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Research status and progress of active health behavior in stroke patients

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Abstract: *Stroke is a disease with high disability and mortality rates worldwide, and its rehabilitation process depends not only on the acute treatment, but also on the long-term active health behavior management of patients. Active health behavior covers multiple dimensions such as exercise, diet regulation, medication compliance, psychological adjustment and social participation, which plays a key role in improving functional prognosis, reducing the risk of recurrence and improving the quality of life. Although the current research has clarified the definition and connotation of active health behavior, there are still some deficiencies in the systematic integration of influencing factors, the localized development of assessment tools, and the verification of long-term effects of intervention strategies. This paper systematically reviews the research status of the definition and connotation, influencing factors, assessment tools and intervention strategies of active health behavior in stroke patients. Combined with the latest evidence-based evidence, this paper analyzes the shortcomings of current research and future development directions, so as to provide a theoretical basis for clinical practice and health management.*

Keywords: *Stroke, Active health behaviors, Rehabilitation, Self-management*

1. Introduction

Stroke, a cerebrovascular disorder marked by high incidence, disability and recurrence, poses a global public health challenge in secondary prevention and rehabilitation. Conventional rehabilitation relies on hospital-based passive care, leaving patients as passive recipients with little initiative for self-disease management. Yet stroke rehabilitation is a long-term dynamic process. For discharged community and home-based patients, daily behavioral management—including regular medication, diet control, rehabilitation training and emotional regulation—directly determines functional recovery and recurrence risk. Thus, empowering patients to take charge of their health and shift from passive receivers to active self-managers is a core research focus in stroke rehabilitation. Centered on this idea, active health behavior highlights patients' dominant role in disease management via self-monitoring, goal-setting and consistent action. Chinese researchers have built a conceptual framework for stroke patients' active health behavior via qualitative studies, categorizing behaviors into three types: internal traits (health motivation, health accountability, mental wellness), routine lifestyle habits, and social behaviors (treatment adherence, social engagement, health information acquisition).They also confirm intervention factors like health awareness, self-control and resource access are critical to shaping such behaviors[1].

2. The connotation and theoretical basis of active health behavior in stroke patients

2.1 Definition and core dimensions of active health behaviors

Active health behavior refers to the behavior pattern that stroke patients actively adopt and maintain based on their own health needs in the process of disease management, which is helpful to promote rehabilitation and prevent recurrence. Its core characteristics include autonomy, goal-oriented and persistence, emphasizing the transformation of patients from "managed" to "self-manager"[1]. In the

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field of stroke, active health behavior usually covers multiple core dimensions. Physical activity is one of the important dimensions, and studies have shown that patients' confidence in their ability to perform rehabilitation behaviors (i.e., self-efficacy) directly affects their initiation and maintenance[2] of exercise. For example, one study found that feeling able to exercise and having a higher walking ability, For example, one study found that feeling able to exercise and being able to walk are key predic[3]tors of exercise adherence in patients with chronic stroke. Healthy eating, adherence to treatment (e.g., taking medication on time), and psychosocial adaptation (e.g., managing emotions, social engagement) are also important components[4] of active health behaviors. The intervention can improve the health behavior, medication adherence, blood pressure control and disability status of patients with hypertensive stroke, and the effects can last for 6 months[14] after discharge. These behaviors are motivated by the interaction of internal health beliefs and external support systems. And participating in daily life activities can better cope with the challenges following a stroke and enhance one's self-management skills [5].

