Association between chronic illness resources and health behaviors in hypertensive stroke patients at 6 months after discharge: a cross-sectional study

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Background: The adoption of appropriate health behaviors can prevent the recurrence of stroke. Previous research found a downward trend in hypertensive stroke patients' health behaviors from 3 to 6 months after discharge. The provision of appropriate support by chronic illness resources has been shown to predict patients' engagement in appropriate health behaviors in other chronic illness populations. This study sought to explore the association between chronic illness resources and health behaviors in hypertensive stroke patients in order to provide a foundation for the secondary prevention of stroke.

Methods: Using convenience sampling method, we enrolled 133 hypertensive stroke patients at 6 months after discharge in Guangzhou, China. All the patients completed a demographic and disease-specific questionnaire, the Health Behavior Scale for Stroke Patients (HBS-SP) and the Chronic Illness Resources Survey (CIRS). A multiple stepwise regression analysis was conducted to test the association of chronic illness resources with health behaviors.

Results: The total scores of the HBS-SP and CIRS were (2.89±0.38) and (2.94±0.66), respectively. The correlation coefficient for chronic illness resources and health behaviors was 0.517 (P<0.001). The positive association between chronic illness resources and health behaviors remained statistically significant after controlling for gender, education level, and the Barthel Index (unstandardized coefficient: 0.317, P<0.001).

Conclusions: The chronic illness resources has positive association with health behaviors in hypertensive stroke patients at 6 months after discharge. A good support provided by chronic illness resources may contribute to promote positive health behaviors, and thus prevent the recurrence of stroke.

Keywords: Health behaviors; health resources; stroke; hypertension

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Introduction

As the leading cause of death and disability in China, stroke creates a huge disease burden for both the government and patients (1). Ischemic stroke has been reported to account for 83.3% of all stroke cases in China (2). Hypertension is the cause of 55.5% of the global burden, which is caused by stroke, and can lead to a poor prognosis for stroke patients (3,4). In China, 64.3% of stroke patients have a history of hypertension before stroke onset (2). The chronic phrase of a stroke refers to the period of recovery that takes place at least 6 months after the stroke (5). In the chronic phase, >30% of stroke patients have different degrees of dysfunction (6). Thus, during this time, it is imperative that the recurrence of stroke be prevented and patient rehabilitation be promoted.

As a major component of the secondary prevention of stroke, appropriate health behaviors can help stroke patients manage controllable risk factors, thereby preventing stroke recurrence (7). However, the health behaviors of stroke patients are suboptimal, and only a portion of stroke patients make lifestyle changes after discharge (8). During the chronic phase, stroke patients' symptoms tend to stabilize, their recovery process slows down, and they receive less attention (9). Furthermore, stroke patients are likely to lose part of the support provided to them and their adherence to health behaviors also tends to decrease in the chronic phase (10). It is worth noting that hypertensive stroke patients' health behaviors are suboptimal before stroke, improve significantly during the first 3 months of the stroke, but decrease 3 to 6 months after discharge (11). Fortunately, the provision of good support by chronic illness resources has been shown to predict patients' engagement in appropriate health behaviors in patients with diabetes and coronary heart disease (12,13).

Under the pyramid model of social-ecological support resources, chronic illness resources are defined as support for health behaviors and chronic disease self-management from a variety of sources, such as healthcare providers, friends, media, community, health policies, and organizations (14). Liu *et al.* (15) found that the provision of support by chronic illness resources were unsatisfactory in patients with initial stroke. Meanwhile, Patients with diabetes and coronary heart disease were not adequately supported by chronic illness resources (12,13). Chronic illness resources consider support from other sources besides social support. Understanding the chronic illness resources of patients can be more likely to support their behavior change. To date, health behaviors of hypertensive stroke patients had a downward trend from 3 to 6 months after discharge. However, very few studies have been conducted on the chronic illness resources of hypertensive stroke patients. The association between chronic illness resources and health behaviors in hypertensive stroke patients at 6 months after discharge is unclear and deserves further research.

