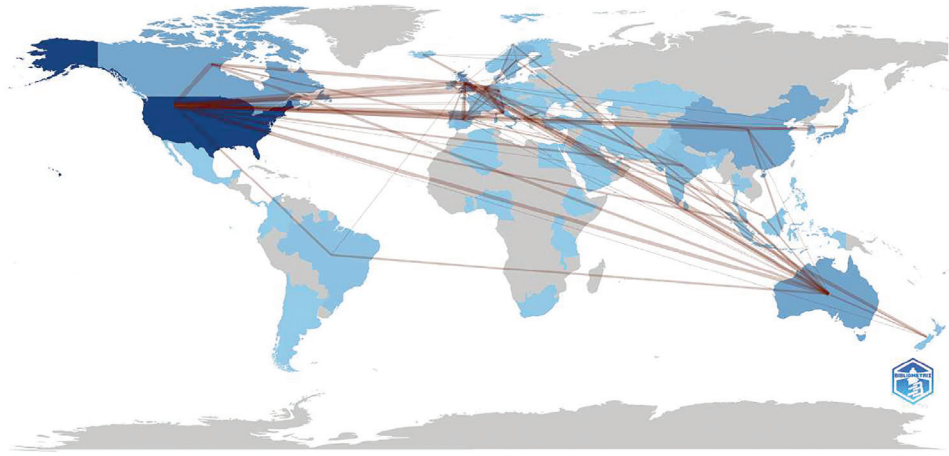


Figure 3. The network of coauthorship among countries/regions (international collaboration).

signifying its profoundest level of collaboration with other nations. United Kingdom behind with 128, followed by Australia (81), the Netherlands (68), and Canada (47) in terms of cooperation intensity.

The top 10 institutions came from the United States (5/10), Canada and Sweden (2/10), and Australia (1/10). The most productive institution is the University of Toronto (1.74%), followed by Karolinska Institutet (1.63%), Massachusetts General Hospital (1.46%), and Harvard Medical School (1.41%) (see Figure 4).

3.3. Authors' and cited reference bibliometric analyses

The search results indicate that there are 1493 papers on exercise therapy at home for stroke patients, authored by 7566 individuals. Table 2 lists the top 10 most productive writers (all authors of each publication were scored equally) in exercise treatment at home for stroke patients' study. Cramer, S.C conducted the highest number of investigations, totaling 19 (2.02% of the

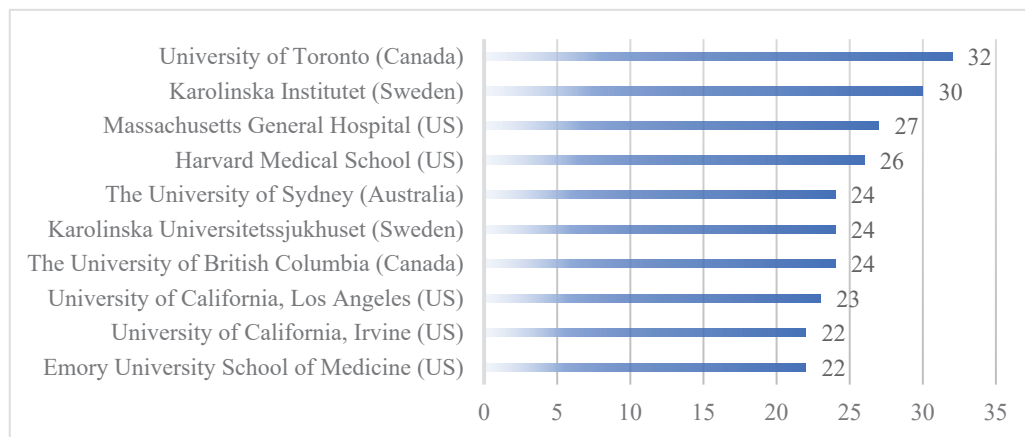


Figure 4. The 10 institutions with the greatest number of research outcomes in this field.

