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Development of a Frailty Intervention Protocol Based on HAPA and HPM Theories for Older Adults with Stroke

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Abstract: This study developed a comprehensive intervention program for frail elderly stroke patients to provide evidence-based clinical nursing guidance. Guided by the Health Action Process Approach (HAPA) and the Health Promotion Model (HPM), the initial program was drafted by synthesizing literature evidence, integrating clinical experience, and considering patient needs, and was subsequently refined through two rounds of Delphi expert consultation. Consensus was reached among 16 experts, with an authority coefficient of 0.866, a *Kendall's W* of 0.314 ($P<0.001$) for item importance, and coefficients of variation ranging from 0 to 0.115. The finalized program consists of 3 first-level, 8 second-level, and 48 third-level items structured within a 3-month intervention cycle. The final program demonstrates strong content validity, practical feasibility, and relevance to patient needs, offering a valuable reference for alleviating frailty, improving emotional well-being and quality of life, and promoting health behaviors in this vulnerable population.

1. Introduction

Frailty is a multidimensional syndrome characterized by diminished physiological reserve across multiple systems, significantly elevating the risk of adverse health outcomes[1]. Among stroke survivors, the prevalence of pre-frailty and frailty is notably high, at 49% and 22%, respectively[2]. Frailty in this population is six times more common than in the general public and independently predicts poor clinical outcomes[3, 4]. Key risk factors include impaired daily activity, poor nutrition, and negative emotional states[3, 5-7]. Early identification and targeted intervention are thus critical to mitigate frailty progression. Interventions such as physical exercise, nutritional support, and psychosocial strategies have demonstrated efficacy in managing frailty in older adults[8-11]. Given its multidimensional nature, a systematic approach to intervention is essential[12]. However, an

integrated intervention protocol specifically for frail older stroke patients remains underdeveloped. To address this gap, this study integrates the Health Action Process Approach (HAPA) as the "vertical axis" to track behavioral stages (pre-intention, intention, action) and the Health Promotion Model (HPM) as the "horizontal axis" to provide multidimensional content at each stage[13, 14]. This dual-theory framework enables dynamic, individualized support tailored to the complex needs of older stroke patients—such as fluctuating motivation and multidimensional health deficits—guiding them effectively from intention to sustained action. The aim of this study is to develop a theory-driven frailty intervention protocol for older adult stroke patients, with the goal of alleviating frailty, enhancing quality of life, promoting health behaviors, and providing an evidence-based strategy to prevent or delay frailty in this vulnerable population.

2. Materials and Methods

2.1. Establish a research team

The multidisciplinary team of nine members, including specialists in neurology nursing, rehabilitation, psychology, and nutrition, was responsible for all stages of the program development—from literature review and initial drafting to expert consultation and finalization of the intervention.

2.2. Formulate a preliminary intervention plan for frailty in elderly stroke patients

A systematic literature search was performed using the keywords “frailty”, “stroke”, “older adults”, “HAPA”, and “HPM”. The search strategy combined subject headings and free-text terms in databases including Wanfang Data, VIP, CNKI, CBM, PubMed, Embase, and Web of Science from their inception up to June 2024. The inclusion criteria were: (1) studies focusing on frailty in older adult stroke patients; and (2) study types of clinical guidelines, expert consensuses, systematic reviews, and randomized controlled trials (RCTs). Studies were excluded if they were (1) duplicate publications, (2) not published in Chinese or English, or (3) for which the full text was unavailable.

Literature screening was independently performed by two researchers with formal training in evidence-based methodology. Any discrepancies were resolved through consultation with a third researcher to reach a final consensus on study inclusion and quality assessment. In cases of conflicting evidence, priority was given to evidence-based sources, high-quality studies, and domestic guidelines. Following the quality assessment, 14 articles were ultimately included, comprising 2 expert consensuses, 3 clinical guidelines, 2 evidence summaries, 2 systematic reviews, and 5 randomized controlled trials.