This study sought to investigate chronic illness resources and its association with health behaviors in hypertensive stroke patients at 6 months after discharge. The results provide a foundation for the secondary prevention of stroke and the provision of appropriate support to hypertensive stroke patients in the chronic phase by chronic illness resources. We present the following article in accordance with the STROBE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1193/rc).

Methods

Design

A cross-sectional descriptive study was conducted. A convenience sampling method was used for this study.

Study methods

Sample

Potential participants who had been hospitalized 6 months previously were contacted by telephone to determine their eligibility to participate in this study. All the participants returned to the Neurology Departments for follow-up visits at 6 months after discharge. Information regarding employment status, household income, living arrangements, chronic illness resources, and health behaviors was gained in face-to-face visit. Some of potential participants were excluded due to their health condition. Therefore, the use of convenience sampling method is necessary. A total of 133 participants were recruited and completed the questionnaires at 2 tertiary hospitals, the Third Affiliated Hospital of Sun Yat-Sen University and Guangdong Provincial Hospital of Traditional Chinese Medicine, in Guangzhou, China. The sociodemographic and disease-specific characteristics of the participants were collected from the hospital information system. To be eligible for inclusion in the study, patients had to meet the following inclusion criteria: (I) have had an ischemic stroke (Diagnosed by a physician of neurology and further confirmed by computed tomography or magnetic resonance imaging results); (II) have a history of hypertension (16); (III) have

had stroke onset six months ago, and have had returned to the clinic after discharge; and (IV) have provided informed consent. Patients were excluded from the study if the met the following exclusion criteria: (I) had Wernicke aphasia; (II) had a history of severe liver or kidney disease, or a malignant tumor; and/or (III) had severe cognitive impairment.

The sample size was calculated based on the sample size calculation formula ($N = \dfrac{(Z_{\alpha/2} + Z_{1-\beta})^2}{1/4\left[\log\left((1+r)/(1-r)\right)\right]} + 4$) (17). The previous study found that correlation coefficient between chronic illness resources and self-management in patients with coronary heart disease was 0.411 (12). With a power of 0.80 and α error of 0.05, the minimum sample size for the study had to be 87.

Measures

The data were collected from all participants at 6 months after discharge.

Sociodemographic and disease-specific characteristics

Sociodemographic characteristics and disease-specific characteristics were collected through self-designed questionnaire. The sociodemographic characteristics included gender, age, marital status (with spouse *vs.* no spouse), education level (elementary school, middle school, high school, undergraduate school), method of medical payment (self-paid, medical insurance, free medical care), employment status (employed, retired, unemployed), household income (<2,000, 2,000–, 3,000–, 4,000–, 5,000–; yuan), and living arrangements (living alone *vs.* living with family). The disease-specific characteristics included the recurrence of stroke (no *vs.* yes), the duration of stroke (<1 *vs.* 1–30; year), and the duration of hypertension (<1, 1–, 5–, 10–30; year), the Barthel Index (severe dependency, moderate dependency, slight dependency, functional independence), and the chronic disease status (yes *vs.* no). The patients' diagnoses were determined from their medical records.

CIRS

Developed by Glasgow *et al.* (14), the Chronic Illness Resources Survey (CIRS) is used to evaluate patients' perceptions of the support for health behaviors provided from multiple sources. Zhong *et al.* (18) translated and modified the CIRS into Chinese. The Chinese version of the questionnaire comprised 19 items for 6 subcategories (i.e., physician/health care team, family and friends, personal, neighborhood/community, media and policy, and organizations). The CIRS uses a 5-point Likert scale

rating on which 1 represents "not at all" and 5 represents "a great deal". The total score of subcategories and the CIRS was calculated separately by computing the means of subcategories items and scale items. A higher total score indicates better support from the chronic illness resources; a score <3 indicates that the provision of support by chronic illness resources was unsatisfactory. Cronbach's alpha coefficient for the CIRS in this study was 0.848.

