

Original Paper

Visual Analysis of a Binary Study of Stroke Patients and Caregivers

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Chunping Ni and Haiyun Gai will handle correspondence at all stages of refereeing and publication.

Received: May 27, 2024

Accepted: June 24, 2024

Online Published: June 28, 2024

doi:10.22158/rhs.v9n3p17

URL: <http://dx.doi.org/10.22158/rhs.v9n3p17>

Abstract

Objective: To understand the current situation and trend of the research on stroke patients and caregivers, and to provide reference for researchers to broaden the research on stroke patients and caregivers. **Design:** The CiteSpace software was used to visually analyze 544 articles related to stroke patients and caregivers. **Methods:** CiteSpace software is a Java application that supports knowledge research, data visualization and literature database analysis. The following data were searched: title, abstract, year, keyword, author, academic institution. CiteSpace software was used for visual analysis of authors and institutions, keyword co-occurrence, keyword clustering and keyword emergence of the included literature. **Results:** A total of 544 articles related to stroke patients and caregivers were included, and the annual number of articles related to stroke patients and caregivers showed an increasing trend in the past 10 years. The top three institutions are from the UK, the US and the Netherlands, and the top three authors are from Italy and the US. The most common keywords were "quality of life," "depression," and "anxiety."

Keywords

stroke; A caregiver, Binary, CiteSpace, Visual analysis, bibliometrics

1. Introduction

In recent years, the incidence of stroke has shown an increasing trend year by year, and the disability rate and fatality rate have also been rising, resulting in various extreme psychological problems for patients and caregivers (Tiwari, Joshi, Rai, et al., 2021), which have seriously affected the physical and mental health and quality of life of patients and caregivers (Tu & Wang, 2023). With the changes of population structure and epidemiology, the social demand for medical care and health care has shown a growing trend, and the role of informal caregivers has become more prominent, and studies on them have been increasing (Bolgeo, De Maria, Vellone, et al., 2022). Studies have shown that people who assume long-term caregiving responsibilities are prone to caregiving burnout, which further reduces the quality of life of caregivers and leads to family conflicts (Guets & Perrier, 2021). Therefore, patients and caregivers should be regarded as a whole, and corresponding personalized intervention strategies should be implemented to help them better cope with stress and enhance their joint coping ability. A systematic review indicated that binary interventions can improve outcomes for stroke patients and caregivers (Bakas, McCarthy, & Miller, 2022). It can be seen that the binary coping of stroke patients has become the focus of current research. Visual analysis can effectively conduct in-depth correlation analysis of complex data, generate detailed analysis charts, help researchers quickly integrate information, reveal international research hotspots in the field, and promote the development of the field. At present, there are no studies using visual technology to conduct in-depth analysis of binary correlation studies between stroke patients and their caregivers. Therefore, in order to accurately extract key information and grasp the latest development trend of research in this field, This study decided to use CiteSpace visual analysis software to sort out and visually analyze the literature related to stroke patients and caregivers collected in the database, reveal the research hotspots and research trends in this field, and provide references for related studies.

2. Data Sources and Research Methods

2.1 Data SOURCES

We used the Web of Science and PubMed databases. The selected databases followed strict screening principles and adopted the expert review system. The literatures included had certain objectivity and could accurately reflect the level and quality of the papers.

2.2 Literature Search and Screening

Search the Web of Science and PubMed core databases for English articles containing the terms "stroke patient" and "caregiver OR carer OR Spouse caregiver OR dyadic OR minder". The search was conducted from January 2003 to December 2023. Select the type of literature for conference papers, dissertations, and journal reviews. A total of 5755 literatures were retrieved. After re-weighting, the researchers read all the literature titles and abstracts according to the research topic, and finally determined 544 literatures to be included.

2.3 Research Tool

CiteSpace5.7.R1 was used as the main research tool in this study. The parameters and indicators in this study are as follows: the time partition is set to 2003.1-2023.12, the time slice is set to 1, the threshold is set to top 50 or top 30, and the network clipping is selected as "pathfinding network" and "clipping network for each slice", and the output graph is clipped. With institutions, authors and keywords as nodes, the knowledge map of stroke patients and caregivers was constructed and analyzed.