This study structured the intervention using the HAPA theory's three stages (pre-intention, intention, and action) and the HPM's six domains (health responsibility, physical activity, nutrition, stress management, interpersonal relationships, and self-actualization). This framework guides patients from initial uncertainty through intention formation to sustained action. Effective interventions from the literature were selected based on applicability to the Chinese context and this patient population. These were systematically mapped into the HAPA-HPM framework, resulting in a final protocol with three intervention perspectives for the pre-intention and intention stages, and two for the action stage—each addressing all six HPM domains.

2.3. Delphi Expert Consultation

The inclusion criteria for experts were: (1) over 10 years of work experience in neurology; (2) professional title at or above the intermediate level; (3) educational level of bachelor's degree or higher; (4) voluntary participation in the study; and (5) commitment to complete two rounds of the

Delphi survey.

A self-administered questionnaire was developed, comprising four sections: (1) an introduction outlining the study background, objectives, and significance; (2) demographic and professional characteristics of the experts; (3) a consultation form on the frailty intervention protocol for older stroke patients based on the HAPA theory and HPM, which included fields for "modification suggestions" and "additional items," with items rated on a 5-point Likert scale (from 1=very unimportant to 5=very important); and (4) an assessment of the experts' familiarity with and basis for their judgments.

From August to September 2024, the questionnaires were distributed and collected via email or WeChat. Following the first Delphi round, the research team collated and analyzed the data. Based on predefined criteria and expert feedback, questionnaire items were revised to develop the second-round survey. After the second Delphi round, the protocol was further refined according to expert suggestions. The criteria for item retention were a mean importance score >3.50 and a coefficient of variation <0.25.

2.4. Data Processing and Analysis

Data were managed and analyzed using Excel and SPSS 26.0. Continuous variables were expressed as mean ±standard deviation, and categorical variables as frequencies (percentages). Expert engagement was assessed by questionnaire response rate (≥70% considered acceptable). Expert authority was quantified by the authority coefficient (*Cr*≥0.70 indicating acceptable consensus). Expert agreement was evaluated using *Kendall's W* coefficient and coefficient of variation, with statistical significance set at $P<0.05$.

3. Results

A total of 16 experts completed both rounds of the Delphi consultation. They were aged 38-53 years (mean 44.38 ± 3.90) with 10-33 years (mean 22.50 ± 6.52) of professional experience. The panel consisted of 11 senior, 4 associate senior, and 1 intermediate-level professionals; 4 held doctoral degrees, 8 master's degrees, and 4 bachelor's degrees. The expert disciplines included cerebrovascular nursing (*n*=8), neurorehabilitation (*n*=3), nursing education (*n*=2), nursing psychology (*n*=2), and nutrition (*n*=1).

Table 1: Findings from Expert Consultation on Frailty Intervention Protocols for Elderly Stroke Patients.

Indicator	Importance Score ($\bar{x} \pm s$)	CV
1 Precontemplation Stage	5.000±0.000	0.000
1.1 Risk Perception	4.938±0.250	0.051
1.1.1 Health Responsibility: Provide personalized education on stroke, frailty, and health responsibilities based on the patient's comprehension level.	4.875±0.342	0.070
1.1.2 Exercise: Highlight the risk of frailty from inadequate physical activity.	4.438±0.512	0.115
1.1.3 Nutrition: Explain the potential risk of frailty linked to poor nutritional status.	4.875±0.342	0.070
1.1.4 Stress Coping: Explain the potential health risks resulting from ineffective stress management.	4.438±0.512	0.115
1.1.5 Interpersonal Relationships: Educate family members on the positive impact and potential barriers of interpersonal relationships on rehabilitation to optimize family support.	4.875±0.342	0.070
1.1.6 Self-Actualization: Facilitate patient participation in dedicated seminars to encourage expression of concerns, promote experience sharing, and foster self-actualization.	4.813±0.403	0.084
1.2 Outcome Expectation	4.625±0.500	0.108
1.2.1 Health Responsibility: Explain the potential positive outcomes of understanding stroke,	4.500±0.516	0.115