No.	Author	Country	Articles (%)	Citation	ACI	TLS	Year of first-last article	Author's h-index
1	Cramer, S.C. ¹⁸	US	19 (2.02)	846	44.5	75	2015–2023	84
2	Ytterberg, C.	Sweden	16 (1.7)	208	13	56	2013–2023	26
3	Eng, J.J.	Canada	13 (1.38)	257	19.7	11	2013–2023	77
4	English, C.	Australia	13 (1.38)	135	10.4	43	2018–2023	29
5	Langhorne, P.	UK	13 (1.38)	278	21.4	41	2014–2023	91
6	von Koch, L.	Sweden	12 (1.27)	203	16.9	56	2013–2023	36
7	Reinkensmeyer, D.J.	US	11 (1.17)	300	27.3	29	2013–2023	59
8	Schwamm, L.H.	US	11 (1.17)	370	33.6	35	2013–2021	100
9	Teasell, R.	Canada	11 (1.17)	188	17.1	27	2013–2022	69
10	Elf, M.	Sweden	10 (1.06)	69	6.9	34	2019–2023	21

Note: ACI, average citation per item; TLS, total link strength.

Table 2. Top 10 most productive authors, from 2013 to 2023.

total). Followed by Ytterberg, C. 16 (1.7%), Eng, J.J., English, C. & Langhorne, P 13 (1.38%), Cramer, S.C., a researcher from David Geffen School of Medicine at UCLA, Los Angeles, United States, has been identified as the most productive author in the field of exercise therapy at home for stroke patients. Her pioneering efforts attracted considerable attention, as evidenced by her highest TLS and high citation rate.

Out of 7566 writers, 133 have produced 5 papers or more; the most related group of 70 authors was found in 9 clusters, according to our co-authorship analysis. A node's label will display the name of the author, and the size of the node will reflect the total number of publications. In Figure 5, thicker links indicate more collaboration between the 2 writers, and links linking 2 nodes indicate co-authorship.

References were vital in academic research as they served as the foundation for intellectual inquiries.

Through the use of reference co-citation analysis, we can gain insights into the development of knowledge in the field and pinpoint the current areas of research concentration. Our analysis of the co-cited references revealed that a total of 50,791 references were cited in 1493 articles. There was a total of 43 references that were cited together more than 10 times. Table 3 displays the 10 most often co-cited references.

3.4 Journal bibliometric analysis

Over the course of 517 journals, articles were published regarding home exercise therapy for stroke patients. Meanwhile, VOSviewer identified 517 co-cited journals in the last decade (see Figure 6) and 77 journals that have a minimum document count of 4 in 6 clusters. The 10 highest-ranking publications

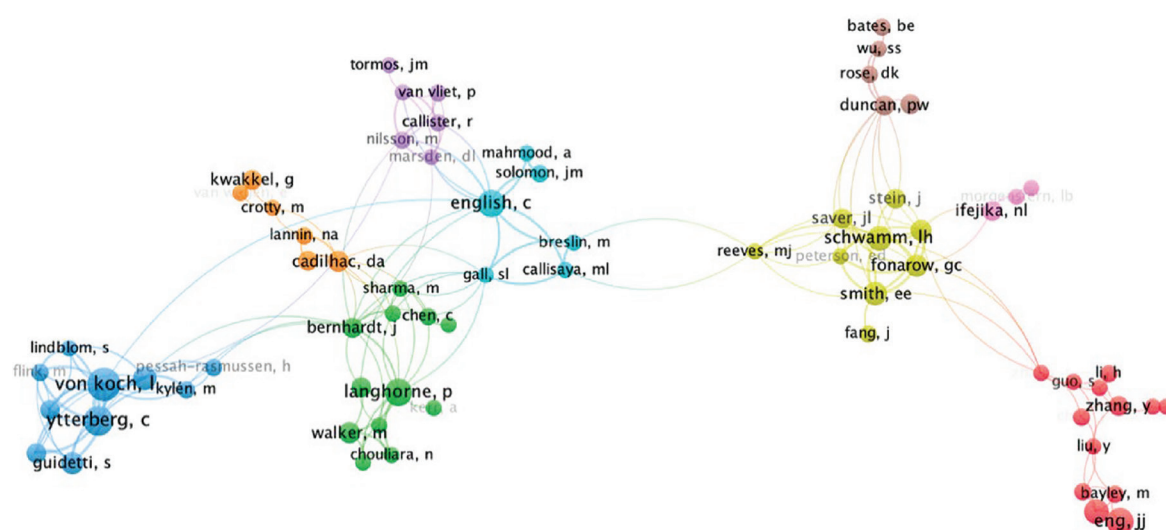


Figure 5. VOSviewer coauthorship analysis network visualization map.