2.2 Related theoretical models and their applications

Several theoretical models have been applied to explain and promote active health behaviors in stroke patients. Social cognitive theory suggests that self-efficacy is a key factor driving behavior. Studies have shown that stroke patients with high self-efficacy are more likely to adhere to exercise and medication management[6]. For example, one study found that self-efficacy is an important variable[7] to predict exercise compliance in stroke patients. Self-determination theory emphasizes the satisfaction of three psychological needs: autonomy, sense of competence and sense of belonging. When patients feel that rehabilitation behaviors are chosen rather than forced to be performed, they internalize them more and have better[8] long-term adherence. A study of a person-centered, self-directed rehabilitation intervention called Take Charge demonstrated that this intervention encourages a sense of purpose, autonomy, control and connection to others, Significantly improves the health-related quality of life of 12 months after stroke and independence[9] health belief model from disease threat awareness, behavior, benefits and barriers evaluation explanations for behavioral decision. The study found that patients with a clearer perception of the risk of recurrent stroke were more likely to initiate preventive behaviors[10]. One study showed that most hypertensive stroke patients misestimated their risk of recurrent stroke, Patients who accurately or overestimated their risk were less[11] likely to smoke. The comprehensive reminder system intervention based on the health belief model has been shown to directly and indirectly improve patients' health knowledge or health belief to improve their health behavior[12]. It has been widely applied in behavioral intervention for stroke rehabilitation [13], targeting patients with transient ischemic attack or mild ischemic stroke. A prospective study found that the fear experienced after the event significantly decreased over time. When self-efficacy and response levels were high, initiating direct intervention measures at the optimal timing after the event to support health-related behavioral changes resulted in better intervention effects.

2.3 The mechanism of the effect of active health behaviors on prognosis

Active health behavior can improve the prognosis of stroke through multiple ways. Regular physical activity promotes neuroplasticity, improves cardiopulmonary function, and reduces muscle wasting[14]. A randomized controlled trial found that stroke patients who participated in a Patient-directed activity program completed more daily steps during inpatient rehabilitation and, at 3 months after discharge, A healthy diet helps to[15] control blood pressure, blood lipids, and blood glucose, thereby reducing the risk[16] of recurrence. Medication adherence directly affects the effectiveness of secondary prevention. Nonadherent patients have a significantly increased risk of recurrence, and active monitoring of blood pressure and blood glucose can provide early warning of abnormal[17] conditions. A comprehensive reminder system based on the health belief model can improve patients' medication adherence and blood pressure control[18] psychosocial adaptation behaviors, such as actively seeking social support and participating in community activities, relieve depression and anxiety, improve cognitive function, and improve quality[19] of life. Stroke survivors see learning as a prerequisite for improving function and coping with uncertainty in rehabilitation. Participation in leisure or social activities can better adapt to post-stroke life[20]. In addition, active health behaviors may also indirectly affect the neural repair process through anti-inflammatory mechanisms. Although direct evidence is limited, the association of improved behavior with levels of inflammatory markers suggests this possibility. Studies have also shown that patients' self-care compliance has a direct impact on the change of left ventricular ejection fraction in patients with myocardial infarction, which provides a reference[21] for understanding the mechanism of behavior on cardiovascular and cerebrovascular

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prognosis. In summary, active health behaviors work together to affect the rehabilitation process and long-term prognosis of stroke patients through physiological, psychological and social mechanisms.

3. Analysis of influencing factors of active health behavior in stroke patients

3.1 Individual level factors

Age and gender are important demographic factors affecting active health behaviors of stroke patients. Studies have shown that younger patients and male patients often exhibit higher levels of physical activity, which may be related to their physical status and social role. However, female patients tend to be more proactive in diet management and psychological adjustment, which may stem from the traditional role of women in family health management. In contrast, older patients with multiple comorbidities, decreased physical performance, and cognitive decline had significantly[22] more difficulty implementing proactive health behaviors. In addition, a study of Korean patients with ischemic stroke found that type D personality (a personality trait that is susceptible to stress) was significantly associated with lower levels of health-promoting behaviors. In addition, a study on patients with ischemic stroke found that type D personality (a personality susceptible to stress) was significantly associated with lower levels of health-promoting behaviors. Patients with type D personality had higher scores on the modified Rankin scale at 3 months after stroke, suggesting that personality traits may regulate health behaviors[23] by affecting psychological state, which is the core driver or barrier factor of active health behaviors. Depression and anxiety can significantly weaken the behavioral motivation of patients, reduce their self-efficacy, and make it difficult for them to initiate and maintain healthy behaviors[24]. On the contrary, positive coping style and optimistic personality traits can help promote the initiation and persistence of healthy behaviors. Health literacy, that is, patients' understanding of stroke etiology, rehabilitation knowledge and drug effects, directly affects their behavioral decisions. Patients with low health literacy often misunderstand doctor's advice, ignore symptom warning and other problems, which hinder the implementation of active health behaviors