Health behavior scale for stroke patients (HBS-SP)

The HBS-SP was developed by Wan *et al.* (19) based on the Chinese version of the Health Promotion Lifestyle Profile-II. The scale is a self-reporting scale with 6 subcategories (i.e., exercise, medication adherence, guideline adherence, nutrition, health responsibility, and smoking and alcohol abstinence). The HBS-SP comprise 25 items in total. The HBS-SP uses 4-point Likert scale, on which a rating of 1, 2, 3 and 4 points indicate never, sometimes, often, and usually, respectively. The "medication adherence" and "smoking and alcohol abstinence" subcategories are reverse scored. A higher total score indicates better health behaviors. The average score of the scale is calculated, and an average score for each subcategory <2 indicates low-level health behaviors, a score of 2–3 indicates medium-level health behaviors, and a score >3 indicates high-level health behaviors. Cronbach's alpha coefficient in this study was 0.833.

Statistical analysis

The data were analyzed using SPSS version 20.0. Descriptive statistics were used to describe the sociodemographic and disease-specific characteristics of the participants. The Shapiro-Wilk test and normal Q-Q plots were utilized as the normality test of continuous variables. An independent samples *t*-test and a one-way analysis of variance were used to examine the relationship between the sociodemographic characteristics and the disease-specific characteristics with the HBS-SP. A Spearman correlation analysis was conducted to analyze the correlations between health behaviors and chronic illness resources. A multiple stepwise regression was conducted to test association of chronic illness resources with health behaviors. A two-sided P value <0.05 was considered statistically significant.

Ethical statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Permission for this research was granted from the managers of the School

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of Nursing of Sun Yat-Sen University, the Third Affiliated Hospital of Sun Yat-Sen University, and Guangdong Provincial Hospital of Traditional Chinese Medicine. Ethical approval (No. [2018]02-421-01) was granted by the ethics committee of the Third Affiliated Hospital of Sun Yat-sen University. The patients were informed that participation was voluntary and that withdrawal from the study was possible at any time. Each participant signed the informed consent form.

Results

In total 133 participants were enrolled in the study. The patients had a mean age of 61.02±9.99 years. Details of patients sociodemographic characteristics and disease-related characteristics are set out in *Tables 1,2*.

The univariate analysis showed that female patients had significantly higher health behavior scores than male patients (see *Table 1*). The health behavior scores of patients with a high school education or undergraduate education were significantly higher than those with an elementary education. The health behavior scores of patients with a slight dependency were significantly higher than those of patients with functional independence (see *Table 2*).

The total HBS-SP score of the participants was 2.89±0.38. The "health responsibility" subcategory had the lowest score. Participants had a total CIRS score of 2.94±0.66. The "organization" subcategory had the lowest score. The total HBS-SP score of patients at 6 months of discharge was positively correlated with the total CIRS score (Spearman r=0.517, P<0.001). Details are shown in *Table 3*.

The results of the regression analysis showed that chronic illness resources, gender, education level, and the Barthel Index were significantly associated with health behaviors (F=10.273, R^2_{ad}=0.413, P<0.001; see *Table 4*). The model explained approximately 41.3% of the variance in health behaviors in hypertensive stroke patients at 6 months after discharge. After controlling for the potential confounding effects of gender, education level, and the Barthel Index, the positive association between chronic illness resources and health behaviors remained statistically significant (unstandardized coefficient: 0.317, P<0.001).