No.	Author	Title	Journal	Citation	FWCI
1	Hammel et al. ¹⁷	Environmental barriers and supports to everyday participation: A qualitative insider perspective from people with disabilities	Archives of Physical Medicine and Rehabilitation	213	11.64
2	Cramer et al. ¹⁸	Efficacy of Home-Based Telerehabilitation vs In-Clinic Therapy for Adults after Stroke: A Randomized Clinical Trial	JAMA Neurology	199	10.95
3	Chiang et al. ¹⁹	2015 Guidelines of the Taiwan, China Society of Cardiology and the Taiwan, China Hypertension Society for the Management of Hypertension	Journal of the Chinese Medical Association	156	11.48
4	Howell et al. ²⁰	Kinetic gait analysis using a low-cost insole	IEEE Transactions on Biomedical Engineering	156	2.65
5	Kumar et al. ²¹	Artificial intelligence in disease diagnosis: a systematic literature review, synthesizing framework, and future research agenda	Journal of Ambient Intelligence and Humanized Computing	154	95.75
6	Dawson et al. ²²	Vagus nerve stimulation paired with rehabilitation for upper limb motor function after ischemic stroke (VNS-REHAB): a randomized, blinded, pivotal, device trial	The Lancet	154	24.17
7	Yoshimura et al. ²³	Sarcopenia is associated with worse recovery of physical function and dysphagia and a lower rate of home discharge in Japanese hospitalized adults undergoing convalescent rehabilitation	Nutrition	128	7.99
8	Dodakian et al. ¹⁶	A Home-Based Telerehabilitation Program for Patients with Stroke	Neurorehabilitation and Neural Repair	108	3.77
9	Dobkin ²⁴	A Rehabilitation-Internet-of-Things in the Home to Augment Motor Skills and Exercise Training	Neurorehabilitation and Neural Repair	101	4.13
10	Lindley et al. ²⁵	Family-led rehabilitation after stroke in India (ATTEND): a randomized controlled trial	The Lancet	99	6.3

Note: FWCI, field-weighted citation impact.

Table 3. The top 10 references cited in studies on exercise therapy for stroke patients at home, from 2013 to 2023.

publishing on this subject are all listed in Table 4. Following Topics in Stroke Rehabilitation (49; 4.4%) and Journal of Stroke and Cerebrovascular Diseases (57; 5.2%), Disability and Rehabilitation published the most papers (73; 6.6%). A total of 36.3% of the publications included in this analysis were published in the top 10 journals.

The top journal with the highest citation score is owned by the Stroke journal, with a score of 12.9 (SJR 2.746). Despite being ranked eighth in terms of the number of publications in the field of exercise therapy at home for stroke patients research, this indicates that the journal has a very high and significant impact in the academic community and this field.

The annual number of publications on home-based exercise therapy for stroke patients in the top 10 article-producing journals is shown in Figure 7. The Journal of Stroke and Cerebrovascular Diseases reached its peak in 2021 with 12 documents (Scite-score 4.3; SJR 0.713; SNIP 0.89), while the journal of Disability and Rehabilitation reached its peak in 2022 with 12 documents (Scitescore 4.4; SJR 0.76; SNIP 1.63)

3.5 Analysis of the research area

A study examined home-based exercise therapy efficacy for stroke patients across 25 specific research locations. Figure 8 illustrates these locations covered in publications between 2013 and 2023. Fields, such as Medicine, Health Professions, Neuroscience, and Nursing, had the highest publication rates, comprising 47.2%, 12.9%, 7.6%, and 7.5%.