3. Result

3.1 Trends in the Publication of Binary Studies of Stroke Patients and Caregivers

The trend of publication volume can reflect the degree of attention and dynamic development trend of this field in a certain period of time, and can help researchers predict the hot research direction in the future, as shown in Figure 1. From 2003 to 2023, the number of publications related to stroke patients and caregivers showed an increasing trend. The number of published papers tended to be stable from 2003 to 2014, and reached the first peak in 2015, with the annual number of published papers reaching 34; From 2016 to 2023, there was a decline, but the number of published documents was greater than that of 2014, showing an increase.

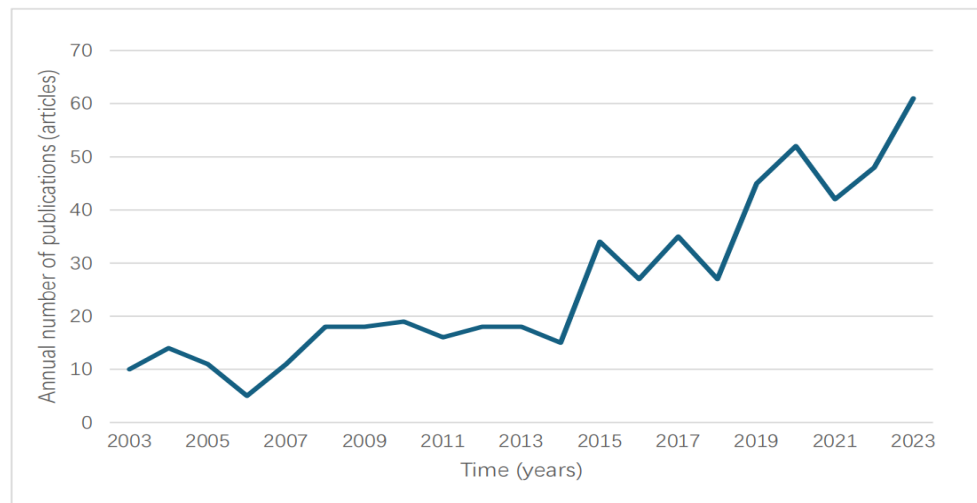


Figure 1. Trends in the Number of Published Studies on Stroke Patients and Caregivers from 2003 to 2023

3.2 Analysis of Study Authors and Institutions

A total of 586 nodes and 841 connections were generated by each institution, and the graph network density was 0.0089 and 0.0049 respectively, indicating that the correlation between the research institutions was not strong, and the cooperation relationship was weak. From the analysis of Table 1 and Figure 2, it can be seen that the top 10 research institutions had relatively little difference in the number of publications in the field of binary coping for stroke patients and their caregivers. It shows

that the scientific research strength in this field is more balanced, and the cooperation between research institutions is relatively weak. The ranking of the top 10 authors and institutions in the number of relevant research publications from 2003 to 2023 is shown in Table 1.