Disease severity is an objective limiting factor that determines the ability of stroke patients to execute active health behaviors. The degree of neurological deficit, as assessed by the National Institutes of Health Stroke Scale (NIHSS) score, was inversely associated with active health behaviors. Patients with severe disability are difficult to independently complete rehabilitation training, drug management and other health behaviors due to mobility limitation, cognitive impairment and aphasia, and often rely on the comprehensive support[25] of caregivers. A study based on latent profile analysis divided the health behaviors of people at high risk of stroke into three types: "positive inertia behavior", "active engagement behavior" and "adjustment and adaptation behavior". In addition, a latent profile analysis of stroke patients' health behavior decisions found that the number of comorbidities was an important factor[26] to distinguish the "passive and hesitant decision-making group" from the "active decision-making group". The more comorbidities, the more inclined the patients were to adopt the passive and hesitant decision-making mode[27]. The accumulation of disease burden will significantly reduce patient willingness and ability to actively participate in health management.

3.2 Social and environmental factors

Family support is an important guarantee for stroke patients to adhere to active health behaviors. Emotional support, supervisory reminders, and practical help from spouses and children, such as accompanying exercise and preparing a healthy diet, are the key external motivation for patients to maintain rehabilitation behaviors. A qualitative study found that the driving force of health promotion behavior in stroke patients with hemiplegia includes exogenous family support, and the level of family responsibility and family support directly affects the compliance behavior[28] of patients. On the contrary, family dysfunction can lead to a significant decline in behavior compliance. Health system factors are also critical. Health education by health care providers and frequency of follow-up after discharge significantly influenced patient behavior. Patients who lack professional guidance are more likely to give up rehabilitation behavior, and structured follow-up programs, such as home visit care, have been shown to be effective in improving secondary prevention compliance behavior[29] in stroke patients. Accessibility of community rehabilitation resources, such as geographic distance and cost of rehabilitation centers, also plays a key role. Socioeconomic status (SES) is an important structural factor affecting health behaviors. Patients with low income and education levels often have lower[30] levels of active health behaviors due to financial stress and limited access to information. However, high social support networks, such as patient groups and community activities, can to some extent fill

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this gap. The influence of cultural beliefs on health behaviors cannot be ignored. Under the influence of traditional concepts, some patients believe that "rest" is better than "activity", or they are overly worried about the side effects of drugs, thus reducing active behaviors. A study of Mexican Americans found that a culturally sensitive intervention implemented in a church-based setting was effective in promoting health behavior change, suggesting that intervention strategies must consider patients' cultural context and beliefs.

3.3 Behavioral phases and dynamic change factors

Active health behaviors after stroke are not static, but evolve dynamically over time. In the acute phase, due to the strong medical dependence of patients, their active behavior is mainly based on treatment compliance, such as taking medicine on time and cooperating with examinations. Into gradually after recovery, patients to self management, but common behavior volatility, often due to slow recovery or life stress and appear slack[31], according to a study health behavior decision after stroke can be divided into "passive hesitation decision group" and "active decision-making group," This classification reflects the difference[32] in behavioral decision-making patterns of patients at different stages. In the behavior maintenance stage, patients are faced with "burnout effect", and they give up behavior due to slow rehabilitation progress or life stress, at which time they need to maintain motivation through goal adjustment and positive feedback. For example, health education based on stage change model, by setting stage goals and maintaining long-term contact with patients, can effectively encourage patients to form and adhere to good self-management behaviors[33]. Recurrence events or complications may trigger behavioral remodeling. Some patients thus enhance health behaviors, while others give up because of frustration. A study has found that stroke recurrence (especially the late recurrence) associated with higher emergency medical services utilization rate, this could be due to experience recurrence in patients with enhanced risk consciousness, thus more proactive in seeking medical help[34] for this prompt intervention needs to focus on the key time node, such as after discharge, after recurrence, in order to provide support and guidance in a timely manner.