Discussion

We found that hypertensive stroke patients had a moderate level of appropriate health behaviors at 6 months after discharge. The hypertensive stroke patients exhibited positive behaviors in terms of medication adherence, smoking and alcohol abstinence, salt and oil restriction, and blood pressure monitoring. The "health responsibility" subcategory had the lowest score, and corresponded to a low level of managing the target heart rate during exercise and of determining the nutritional composition of food. Our results are consistent with those of a Chinese study of stroke patients (20). An optimal target heart rate is necessary to ensure the safety of the stroke patients and the effect of the exercise (21). Paying little attention to the nutrient content of food can easily lead to the excessive intake of carbohydrates, fats, or salt. Despite this, we found that only a few patients recognized the importance of maintaining a target heart rate and paying attention to the nutritional composition of food. In long-term care, health care professionals should increase patients' education about exercise and healthy diet and seek to raise patients' related awareness. A further improvement in patients' health behaviors is necessary.

In the complex process of behaviors change, multiple factors were associated with health behaviors. As reported previously (22), we found that female patients displayed better health behaviors than male patients. The "traditional masculinity" that requires men to be more independent and resilient may be an important reason for this phenomenon (23). Additionally, the male-female differences in the division of labor and dietary habits also affected patients' health behaviors (22). Thus, health education content needs to be designed for stroke patients of different genders.

In this study, patients with a high-school education or higher had better health behaviors than those with an elementary-school education. Our results are consistent with the findings of a previous study on stroke patients (24). A high level of education helps people to increase their health knowledge and master more health skills, and thus promotes healthy behaviors (25). The provision of customized health education according to stroke patients' level of education is essential.

Saqlain *et al.* (26) found that independent elderly hypertensive patients had better medication adherence than dependent elderly hypertensive patients, which is inconsistent with the results of our study. In our study, patients with a slight dependency had better health behaviors than patients with functional independence. This may be because slight symptoms alert patients to the potential harm caused by stroke and thereby enhances their health beliefs.

Table 1 Associations between patients' health behaviors at 6 months after discharge and their sociodemographic characteristics at admission (n=133)

Characteristics	n [%]	Total score of HBS-SP[a], mean ± standard deviation	t value/F value	P value
Gender			−2.066	0.041*
Male	94 [70.68]	2.84±0.37		
Female	39 [29.32]	2.99±0.38		
Age (years)			0.016	0.984
38–44	7 [5.26]	2.91±0.39		
45–59	52 [39.10]	2.88±0.39		
60–83	74 [55.64]	2.89±0.37		
Education level[b]			1.831	0.145
Elementary school	25 [18.80]	2.74±0.27		3>1*
Middle school	38 [28.57]	2.87±0.35		4>1*
High school	38 [28.57]	2.95±0.45		
Undergraduate school	32 [24.06]	2.94±0.38		
Marital status			0.231	0.818
With spouse	121 [90.98]	2.89±0.37		
No spouse	12 [9.02]	2.86±0.46		
Employment status			1.570	0.212
Employed	41 [30.83]	2.92±0.35		
Retired	63 [47.37]	2.91±0.43		
Unemployed	29 [21.80]	2.77±0.26		
Household income (yuan/month/person)			0.429	0.787
<2,000	10 [7.52]	2.88±0.37		
2,000–	21 [15.79]	2.84±0.23		
3,000–	28 [21.05]	2.89±0.34		
4,000–	23 [17.29]	2.82±0.41		
5,000–	51 [38.35]	2.93±0.44		
Method of medical payment			0.744	0.477
Self-paid	5 [3.76]	2.74±0.22		
Medical insurance[c]	112 [84.21]	2.88±0.39		
Free medical care	16 [12.03]	2.97±0.33		
Living arrangement			-0.998	0.320
Living alone	11 [8.27]	2.78±0.52		
Living with family	122 [91.73]	2.90±0.37		

[a], the score ranges from 1 to 4; [b], 1: elementary school; 2: middle school; 3: high school; 4: undergraduate school. [c], including medicare and commercial insurance. Least significant difference test was used for comparisons between multiple groups; *, P<0.05. HBS-SP, health behavior scale for stroke patients.