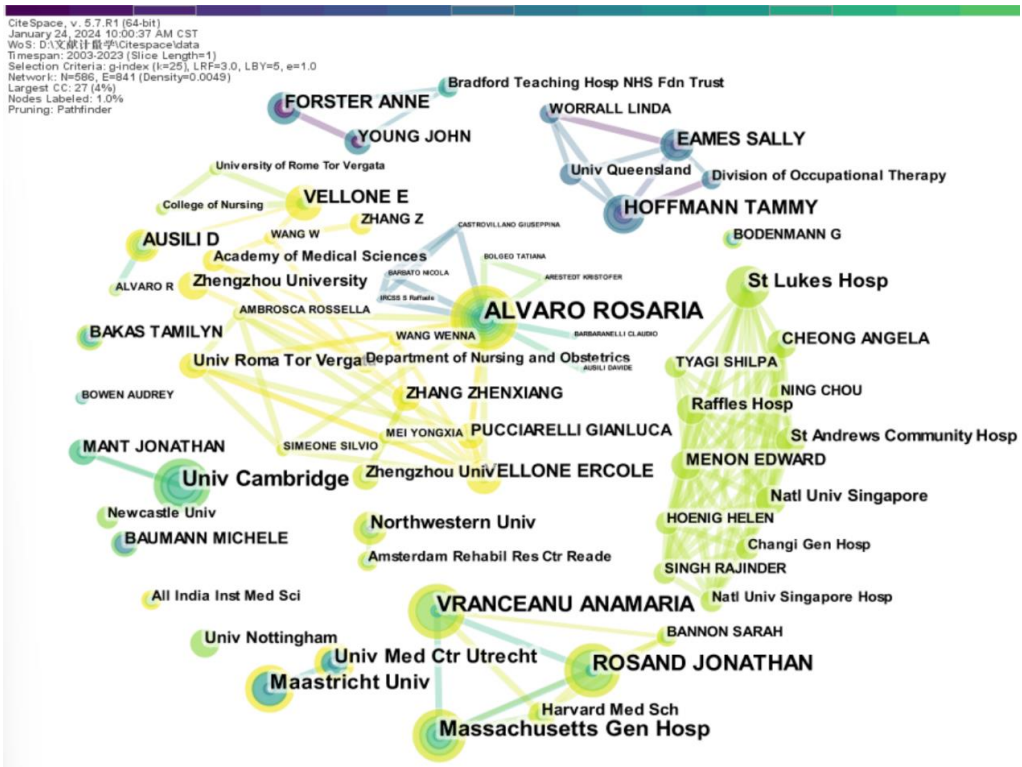


Figure 2. Visual Analysis of Authors and Institutions from 2003 to 2023

Table 1. Ranking of Authors and Institutions (Top 10)

Author			Institution		
Number of publications/articles	First publication time	Author	Name of organization	Number of publications/articles	
10	2011	ALVARO ROSARIA	Univ Cambridge	9	
8	2016	ROSAND JONATHAN	Massachusetts Gen Hosp	8	
8	2016	VRANCEANU ANAMARIA	Maastricht Univ	8	
6	2003	EAMES SALLY	Univ Queensland	6	
6	2004	HOFFMANN TAMMY	Northwestern Univ	6	
5	2017	AUSILI D	St Lukes Hosp	6	
5	2021	VELLONE E	Univ Med Ctr Utrecht	6	
5	2022	VELLONE ERCOLE	Univ Roma Tor Vergata	5	
5	2003	FORSTER ANNE	Changi Gen Hosp	5	
4	2016	MANT JONATHAN	Univ Florida	5	

3.3 Keyword Analysis

3.3.1 Keywords Collinear Analysis

In the keyword co-occurrence map, if the keywords appear more frequently in the research field, these keywords can reflect the development trend of the research field in a specific period to a certain extent (Chen, Chen, Hou, et al., 2009). The size of the node represents the number of times that the keyword appears in the literature and reports, the link of the node represents the connection between the keywords, and the thickness of the line represents the correlation degree of the keywords. In this study, synonyms were integrated, invalid keywords were removed, and the required keywords were finally obtained, as shown in Table 3 and Figure 3.