4. Assessment and intervention strategies for active health behaviors of stroke patients

4.1 Research progress of assessment tools

Accurate assessment of active health behaviors in stroke patients is the premise of developing effective intervention strategies. At present, assessment tools are mainly divided into two categories: general scale and disease-specific scale. General scale such as health promoting lifestyle scale (HPLP - II) and health behavior self-efficacy scale, is applied in the crowd stroke, but the item design is not aimed at the specific requirements of the stroke rehabilitation. For example, HPLP-II focuses on general healthy lifestyle, such as nutrition, interpersonal relationship and stress management, but fails to fully cover the specific rehabilitation behaviors of stroke patients, such as limb function exercise, swallowing training and fall[33,34] prevention. Therefore, these scales are difficult to reflect the dynamic changes and characteristics of rehabilitation behaviors of stroke patients comprehensively and sensitive.

To make up for the shortcomings of generic scales, researchers have developed disease-specific scales. Tools such as the Stroke Self-Management Behavior Scale (SSMBS) and the Stroke Behavior Change Scale (SBCS) have targeted to assess multiple dimensions such as medication adherence, exercise, diet control, and mood management. Their reliability and validity have been verified[17,35] in a number of studies. However, some items, especially those involved in complex motor function or fine activities, have limited applicability to patients with severe physical disability or cognitive impairment, which may lead to bias[36] in the assessment results. Therefore, it is necessary to select the appropriate assessment tool according to the specific degree of dysfunction of patients in clinical application.

In recent years, the development of objective measurement technology has provided a new way for the assessment of health behavior. Accelerometers and wearable devices can monitor patients' physical activity, step count and sleep quality in real time and continuously, which effectively compensate for possible recall bias and social expectation bias[20] in subjective reports (such as questionnaires). Meanwhile, electronic medicine boxes and mobile phone applications can objectively record patients' medication time and compliance. Providing reliable data for drug management [14], these technologies can offer more precise and dynamic objective indicators for evaluating the effectiveness of intervention measures. Despite the increasing abundance of assessment tools, the assessment of health behavior in

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stroke patients still faces many challenges. Firstly, patients are often accompanied by cognitive impairment (such as aphasia and unilateral neglect), which will seriously affect the accuracy and reliability of their self-assessment, so it is necessary to combine caregiver reports and clinical observation to make a comprehensive judgment[37]. Secondly, cultural differences will lead to misunderstanding of scale items in different populations. For example, the understanding of concepts such as "health responsibility" or "self-actualization" may vary with cultural background. Therefore, strict cross-cultural adaptation and reliability and validity testing are needed before cross-cultural application.

4.2 Theory-based intervention strategies

Theory-based intervention strategies are the core of promoting active health behaviors in stroke patients. Cognitive behavioral intervention aims to enhance patients' self-efficacy and behavioral planning through motivational interviewing, goal setting and problem solving training. For example, health care providers can work with patients to set specific weekly exercise goals (e.g., walk 15 minutes daily) and record completion, building behavioral habits and confidence[40] through progressively achieving smaller goals. This intervention strategy emphasizes changing patients' perceptions of illness and recovery to drive behavior change and has been shown to be effective in improving physical activity levels.

Self-management education programs are another important intervention strategy. Structured curricula, such as the Stroke Self-Management Program, systematically cover disease knowledge, symptom management, substance use, and emotion regulation. Studies have shown that such educational programs can significantly improve health behaviors, medication adherence, and[39] blood pressure control[41,43] in patients with stroke. However, the long-term effects of such educational programs need to be further explored.

Technology-assisted interventions, especially mobile health applications and virtual reality technologies, offer the possibility to break through the time and space limitations of traditional interventions. Rehabilitation apps can provide personalized exercise guidance, medication reminders, and health knowledge push, combined with remote video follow-up, so that patients can get continuous professional support[40] at home. Virtual reality technology can enhance patients' exercise motivation and participation through immersive and interesting training environment. Although these technologies show great potential, their effectiveness is limited by accessibility to the technology, patient digital literacy, and the need for initial setup and guidance from a professional.