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Table 2 Associations between patients' health behaviors at 6 months after discharge and their disease-specific characteristics at admission (n=133)

Characteristics	n [%]	Total score of HBS-SP[a], mean ± Standard Deviation	t value/F value	P value
Recurrence of stroke			−0.407	0.685
No	94 [70.68]	2.90±0.40		
Yes	39 [29.32]	2.87±0.32		
Duration of stroke (year)			0.551	0.582
<1	99 [74.44]	2.90±0.39		
1–30	34 [25.56]	2.86±0.34		
Duration of hypertension (year)			0.641	0.590
<1	34 [25.56]	2.81±0.40		
1–	28 [21.05]	2.92±0.39		
5–	22 [16.54]	2.90±0.49		
10–30	49 [36.84]	2.92±0.30		
Barthel index[b]			1.799	0.151
Severe dependency	3 [2.26]	2.77±0.13		3>4*
Moderate dependency	11 [8.27]	2.78±0.41		
Slight dependency	47 [35.34]	2.99±0.44		
Functional independence	72 [54.14]	2.84±0.32		
Chronic disease status[c]			−0.591	0.556
Yes	83 [62.41]	2.90±0.39		
No	50 [37.59]	2.86±0.37		

[a], the score ranges from 1 to 4; [b], 1: severe dependency; 2: moderate dependency; 3: slight dependency; 4: functional independence. [c], refers to combined diabetes mellitus or hyperlipidemia. Least significant difference test was used for comparisons between multiple groups; *, $P<0.05$. HBS-SP, health behavior scale for stroke patients.

We also found that the poorer the ability of dependent patients to perform daily activities, the worse their health behaviors. Patients with moderate-to-severe dependence require more support from chronic illness resources and more attention from health care professionals (27).

Chronic illness resources are positively and significantly associated with health behaviors in this study. Similar to the results of our study, a survey study have demonstrated that diabetic patients provided with better support by chronic illness resources displayed better self-management behaviors (28). However, the support provided to hypertensive stroke patients from surrounding chronic illness resources was poor at 6 months after discharge. Similar results have been found in studies of patients with diabetes and coronary heart disease (12,13). The provision of support by chronic illness resources in our study was better than that in a study conducted in the Xinjiang region of China (13). This finding is likely due to the fact that patients have better access to chronic illness resources in Guangzhou, China (29).

We observed that the most used chronic illness resources among the hypertensive stroke patients were the resources provided by family, friends, and the patients themselves. Patients were unprepared for the shock of a stroke and required help from external resources (30). The patients' relatives were not ready to become caregivers after the patients' discharge from the hospital; however, most of the stroke patients' relatives volunteered to undertake caregiving responsibilities because of the norms of traditional Chinese culture (31). Support from family and friends is beneficial to stroke patients (31), and patients also prefer support from family and friends to cope with disease (32). However, it is

Table 3 Association between chronic illness resources and health behaviors at 6 months after discharge (n=133, Spearman correlation)

Project	Mean ± standard deviation	Spearman correlation coefficients (total of HBS-SP)	P value
Total CIRS[a]	2.94±0.66	0.517	<0.001***
Physician/healthcare team	3.11±1.22	0.185	0.033*
Family and friends	3.52±0.79	0.565	<0.001***
Personal	3.28±0.86	0.473	<0.001***
Neighborhood/community	2.95±0.92	0.541	<0.001***
Media and policy	3.13±0.87	0.356	<0.001***
Organizations	1.64±0.82	0.238	0.006**
Total HBS-SP[b]	2.89±0.38	–	–
Physical activity	2.54±0.66	–	–
Medication adherence	3.61±0.54	–	–
Guideline adherence	3.04±0.55	–	–
Nutrition	2.93±0.43	–	–
Health responsibility	1.81±0.70	–	–
Smoking and alcohol abstinence	3.67±0.64	–	–

[a], the score ranges from 1 to 5; [b], the score ranges from 1 to 4; *, $P<0.05$; **, $P<0.01$; ***, $P<0.001$. CIRS, chronic illness resources survey; HBS-SP, health behavior scale for stroke patients.