3.6 Analysis of co-occurring keywords using bibliometrics

In this study, VOSviewer identified 2786 keywords from 1493 articles. Among these, 117 keywords appeared at least 7 times. VOSviewer was utilized to generate a knowledge map depicting keyword occurrences, revealing 73 terms grouped into 8 clusters (see Figure 9A). The top 10 keywords are “stroke” (807 occurrences; TLS 712), followed by “rehabilitation” (436 occurrences; TLS 400), “telerehabilitation” (72 occurrences; TLS 70), “Upper Extremity” (55 occurrences; TLS 55), “virtual reality” (50 occurrences; TLS 156), “exercise” (47 occurrences; 124 TLS), “occupational therapy” (42 occurrences: TLS 114),

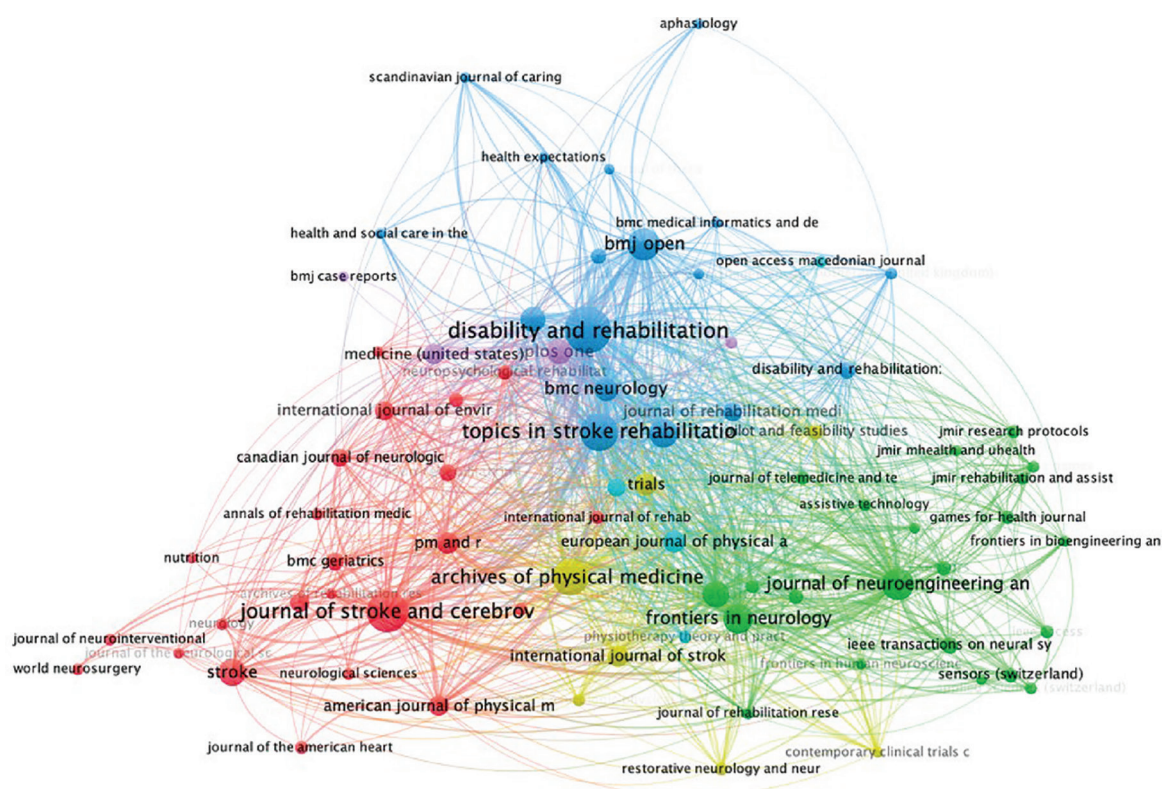


Figure 6. VOSviewer network visualization of the Journal analysis.