Social support interventions emphasize the use of external resources to facilitate behavior maintenance. The establishment of patient mutual support groups and community rehabilitation networks, through experience sharing and peer motivation, can effectively alleviate the loneliness of patients and enhance their confidence[42] in rehabilitation. Family participation intervention, by training caregivers to become "health coaches", provides patients with continuous, daily supervision and emotional support[43], which is a multi-level linkage model, and combines professional medical support with family and community resources. It can help to build a supportive rehabilitation environment, so as to promote the long-term maintenance of health behaviors more effectively.

4.3 Intervention effects and future directions

Existing studies have shown that multi-component intervention strategies (i.e., combining education, skill training, social support, and/or technical assistance) are generally more effective than single strategies in promoting health behaviors among stroke patients. For example, a comprehensive reminder system based on the health belief model, which combines health education, a calendar manual, text messaging, and telephone follow-up, has significantly improved patients' health behaviors, medication adherence, and blood pressure control[14,18]. However, a common challenge is that the intervention effects are limited in duration, with most patients showing behavioral degradation at 6 months after the end of the intervention. This points to the need for longer-term follow-up and ongoing support strategies.

Personalized intervention is the inevitable trend of future development. Tailored intervention programs based on the stage of behavior change, personal preferences, and specific obstacles faced by patients are expected to improve the pertinence and efficiency of intervention. For example, for patients with low motivation level, motivational interviewing can be used to stimulate their intrinsic willingness to change[38]; For patients with high motivation, advanced training programs and more challenging

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goals[19] can be provided. Identifying subgroups of patients with different behavioral characteristics through latent class analysis and other methods, and designing differentiated interventions accordingly is the key to achieving precise intervention [47].

In order to cope with the challenges of behavior maintenance, long-term follow-up and "nudging" strategies are particularly important. Nudge means, such as regular text message reminders and reward mechanisms (such as point exchange), can continuously strengthen patients' health behaviors[14] without increasing their cognitive burden. In addition, a three-level linkage service model of medical-community-family should be integrated to ensure that patients can still receive continuous and accessible support after discharge. This model emphasizes the seamless[45] connection between professional guidance from the hospital, rehabilitation resources from the community, and daily supervision from the family.

There are still limitations in current studies, such as small sample size, short follow-up period, and lack of cost-effectiveness analysis[44]. In the future, large sample and multi-center randomized controlled trials are needed to verify the long-term effect and universality of different intervention strategies. At the same time, exploring the application of artificial intelligence in behavioral prediction and dynamic adjustment, such as predicting the risk of behavioral degradation by analyzing the data of wearable devices and automatically adjusting the intervention plan, will be a promising research direction[46]. In addition, health economic evaluation to clarify the cost-effectiveness of different intervention strategies is essential to guide clinical decision-making and resource allocation.

5. Conclusion

Active health behavior for stroke survivors has shifted from mere rehabilitation to the core of secondary prevention. Its four interrelated dimensions—physical activity, healthy diet, medication adherence, and psychosocial adjustment—form an interconnected system. Analyses grounded in social cognitive and self-determination theories show behavioral change is non-linear. It functions as a complex adaptive system shaped by dynamic interplay between personal cognition, social surroundings and behavioral phases. This explains why basic health education or single-target interventions rarely yield long-term outcomes: interventions stay ineffective if they fail to address self-efficacy, autonomy support and stage-specific demands. Assessment tools have shifted from subjective self-reports to objective tracking, yet two critical limitations remain: biased self-reports from cognitively impaired patients, and poor cross-cultural applicability of evaluation items. Future wearable tech paired with ecological momentary assessment can generate authentic real-time data, though over-reliance on technology risks undermining patients' independent decision-making. Triple combined interventions (cognitive behavioral therapy, self-management guidance, digital aids) deliver prominent benefits. Still unresolved issues include the cost efficiency of multi-measure programs and generalized applicability of personalized algorithms. No universal best intervention exists, as optimal approaches rely heavily on individual context. Simplified guidance plus home supervision works better for patients with severe cognitive deficits, while digital tools and peer support suit those with strong health literacy.

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