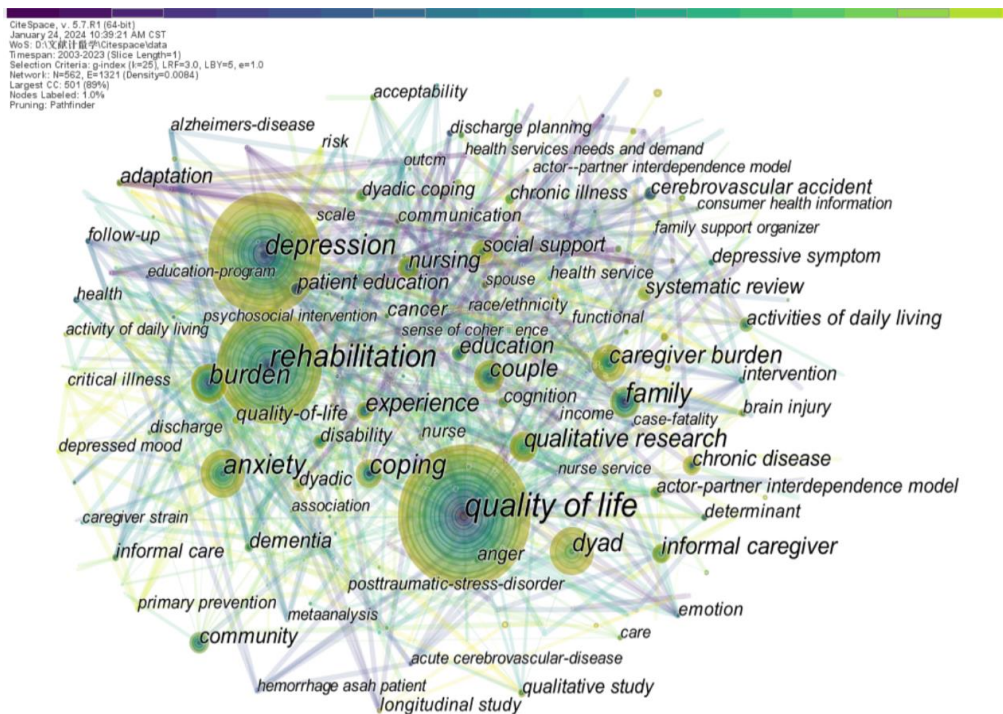


Figure 3. Collinear Analysis of Key Words from 2003 to 2023

Table 3. Frequency Table of Keywords in Binary Related Studies on Stroke Patients and Caregivers

Serial number	Keyword	frequency
1	quality of life	81
2	depression	69
3	rehabilitation	64
4	dyad	27
5	anxiety	27
6	burden	22

7	caregiver burden	21
8	family	18
9	couple	18
10	qualitative research	17
11	coping	16
12	social support	13
13	nursing	13
14	community	12
15	chronic disease	11
16	experience	10
17	education	9
18	disability	8
19	activities of daily living	8
20	systematic review	8

3.3.2 Key Words Cluster Analysis

Based on the keyword co-occurrence map, the LLR clustering algorithm was used for analysis. The results show that the clustering module values are as follows: $Q=0.7783 > 0.3$, $S=0.561 > 0.5$, indicating high reliability of the clustering results (Chen, Chen, Liu, et al., 2015), as shown in Figure 4. Finally, 15 effective clusters are formed, and the first 8 clusters are selected according to the sequence of cluster ids, namely #0acceptability, #1quality of life, #2carers, #3longitudinal study, #4dementia and #5remote consultation, #6dyadic coping, #7systematic review.