frailty, and their interconnection.		
1.2.2 Exercise: Emphasize the role of physical activity in managing post-stroke frailty.	4.938±0.250	0.051
1.2.3 Nutrition: Explain the key role of adequate nutrition in managing post-stroke frailty.	4.438±0.512	0.115
1.2.4 Stress Coping: Emphasize to patients and families the importance of emotional regulation and its positive impact on recovery and prognosis.	4.875±0.342	0.070
1.2.5 Interpersonal Relationships: Explain the positive effects of harmonious family and social relationships.	4.938±0.250	0.051
1.2.6 Self-Actualization: Present successful outcomes of this intervention in other health domains and invite patients with positive prognoses to share experiences.	4.375±0.500	0.114
1.3 Action Self-Efficacy	4.938±0.250	0.051
1.3.1 Health Responsibility: Enhance motivation for rehabilitation through knowledge dissemination, building the patient's confidence in understanding the link between stroke and frailty.	4.875±0.342	0.070
1.3.2 Exercise: Build patient confidence to overcome barriers (e.g., lack of time, low energy) and adhere to regular exercise.	4.438±0.512	0.115
1.3.3 Nutrition: Build patient self-efficacy for maintaining daily nutrition.	4.875±0.342	0.070
1.3.4 Stress Coping: Increase patient confidence in effectively implementing and sustaining stress management strategies.	4.438±0.512	0.115
1.3.5 Interpersonal Relationships: Foster a sense of belonging and self-identity through WeChat groups, encouragement of social activities, and family companionship, thereby enhancing self-efficacy.	4.875±0.342	0.070
1.3.6 Self-Actualization: Guide patients to view rehabilitation positively. Use case studies and peer exchanges to help maintain confidence through setbacks, framing recovery as a growth opportunity.	4.438±0.512	0.115
2 Contemplation Stage	5.000±0.000	0.000
2.1 Action Planning	4.688±0.479	0.102
2.1.1 Health Responsibility: Reinforce the patient's role as the primary agent in their recovery and educate on core prevention knowledge for stroke and frailty.	4.938±0.250	0.051
2.1.2 Exercise: Collaboratively develop a personalized exercise plan based on risk assessment. The plan includes aerobic, balance, flexibility, and resistance training, with a frequency of ≥3 times/week, 40 minutes/session, intensity starting from 40% 1RM and progressively increasing to 80%. Instruct the patient to log exercise adherence.	5.000±0.000	0.000
2.1.3 Nutrition: Collaboratively develop a personalized dietary plan based on nutritional and swallowing assessments. Adhere to "Dietary Guidance for Stroke Patients," ensure protein intake (1.0-1.5 g/kg/day), recommend a Mediterranean diet, supplement with Vitamin D and calcium if needed, and adjust food texture based on swallowing function. Instruct the patient to log food intake and monitor relevant indicators.	4.938±0.250	0.051
2.1.4 Stress Coping: Guide patients in time management, participation in enjoyable recreational activities, and learning techniques for emotional regulation and cultivating a positive mindset.	4.375±0.500	0.114
2.1.5 Interpersonal Relationships: Assist patients in identifying support resources and train them in effective communication and clear expression of their needs.	4.875±0.342	0.070
2.1.6 Self-Actualization: Collaboratively set clear rehabilitation goals with the patient and define their specific roles and tasks within the action plan.	4.875±0.342	0.070
2.2 Coping Planning	5.000±0.000	0.000
2.2.1 Health Responsibility: Guide patients to establish adherence awareness, strictly follow the personalized rehabilitation plan, and avoid arbitrary modifications or interruptions.	4.375±0.500	0.114
2.2.2 Exercise: Collaboratively develop strategies to overcome exercise barriers (e.g., fall prevention) by encouraging family/peer support and WeChat group check-ins.	4.875±0.342	0.070
2.2.3 Nutrition: Assist patients in identifying specific barriers to adequate nutrient intake and develop coping strategies, such as choosing easily digestible foods.	4.938±0.250	0.051
2.2.4 Stress Coping: Guide families to supervise behaviors using prompts (e.g., alarms, reminder cards), and arrange access to professional counseling to address negative emotions.	4.438±0.512	0.115
2.2.5 Interpersonal Relationships: Consistent encouragement from families and clinicians reinforces the patient's capability to overcome obstacles and promotes engagement in online social activities.	4.875±0.342	0.070
2.2.6 Self-Actualization: Collaboratively identify barriers to interests and goals, developing	4.875±0.342	0.070