Table 4 Results of multiple stepwise regression on the association between chronic illness resources and health behaviors at 6 months after discharge (n=133)

Model	Unstandardized coefficient	Standard error	Standardized coefficient	t value	P value
(Constant)	1.355	0.184	–	6.629	<0.001***
CIRS[a]	0.317	0.039	0.555	8.085	<0.001***
Gender[b]	0.222	0.060	0.268	3.708	<0.001***
Education level (high school)	0.194	0.080	0.231	2.406	0.018*
Barthel index (slight dependency)	0.132	0.056	0.167	2.359	0.020*

[a], the score ranges from 1 to 5; [b], male =1, female =2. $F=10.273$, $R=0.676$, $R^2=0.457$, $R^2_{ad}=0.413$; *, $P<0.05$; ***, $P<0.001$. CIRS, chronic illness resources survey.

important to note that relying on family or friends as the primary chronic illness resources can potentially increase the burden placed on caregivers, and consequently compromise the health of caregivers (33). A score above 3 for the "personal" subcategory indicated that the stroke patients were able to self-manage at 6 months after discharge. Based on the scores of the HBS-SP, the self-management of hypertension stroke patients should be further improved.

In our study, the stroke patients used chronic illness resources from health organizations, their neighborhoods, and communities infrequently. Glasgow *et al.* (14) found

similar results in a follow-up survey of diabetic menopausal women. This might be related to the imperfect system of primary health care and the lack of primary health organizations in China (34). An interview study of the caregivers of stroke patients found that some caregivers do not know how to seek access to chronic illness resources from health organizations and the community (30). Post-stroke disability, depression, and cognitive impairments can lead to poor social engagement, which can impede stroke patients' access to chronic illness resources from neighbors, the community, or related organizations (35).

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The scores of the "healthcare team" and "media and policy" subcategories reflected patients had effectively utilized chronic illness resources from media, policy, and health care team. The patients' scores for the "media and policy" subcategories in our study were higher than those of the diabetic patients in Zhong *et al.*'s (13) study. This may be due to developments in new media technology, an increase in health knowledge publicity, and the continuous improvement of the Chinese health insurance system. Current online media have made it easy to disseminate health information, but the chronic illness resources provided by the media still have limitations (e.g., some resources contain false information and advertisements) (36).

We were concerned that the support provided to hypertensive stroke patients by chronic illness resources remained poor at 6 months after discharge. The support provided by chronic illness resources for hypertensive stroke patients and the number of available chronic illness resources should be the focus of attention from health care providers. Family members and friends were found to be the primary chronic illness resources for most patients at 6 months after discharge, which suggests that family caregivers training needs to be enhanced to help them become more competent caregivers. Patients and family caregivers should also be educated about obtaining resources from other channels, especially formal channels (33), and overload of caregivers also needs to be addressed. The media should disseminate correct health information in a timely manner. Additionally, enhancing patients' use of chronic illness resources may be an effective method for promoting lifestyle changes. Community centers and health organizations should advertise more to allow increased use by hypertensive stroke patients. Medical professionals should provide new health knowledge and skills to the community.

Limitations

The study had 2 main limitations. First, the exclusion of patients with severe cognitive impairment limits the generalizability of the findings. Second, both the chronic illness resources and health behaviors of the patients were self-reported, and thus are prone to bias.

Conclusions

In summary, the chronic illness resources are positively associated with health behaviors in hypertensive stroke patients at 6 months after discharge. This result suggests that the provision of excellent support by chronic illness resources may be helpful for enhancing hypertensive stroke patients' health behaviors. Moreover, Hypertensive stroke patients' health behaviors at 6 months after discharge need to be improved, especially in terms of their taking responsibility for their health. The support provided to these patients by chronic illness resources also needs to be improved, especially in relation to the resources available from health organizations. Our findings suggest that health care providers need to pay more attention to the support provided by chronic illness resources to hypertensive stroke patients at 6 months after discharge to improve patients' health behaviors and prevent the recurrence of stroke.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1193/rc

Data Sharing Statement: Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1193/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1193/coif). All authors report that this study was funded by the General Program, National Natural Science Foundation of China (No. 71874211). The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are

appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics committee of the Third Affiliated Hospital of Sun Yat-sen University (No. [2018]02-421-01) and informed consent was taken from all individual participants.