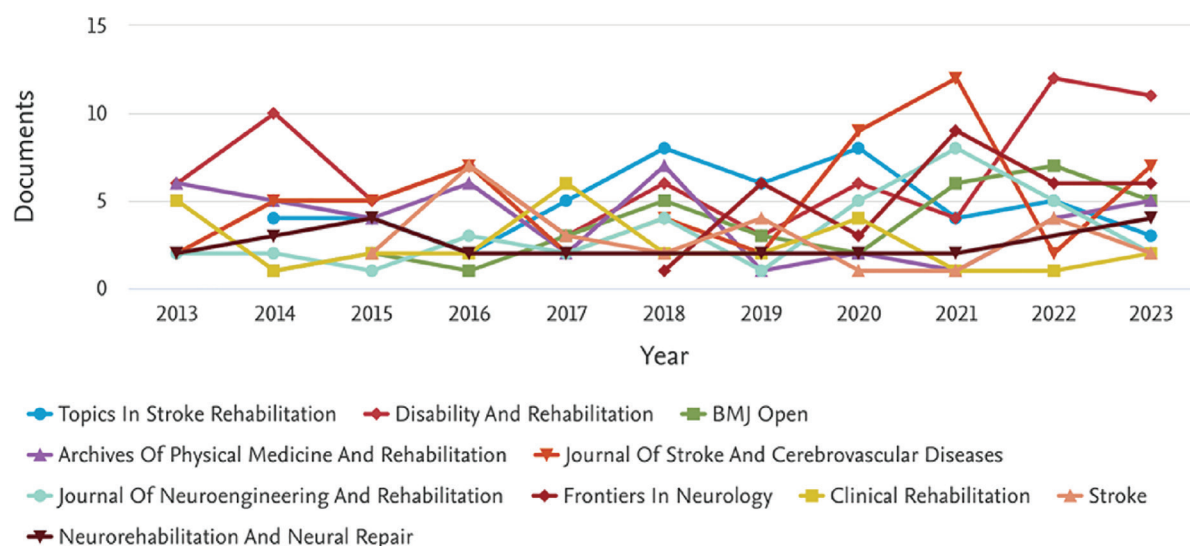


Figure 7. Report every year by source.

No.	Journal	Articles (%)	Cite Score 2022	SJR 2022	SNIP 2022	JCR/ Best Quartile	Category
1	Disability and Rehabilitation	73 (6.6)	4.4	0.762	1.635	Q1	Medicine: Rehabilitation
2	Journal of Stroke and Cerebrovascular Diseases	57 (5.2)	4.3	0.713	0.893	Q1	Medicine: Rehabilitation
3	Topics In Stroke Rehabilitation	49 (4.4)	4.5	0.705	1.324	Q1	Nursing: Community and Home Care
4	Archives of Physical Medicine and Rehabilitation	43 (3.9)	6.2	1.062	1.696	Q1	Health Professions: Physical Therapy, Sports Therapy and Rehabilitation
5	BMJ Open	35 (3.2)	4.4	1.059	1.168	Q1	Medicine: General Medicine
6	Journal of Neuroengineering and Rehabilitation	35 (3.2)	8.8	1.134	1.924	Q1	Medicine: Health Informatics
7	Frontiers In Neurology	31 (2.8)	4.8	0.978	1.151	Q2	Neuroscience: Neurology
8	Clinical Rehabilitation	28 (2.5)	5.7	0.874	1.612	Q1	Health Professions: Physical Therapy, Sports Therapy and Rehabilitation
9	Stroke	26 (2.4)	12.9	2.746	2.734	Q1	Nursing: Advanced and Specialized Nursing
10	Neurorehabilitation and Neural Repair	23 (2.1)	7.2	1.306	1.573	Q1	Neuroscience: Neurology

Note: JCR, journal citation report; SJR, SCImago Journal Rank; SNIP, source normalized impact per paper.

Table 4. Top 10 journals publishing stroke patients' home exercise therapy research, from 2013 to 2023.

“activity of daily living” (42 occurrences; TLS 95), “quality of life” (40 occurrences; TLS 105), and “physical therapy” (32 occurrences; TLS 96).

In Figure 9B, the most recent appearance of the keywords is depicted. The keywords highlighted in yellow

represent the newest additions, including “telerehabilitation,” “telehealth,” “home-based,” “machine learning,” “home discharge,” “mirror therapy,” and “traumatic brain injury,” among others, while the purple keywords have been present for an extended period.