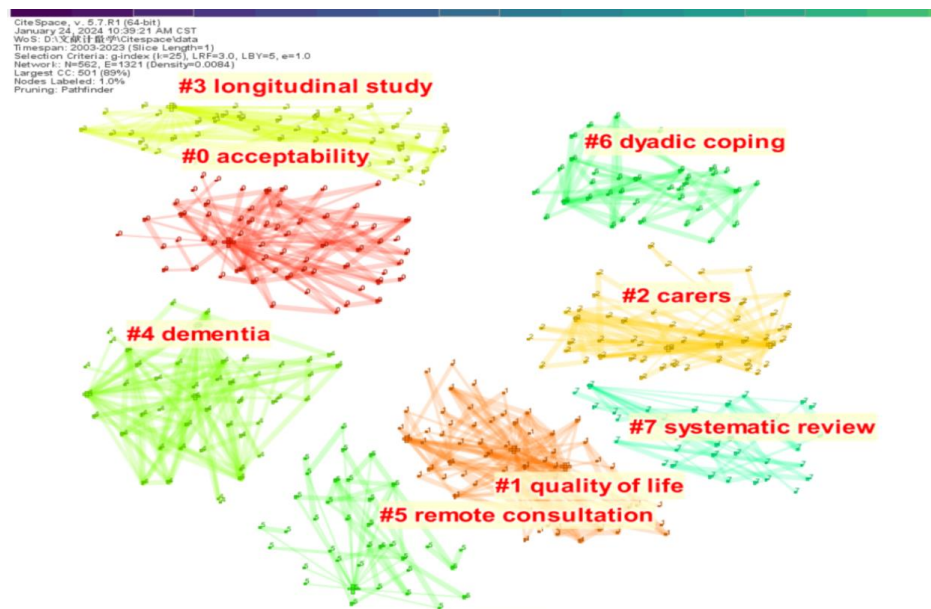


Figure 4. Cluster Analysis of Literature Keywords from 2003 to 2023

3.3.3 Keyword Emergence Analysis

The "burcontrol" option in CiteSpace software is used to screen out the keywords that changed significantly within a short time (Li, 2018). In this paper, the first 25 keywords are selected, as shown in Figure 5. As can be seen from Figure 5, the overall emergence intensity of keywords is large, but the difference between the emergence intensity of keywords is small. "carer" and "community" are the words with the highest emergence intensity and the longest emergence time, "carer" and "patient education" are the words with the earliest emergence time, and "systematic review", "dyad" and "social" "support", "chronic condition", "meta-analysis" and "rehabilitation medicine" will continue to emerge in 2023, which may become the focus and direction of future research.