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References

1. Zhou M, Wang H, Zeng X, et al. Mortality, morbidity, and risk factors in China and its provinces, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2019;394:1145-58.
2. Gu HQ, Yang X, Wang CJ, et al. Clinical Characteristics, Management, and In-Hospital Outcomes in Patients With Stroke or Transient Ischemic Attack in China. JAMA Network Open 2021;4:e2120745.
3. GBD 2019 Stroke Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Neurol 2021;20:795-820.
4. Maïer B, Kubis N. Hypertension and Its Impact on Stroke Recovery: From a Vascular to a Parenchymal Overview. Neural Plast 2019;2019:6843895.
5. Bernhardt J, Hayward KS, Kwakkel G, et al. Agreed definitions and a shared vision for new standards in stroke recovery research: The Stroke Recovery and Rehabilitation Roundtable taskforce. Int J Stroke 2017;12:444-50.
6. Lv Y, Sun Q, Li J, et al. Disability Status and Its Influencing Factors Among Stroke Patients in Northeast China: A 3-Year Follow-Up Study. Neuropsychiatr Dis Treat 2021;17:2567-73.
7. Diener HC, Hankey GJ. Primary and Secondary Prevention of Ischemic Stroke and Cerebral Hemorrhage. J Am Coll Cardiol 2020;75:1804-18.
8. Faiz KW, Labberton AS, Thommessen B, et al. Stroke-Related Knowledge and Lifestyle Behavior among Stroke Survivors. J Stroke Cerebrovasc Dis 2019;28:104359.
9. Sun Y, Boots J, Zehr EP. The lingering effects of a busted myth — false time limits in stroke rehabilitation. Appl Physiol Nutr Metab 2015;40:858-61.
10. Yao M, Chen J, Jing J, et al. Defining the rehabilitation adherence curve and adherence phases of stroke patients: an observational study. Patient Prefer Adherence 2017;11:1435-41.
11. Wang MY, Shen MJ, Wan LH, et al. Effects of a Comprehensive Reminder System Based on the Health Belief Model for Patients Who Have Had a Stroke on Health Behaviors, Blood Pressure, Disability, and Recurrence From Baseline to 6 Months. J Cardiovasc Nurs 2020;35:156-64.
12. Zhang X, Chen H, Liu Y, et al. Influence of chronic illness resources on self-management and the mediating effect of patient activation among patients with coronary heart disease. Nurs Open 2021;8:3181-9.
13. Zhong H, Shao Y, Fan L, et al. Perceived resource support for chronic illnesses among diabetics in north-western China. Front Med 2016;10:219-27.
14. Glasgow RE, Toobert DJ, Barrera M Jr, et al. The Chronic Illness Resources Survey: cross-validation and sensitivity to intervention. Health Educ Res 2005;20:402-9.
15. Liu L, Li R, Meng J, et al. Effect of chronic disease resource utilization on fatigue coping for patients with initial stroke. Journal of Nursing Science 2016;31:32-4.
16. Wang JG, Chia YC, Chen CH, et al. What is new in the 2018 Chinese hypertension guideline and the implication for the management of hypertension in Asia? J Clin Hypertens (Greenwich) 2020;22:363-8.
17. Serdar CC, Cihan M, Yücel D, et al. Sample size, power and effect size revisited: simplified and practical approaches in pre-clinical, clinical and laboratory studies. Biochem Med (Zagreb) 2021;31:010502.
18. Zhong H, Fan L, Shao Y, et al. Reliability and Validity of Chronic Illness Resources Survey (Chinese Version) in Patients with Diabetes. Chinese General Practice 2014;17:2779-82.
19. Wan L, Xiong X, Zhang X, et al. Development and reliability as well as validity test of Health Behavior Scale for Stroke Patients. Journal of Nursing Science 2017;32:25-9.
20. Wan LH, Zhang XP, You LM, et al. The Efficacy of a Comprehensive Reminder System to Improve Health Behaviors and Blood Pressure Control in Hypertensive Ischemic Stroke Patients. J Cardiovasc Nurs 2018;33:509-17.
21. Kim Y, Lai B, Mehta T, et al. Exercise Training Guidelines for Multiple Sclerosis, Stroke, and Parkinson Disease. Am