4. Discussion

4.1. Home exercise therapy for stroke: Global trends

As the first bibliometric study based on SCOPUS, we found that a total of 1493 articles worldwide have been published in the field of home-based exercise therapy for stroke patients between 2013 and 2023. The results indicate a significant increase in the past decade. Changes in the number of academic publications in a field serve as important indicators of emerging trends in that field.¹⁵

Journals discussing home-based exercise therapy for stroke patients have gained significant attention in the medical field. Cramer, S.C. is noted as one of the most productive researchers in this area, having published the highest number of articles on the topic. Additionally, the majority of the top 10 most productive authors and the top 5 institutions are from the United States, establishing the country as a leading center of productivity in this global research domain. According to Chen, Abel, Janecek, Chen, Zheng, and Cramer,²⁶ stroke stands as a primary cause of serious and long-term disability in the United States. This drives American researchers to continuously innovate in efforts to assist in the post-stroke recovery of patients at home.

According to the findings of Hammel, Magasi, Heine-mann, Gray, Stark, Kisala, Carlozzi, Tulsy, Garcia, and Hahn,¹⁷ titled "Environmental Barriers and Supports to Everyday Participation: A Qualitative Insider Perspective from People with Disabilities," it is the top-cited reference globally in this field. This research highlights the importance of understanding how environmental factors influence the participation of people with disabilities, particularly in the context of home-based exercise therapy for stroke patients. These factors include buildings, nature, assistive technology, transportation, access to information and technology, support and social attitudes, systems and policies, as well as economics. Therefore, a deep understanding of how these environmental factors affect the participation of people with disabilities in home-based therapy for stroke patients is crucial. This helps in designing effective and inclusive interventions, ensuring optimal rehabilitation outcomes.

4.2. Hot topic in research: Home exercise therapy for stroke

The co-occurrence network of keywords shows that "stroke," "rehabilitation," and "telerehabilitation" occur most frequently; thus, the subject of rehabilitating stroke patients remains among the top topics in the domain

of exercise for stroke. Based on Figure 9 out of 10 frequently occurring keywords, there are 5 keywords related to home exercise therapy programs for stroke patients: telerehabilitation, virtual reality (VR), exercise, occupational therapy, and physical therapy. This indicates that the differences in home exercise therapy programs for stroke patients have become a hot research topic in this field. The 3 research trends are as follows:

4.2.1. Telerehabilitation

Telerehabilitation, which started to acquire prominence in 2016, is one of the most utilized subdisciplines of telemedicine over the past decade. It involves the application of rehabilitation services through telecommunication technologies.²⁷ The advancement of technology is crucial in the rehabilitation of stroke patients.²⁸ In the context of home exercise therapy for stroke patients, telerehabilitation allows patients to receive guidance and supervision from healthcare professionals without having to visit medical facilities in person. Telerehabilitation may serve as an acceptable alternative for conventional rehabilitation for poststroke patients, particularly in geographically isolated or underserved regions.²⁹

Research has demonstrated that telerehabilitation effectively enhances the functional capacity of individuals recovering from stroke, leading to enhanced quality of life and a more rapid reestablishment of independence.³⁰ The most common indications for telerehabilitation treatment are neurological, cardiac, and musculoskeletal disorders. Online platforms, telemonitoring, and videoconferencing systems are the preferable telerehabilitation tools. The exercise regimens for the control and intervention groups were comparable in duration, spanning from 10 min to 30 min.³¹ Several studies employ different telerehabilitation models, ranging from mere telephone calls, video conferences, educational videos, web-based chats, to VR systems. Different studies have different rehabilitation program durations and medical staff follow-ups. The literature is lacking on whether telerehabilitation model or technology is best for these patients. Thus, future direct comparative investigations are advised.²⁹

This study highlights that telerehabilitation has emerged as an innovative approach in stroke rehabilitation, allowing patients to receive guidance and supervision from healthcare professionals without the need to visit medical facilities in person. This is particularly important for patients in remote or underserved areas. Direct comparisons between various telerehabilitation models are still needed to strengthen the evidence of its benefits.