Top 25 Keywords with the Strongest Citation Bursts

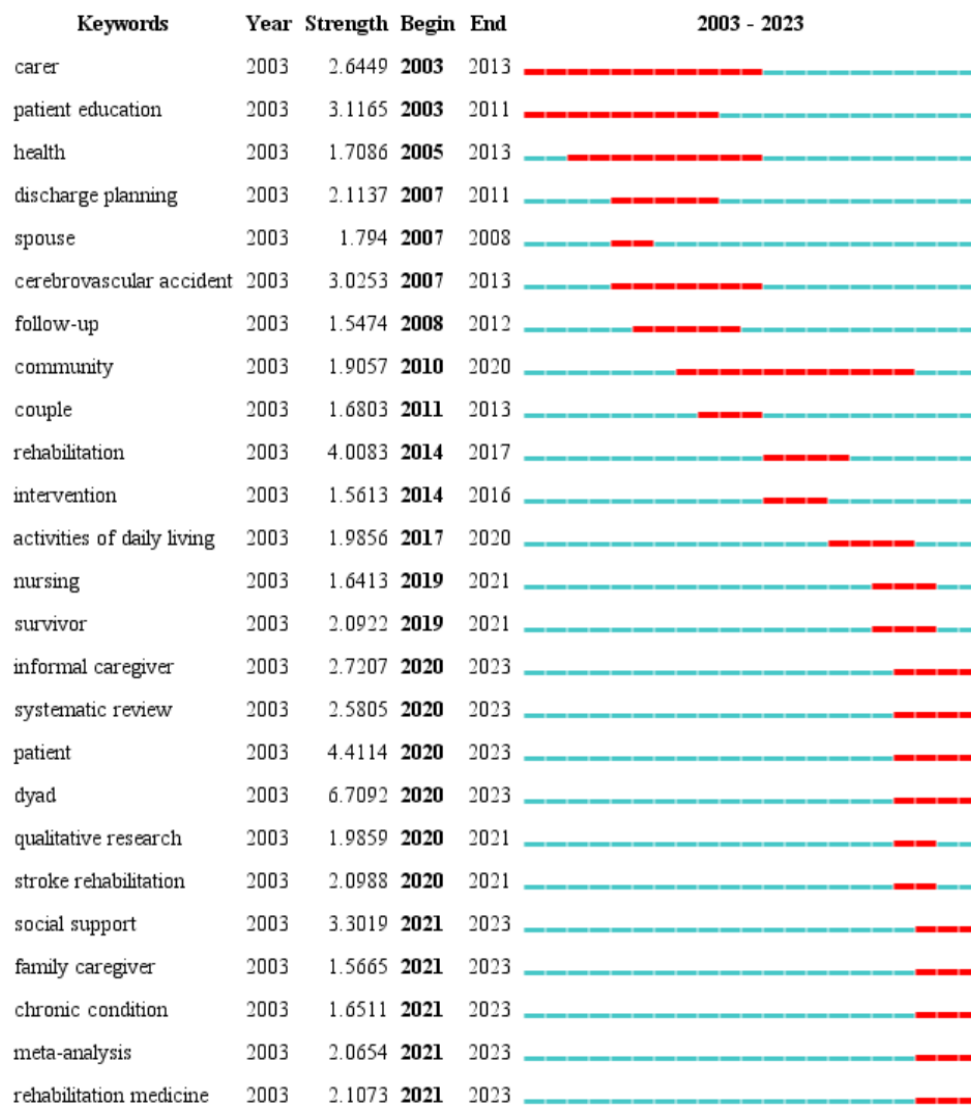


Figure 5. Starting and Ending Year and Intensity of Keyword Mutation

4. Discussion

4.1 Research Status of the Binary Correlation between Stroke Patients and Caregivers

From 2003 to 2023, the number of published papers in the field of binary research related to stroke patients and caregivers is generally on the rise, among which the top three authors are Alvaro Rosaria, Rosand Jonathan and Vranceanu Anamaria. Through analyzing the author-institutional cooperation graph, It is found that Alvaro has worked closely with many scholars and institutions, and his research mainly focuses on anxiety, depression and binary intervention of stroke patients and caregivers (Bartoli, Brugnera, Grego, et al., 2024; Bolgeo, De Maria, Vellone, et al., 2022; Pucciarelli, Lommi, Magwood, et al., 2021). However, Rosand and Vranceanu paid more attention to the impact of resilience on patients and caregivers (Bartoli, Mace, Bannon, et al., 2021; Bannon, Lester, Gates, et al., 2020; Meyers, Shaffer, Gates, et al., 2020), and the interaction between lifestyle factors and emotional distress (Lester, Fishbein, Higgins, et al., 2022). The top three institutions for publication are the University of Cambridge, Massachusetts General Hospital and Maastricht University, and these institutions are spread across the UK, the US and the Netherlands, with a fairly balanced research strength. The map shows that the cooperation among scholars is relatively weak, the international influence is limited, and the cooperation with other research institutions is relatively small, which indicates that there is still room for improvement in the research of various researchers in this field. The top 10 academic institutions are all located in developed countries, with US academics contributing the most. There are few high-quality papers from developing countries. To sum up, researchers in various countries and institutions should pay more attention to this field, use theories and previous studies to broaden research results in this field, provide reliable scientific data for this field, and promote the development of related research.

4.2 An Analysis of the Research Hotspot of Stroke Patients and Caregivers

Combined with keyword co-occurrence and keyword cluster association emergent words, the research hotspot of stroke patients and caregivers was summarized.

4.2.1 To Expand the Research on Stroke Patients and Caregivers

Since 2003, research in this field has mainly been carried out with the keywords of quality of life (Bartoli, Brugnera, Grego, et al., 2024; Lester, Mace, Bannon, et al., 2021), depression (Bartoli, Brugnera, Grego, et al., 2024), anxiety (Bartoli, Brugnera, Grego, et al., 2024), rehabilitation (Manzekele Bin Kitoko, Vivalya, Vagheni, et al., 2022), caring burden (Deepradit, Powwattana, Lagampan, et al., 2023), binary coping (Gu, Wang, Pei, et al., 2023), hemiplegia (Yuliana, Yu, Rias, et al., 2023), and daily living ability (Bosma, Nijboer, Caljouw, et al., 2020). Poststroke depression occurs after stroke and is manifested as a series of depressive symptoms and corresponding physical symptoms of the syndrome. It is a common complication after stroke, and its incidence increases year by year, up to 55% (Villa, Ferrari, & Moretti, 2018). After acute treatment, 17.1%-52.6% of stroke patients have limited activities (Ewing, Li, Chen, Gallis, Su, Turner, & Yan, 2023), and 50% of patients need follow-up rehabilitation at home after discharge (O'Dell, 2023). Spouses, family members, friends