adaptive strategies like exploring suitable new hobbies.		
2.3 Maintenance Self-Efficacy	4.625±0.500	0.108
2.3.1 Health Responsibility: Review the personalized action plan with the patient, address questions, and ensure understanding and agreement.	4.438±0.512	0.115
2.3.2 Exercise: The researcher disseminates knowledge on exercise rehabilitation for patients with stroke and frailty weekly within the group to enhance awareness.	4.875±0.342	0.070
2.3.3 Nutrition: Share content related to nutritional support for stroke and frailty patients regularly in the group to reinforce dietary management awareness.	4.500±0.516	0.115
2.3.4 Stress Coping: The researcher addresses patient inquiries primarily, escalating to online multi-disciplinary team meetings (e.g., with physicians, physiotherapists, psychologists) when necessary.	4.875±0.342	0.070
2.3.5 Interpersonal Relationships: Guide patients in building a sustained social support network. Train family members on providing positive feedback, acknowledging the patient's efforts and progress.	4.500±0.516	0.115
2.3.6 Self-Actualization: Collaboratively clarify the patient's specific goals and roles within the action plan to enhance engagement and execution focus.	4.938±0.250	0.051
3 Action Stage	5.000±0.000	0.000
3.1 Action	5.000±0.000	0.000
3.1.1 Health Responsibility: Promote sustained plan adherence through WeChat check-ins.	4.500±0.516	0.115
3.1.2 Exercise: Reinforce guidance on exercise techniques and teach patients self-monitoring to prevent adverse events from overexertion.	4.938±0.250	0.051
3.1.3 Nutrition: Regularly assess the patient's nutritional status and promote adherence to the established personalized dietary plan to facilitate adequate nutritional intake.	4.875±0.342	0.070
3.1.4 Stress Coping: The researcher sends time-phased daily rehabilitation goals to the patient, checks completion in the evening, and provides guidance and supervision.	4.313±0.479	0.111
3.1.5 Interpersonal Relationships: Organize weekly online peer exchange meetings and provide additional communication opportunities to reduce feelings of loneliness and social isolation.	4.875±0.342	0.070
3.1.6 Self-Actualization: Provide necessary skill training to help patients overcome competency barriers. Encourage participation in community and social groups to expand support networks.	4.875±0.342	0.070
3.2 Recovery Self-Efficacy	4.500±0.516	0.115
3.2.1 Health Responsibility: Patients and families jointly monitor to ensure sustained health behaviors and make timely adjustments when issues arise.	4.375±0.500	0.114
3.2.2 Exercise: Start with low intensity and frequency based on the patient's condition and interests, gradually increasing the exercise load to avoid injury or frustration from overexertion.	4.938±0.250	0.051
3.2.3 Nutrition: Acknowledge positive dietary changes made by the patient, reinforcing the value of these behaviors. Encourage shared meals with family/friends to enhance support and motivation.	4.375±0.500	0.114
3.2.4 Stress Coping: Teach patients strategies for coping with plan interruptions and setbacks (e.g., social support, mindfulness). Guide them in keeping a health behavior diary and regularly evaluating progress.	4.875±0.342	0.070
3.2.5 Interpersonal Relationships: During execution lapses, clinicians and family should provide prompt support to facilitate plan resumption and rebuild self-efficacy.	4.438±0.512	0.115
3.2.6 Self-Actualization: Provide timely praise and share feelings with the patient. Analyze reasons for setbacks together and adjust strategies, such as offering additional skill training or social support.	4.938±0.250	0.051