4.2.2. VR

VR has emerged as a result of recent technological developments in rehabilitation. Through the use of interactive computer simulations, VR enables therapists to construct and modify workouts that could be risky, difficult, or expensive in traditional treatment. Furthermore, in comparison to conventional care rehabilitation, gamification components in VR therapy increase patient enthusiasm and compliance.³² The sense of presence in VR is another important feature that causes people to respond as though the environment was real, which stimulates their emotions and bodies. Additionally, this immersive experience may lessen pain during VR distraction by influencing how pain is perceived.³³

Telerehabilitation and home-based VR training can enhance postural balance in central neurological disease patients. Additionally, home-based VR and TR can supplement conventional therapy.³⁴ VR-assisted rehabilitation has a positive effect on the motor function of the upper and lower extremities, balance, gait pattern, and activities of daily living in stroke patients. The duration of VR intervention significantly influences several health benefits.³⁵

The researchers argue that the integration of VR into rehabilitation practices offers various benefits, ranging from better therapy customization to increased patient engagement, and improved treatment outcomes for various neurological conditions. Continued research and exploration in this domain are crucial for maximizing the potential of VR technology in rehabilitation settings.

4.2.3. Exercise

Various types of physical exercises, including aerobic, strength, flexibility, neuromuscular, and traditional Chinese exercises, offer significant benefits for stroke patients. Aerobic exercises aid in improving cardiovascular fitness, cognitive abilities, walking speed, balance, and quality of life among stroke survivors. Strength exercises enhance functionality, psychosocial aspects, and overall quality of life post-stroke, as recommended in national guidelines. Flexibility and neuromuscular exercises help alleviate muscle spasticity, improve motor function, and prevent contractures. Traditional Chinese exercises contribute to enhancing walking ability, balance, and muscle strength in stroke patients.³⁶

These findings can provide valuable insights for researchers interested in delving deeper into the trends and focus on home-based exercise therapy for stroke patients. By understanding the significant benefits of physical exercises, such as aerobic, strength, flexibility, neuromuscular, and traditional Chinese exercises, researchers

can further focus on developing and enhancing home-based exercise therapies for stroke patients. Therefore, this research can lay a strong foundation for further studies in this field, which is an integral part of the current research trends in stroke patient rehabilitation at home.

The innovations highlighted in this study, such as the use of telerehabilitation and VR in home-based exercise therapy, represent crucial advancements in improving accessibility and engagement for stroke patients. Telerehabilitation allows patients in remote areas to receive professional guidance, while VR enhances motivation through gamification. These technologies have the potential to significantly improve motor function, balance, and daily activities. Future research should focus on direct comparisons between different telerehabilitation models and the impact of VR to strengthen the evidence supporting these innovative therapies.

5. Strengths and limitations

This bibliometric analysis presents a comprehensive summary of the progress and patterns in exercise therapy at home for stroke patients over the last decade, using data from SCOPUS. We conducted a thorough bibliometric analysis using VOSviewer in our study. This analytical methodology enables the clarification of significant domains of scientific inquiry and the promotion of joint endeavors among nations, organizations, and writers. By conducting an impartial and thorough study of data, we have obtained valuable knowledge about the past and present state of this area. Furthermore, we have the confidence to make educated guesses about the limits of future research.

Nevertheless, this research is subject to many limitations. Initially, our literature search was limited to the SCOPUS database, which could lead to partial retrieval of literature. Furthermore, our analysis failed to accurately identify and distinguish the links among authors, regions, or countries, even though we specifically examined their collaborative networks. Furthermore, this study exclusively examined literature written in the English language. This strategy may fail to consider pertinent studies published in languages other than the one being focused on.

6. Conclusions

This study examined the nations, institutions, authors, journals, and keywords of research papers on home-based exercise therapy interventions for stroke patients published between 2013 and 2023. The findings indicate that there has been significant interest and consistent development in the field of home-based exercise therapy for stroke patients' therapies in the past 10 years. Research in this

field is concentrated in America, with the United States having extensive collaborative networks and numerous research institutions dominating the region. Other nations should enhance global collaboration and institutional alliances to foster additional progress. Most publications are in the field of medicine, and keyword analysis suggests further exploration of tele-rehabilitation, VR, and exercise, which are the current top trends.

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Ethical approval

Ethical issues are not involved in this paper.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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