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J Phys Med Rehabil 2019;98:613-21.

22. Li ZR, Ruan HF, Shen LP, et al. Gender Difference in the Association Between Stroke Knowledge and Health Behavior Before the Onset of Stroke Among Chinese Hypertensive Patients. J Neurosci Nurs 2021;53:160-5.

23. Sullivan L, Camic PM, Brown JS. Masculinity, alexithymia, and fear of intimacy as predictors of UK men's attitudes towards seeking professional psychological help. Br J Health Psychol 2015;20:194-211.

24. Zhang XP, Pan JH, Wan LH, et al. Factors influencing health behaviour, blood pressure control, and disability in hypertensive ischaemic stroke patients after a comprehensive reminder intervention. J Adv Nurs 2020;76:1384-93.

25. Wan LH, Zhao J, Zhang XP, et al. Stroke prevention knowledge and prestroke health behaviors among hypertensive stroke patients in mainland China. J Cardiovasc Nurs 2014;29:E1-9.

26. Saqlain M, Riaz A, Malik MN, et al. Medication Adherence and Its Association with Health Literacy and Performance in Activities of Daily Livings among Elderly Hypertensive Patients in Islamabad, Pakistan. Medicina (Kaunas) 2019;55:163.

27. Satink T, Josephsson S, Zajec J, et al. Self-management develops through doing of everyday activities—a longitudinal qualitative study of stroke survivors during two years post-stroke. BMC Neurol 2016;16:221.

28. Adhikari M, Devkota HR, Cesuroglu T. Barriers to and facilitators of diabetes self-management practices in Rupandehi, Nepal- multiple stakeholders' perspective. BMC Public Health 2021;21:1269.

29. Li J, Chen X, Han X, et al. Spatiotemporal matching between medical resources and population ageing in China from 2008 to 2017. BMC Public Health 2020;20:845.

30. Lutz BJ, Young ME, Creasy KR, et al. Improving Stroke Caregiver Readiness for Transition From Inpatient Rehabilitation to Home. Gerontologist 2017;57:880-9.

31. Qiu X, Sit JWH, Koo FK. The influence of Chinese culture on family caregivers of stroke survivors: A qualitative study. J Clin Nurs 2018;27:e309-19.

32. Mei YX, Lin B, Zhang W, et al. Benefits finding among Chinese family caregivers of stroke survivors: a qualitative descriptive study. BMJ Open 2020;10:e038344.

33. Farahani MA, Bahloli S, JamshidiOrak R, et al. Investigating the needs of family caregivers of older stroke patients: a longitudinal study in Iran. BMC Geriatr 2020;20:313.

34. Li X, Krumholz HM, Yip W, et al. Quality of primary health care in China: challenges and recommendations. Lancet 2020;395:1802-12.

35. Cai Y, Towne SD Jr, Bickel CS. Multi-Level Factors Associated with Social Participation among Stroke Survivors: China's Health and Retirement Longitudinal Study (2011-2015). Int J Environ Res Public Health 2019;16:5121.

36. Nguyen A, Catalan-Matamoros D. Digital Mis/ Disinformation and Public Engagement with Health and Science Controversies: Fresh Perspectives from Covid-19. Media and communication (Lisboa) 2020;8:323-8.