Two rounds of Delphi consultation were completed by 16 experts. Both rounds achieved a 100% questionnaire return rate. In the first round, 12 experts provided modification suggestions, while 3 experts offered recommendations in the second round. The judgment coefficient (*Ca*) was 0.925, familiarity coefficient (*Cs*) was 0.806, and the resulting authority coefficient (*Cr*) was 0.866. In both Delphi rounds, the mean importance scores for all items ranged from 4.31 to 5.00. The coefficients of variation (*Cv*) were 0.000-0.186 in the first round and 0.000-0.115 in the second round. The *Kendall's W* coefficients were 0.197 for the first round and 0.314 for the second round ($P<0.001$).

Based on expert suggestions from both Delphi rounds, statistical requirements of the method, and clinical feasibility, revisions were made through panel discussions. After the first round, six third-level items were modified and two first-level items were added. Following the second round, two third-level items were revised. The final intervention protocol comprised three first-level items, eight second-level items, and forty-eight third-level items, see Table 1.

4. Discussion

Improving rehabilitation adherence is crucial for enhancing outcomes in older adult stroke patients, yet this population often demonstrates suboptimal adherence[15]. The scientific rigor of this protocol is reflected in three key aspects: (1) the integration of HAPA and HPM theories to incorporate essential behavior-change elements; (2) the synthesis of evidence-based findings through systematic review; and (3) comprehensive coverage of the entire behavioral transition process from intention formation to maintenance. This approach facilitates the shift from passive reception to active engagement in rehabilitation, thereby strengthening motivation and adherence. Further refined through two rounds of Delphi expert consultations, the protocol embodies professional consensus and integrates theoretical foundation, empirical support, and expert endorsement, providing a scientifically sound and clinically applicable intervention framework.

This study developed a frailty intervention protocol for older stroke patients to address the scarcity of personalized rehabilitation approaches in China. Its key innovation is the integration of the HAPA and the HPM. HAPA explains the dynamic process of health behavior change, while HPM provides a structured framework covering multiple health promotion domains. This combined approach addresses both the mechanisms of behavior change and the content areas of health promotion. The resulting protocol emphasizes personalized assessment and multidisciplinary support, providing continuous care during hospitalization and early post-discharge to facilitate behavioral changes and enhance active patient engagement. This design systematically addresses the core challenges of low participation and poor adherence in rehabilitation, offering a scientifically sound and practical approach to frailty management.

The protocol dynamically addresses patients' rehabilitation motivation across different stages while incorporating multidimensional factors such as cultural background, psychosocial status, and physical function to deliver personalized interventions[16]. It employs a multidisciplinary team (MDT) approach where nurses serve as central coordinators, responsible for health assessment, patient education, behavior monitoring, and follow-up, requiring specialized rehabilitation knowledge for accurate implementation[17]. This theoretically grounded, evidence-based protocol enhances nurses' capability in assessing frailty and managing behavioral changes while optimizing their role in multidisciplinary care. It provides an effective approach to improving frailty, quality of life, and rehabilitation outcomes in older stroke patients, contributing significantly to healthy aging and demonstrating nursing's professional value.

5. Conclusions

This study developed a frailty intervention protocol for older stroke patients using the HAPA model and Delphi method. The protocol demonstrates strong validity and provides clinical guidance, with future studies needed to evaluate its effects on frailty, function, and quality of life to facilitate implementation.

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