or "significant others" of stroke patients provide daily life care, medication supervision, emotional support, functional exercise and other care contents during their home rehabilitation. These caregivers usually have no professional qualification training and do not need to be paid. This group is defined as informal caregivers of stroke patients (Mou, Lam, & Chien, 2023). Unlike other chronic diseases, stroke occurs suddenly and caregivers have little time to prepare and adapt to a new role. The shock brought by sudden illness, the uncertainty of the rehabilitation effect of patients and the long-term care burden lead to the psychological problems of caregivers. The deterioration of neuropsychiatric function in post-stroke depression has a great impact on the recovery of physical function and quality of life of stroke patients (Bartoli, Brugnera, Grego, et al., 2024; Lester, Mace, Bannon, et al., 2021). The prevalence of anxiety and depression among family caregivers of stroke patients is also relatively high, ranging from 27% to 60% (McCurley, Funes, Zale, et al., 2019). As an acute medical event, stroke has a significant impact on families, with about 59% of patients suffering from disability or hemiplegia (Li, Wu, Wang, et al., 2019), which promotes the need for rehabilitation and increases the burden of caregivers (Deepradit, Powwattana, Lagampan, et al., 2023). Therefore, researchers in various institutions attach great importance to the research in this field. However, there are still some defects in the research in this field, with a small number of literatures and relatively single keywords. Therefore, researchers should attach importance to this field, apply the latest theories and expand this field in combination with previous studies, in order to improve the quality of life of stroke families from a binary perspective, lay a foundation for the formulation of binary interventions, and enrich research achievements in this field.

4.2.2 Stroke Caregivers Have Greater Stress, Which Affects the Quality of Family Life

Clustering #1 quality of life, keyword collinear "burden" and "caregiver burden" have been the focus of research in this field. After the acute treatment of stroke patients and their condition is stabilized, about 75% of patients will have varying degrees of physical decline (Hu, Gao, Liu, et al., 2019). 75% to 80% of patients need to continue rehabilitation after discharge (Guo, Lu, Tian, et al., 2019). Unlike other chronic diseases, stroke occurs suddenly, patients and caregivers lack relevant knowledge, and caregivers often do not have sufficient time to adjust to the new role, leading to psychological problems. A systematic review of 12 studies indicated that the prevalence of depression and anxiety among caregivers of stroke patients was as high as 40.2% and 21.4%, respectively (Loh, Tan, Zhang, et al., 2017), which significantly affected the quality of life of stroke families. According to the research results of Indonesian scholar Yuliana et al., based on the analysis of the subject-object interdependence model, anxiety and depression symptoms of patients and caregivers will have an impact on their own and each other's overall quality of life (Yuliana, Yu, Rias, et al., 2023). Existing research has demonstrated the interplay between anxiety, depression and quality of life in stroke patients and caregivers. Therefore, stroke, as an acute medical event, requires the active response of the whole family. Scholars at home and abroad should pay more attention to the whole stroke family, so as to improve the quality of life of stroke families.

4.2.3 Stroke Patients and Caregivers Work Together to Address Challenges and Improve the Mental Health of Stroke Families

The clustering #6dyadic coping combined with the emergent word "social support" suggests that coping with stroke events requires stroke patients and caregivers to face this disease together. At present, the intervention for stroke families has achieved some results. One study showed that a family-centered dual psychoeducational intervention significantly improved coping styles, depression and anxiety symptoms, family functioning, and relationship among stroke survivors and their caregivers (Mou, Lam, & Chien, 2023). Zhang et al. further pointed out that dual psychosocial intervention can improve anxiety, depression, quality of life, self-efficacy and caregiver burden of stroke patients and caregivers (Zhang, Sha, Ma, et al., 2023). In addition, a nursing intervention based on the IKAP model improved the knowledge, beliefs and behaviors of stroke patients and improved the comprehensive care ability of caregivers (Tian, 2024). Therefore, in order to reduce the negative impact of stroke events on the whole family, comprehensive binary intervention should run through the whole stroke family.

5. Conclusion

At present, the prevalence of stroke is increasing and tends to be younger. In addition, nursing models such as extended care, community care and family care have become the mainstream, and the overall demand for caregivers has increased and higher requirements have been put forward for the quality of care (Zhang, Zhang, Zhao, et al., 2023). At present, most researches are conducted from the psychological aspects of anxiety and depression. It is suggested that scholars should broaden the research field and use the latest theories to study from multiple angles. In addition, the lack of cooperation among scholars in this field suggests that it is possible to share superior resources online, expand the research population, carry out relevant research in multiple centers, build systematic and targeted evaluation and intervention programs, and apply theories into practice to improve the quality of life of stroke families and their ability to cope with the disease.

Funding

This work was supported by the Research Project of "Clinical Medicine +X" Research Center, Air Force Medical University (LHJJ24HL02, LHJJ24HL07)

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