

Research on the nutrition and cognition of high-risk stroke groups in community and the relevant factors

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Abstract. – **OBJECTIVE:** To investigate the prevalence rate of nutritional risk in high-risk stroke groups in community, analyze its influencing factors, and analyze and compare the relationship between nutritional risk or malnutrition assessed by different nutritional evaluation methods and cognitive function, so as to provide the basis and guidance for clinical nutritional assessment and support.

PATIENTS AND METHODS: A cross-sectional survey was performed for 1196 cases in high-risk stroke groups in community from December 2015 to January 2017. At the same time, the nutritional status of patients was evaluated using the mini nutritional assessment (MNA) and MNA-short form (MNA-SF), and the cognitive status of patients was evaluated using the mini-mental state examination (MMSE). Moreover, the relevant influencing factors of nutritional risk and MMSE score were analyzed and compared.

RESULTS: High-risk stroke groups in community suffered from a high risk of malnutrition. MNA-SF had a higher specificity and lower false positive rate than MNA. Nutritional risk occurred more easily in high-risk stroke groups in community with a history of diabetes mellitus, less physical exercise or light manual labor, daily use of multiple drugs, and higher age. Those with a higher nutritional risk were more prone to cognitive impairment. High-risk stroke groups in community, complicated with hyperhomocysteinemia, daily use of three or more kinds of prescription drugs,

and a previous history of stroke, were accompanied by cognitive impairment easily.

CONCLUSIONS: MNA-SF can be used for the nutritional screening of high-risk stroke groups in community. For the high-risk stroke groups in community, the rational nutritional diet should be publicized, blood sugar should be controlled in a scientific manner and physical exercise should be moderately increased.

Key Words:

High-risk stroke group, Community, Nutritional assessment, Cognitive function, Influencing factor.

Introduction

High-risk stroke groups are often accompanied by a variety of diseases and take a variety of drugs simultaneously, affecting the absorption of nutrients¹⁻³. The elderly are often accompanied by decreased food intake caused by tooth loss, organ and tissue hypofunction, depression, etc., and nutrient absorption obstacle due to gastrointestinal dysfunction. Besides, some patients are accompanied by hypermetabolism caused by chronic diseases, leading to nutritional risk^{4,5}. The nutritional risk will be increased in patients with cerebrovascular disease once they suffer from

dizziness, nausea, vomiting, neurogenic gastrointestinal dysfunction, cognitive impairment and severe complications, especially in elderly patients complicated with diabetes mellitus, bedridden state, recurrent lacunar infarction and Parkinson's disease⁶. Nutritional risk can also aggravate the primary disease, increase the complications, prolong the hospitalization time, increase the hospitalization costs and mortality rate⁷. However, the nutritional status of high-risk stroke groups in community is often neglected, affecting the life quality and prognosis of patients, so it is particularly important to perform the nutritional screening and assessment, establish the nutritional assessment and diagnosis records, develop the intervention measures of nutritional risk and strengthen the nutritional management for high-risk stroke groups in community. There are few studies on the nutritional assessment scale used in the evaluation of nutritional status, cognitive function and relevant influencing factors of high-risk stroke groups in community. Thus, this aspect was studied to provide the basis and guidance for clinical nutritional assessment and support.

Patients and Methods

Patients

A cross-sectional survey was performed for 1196 cases in high-risk stroke groups in community under the jurisdiction of the Health Center in Guangzhou City from December 2015 to January 2017. Inclusion criteria: patients with a previous history of stroke or transient ischemic attack (TIA), or with at least three of the following risk factors: smoking, hypertension, atrial fibrillation, valvular heart disease, dyslipidemia, diabetes mellitus, less physical exercise, light physical labor, overweight, or family history of stroke. There were 1023 cases with complete information, including 474 males and 549 females aged 40-80 years old with an average of (64.15±7.79) years old. The patients' name, gender, age, occupation, educational level, history of stroke and family history, histories of TIA, heart disease, diabetes mellitus, hypertension, hyperlipidemia, smoking and drinking, physical exercise and physical labor intensity, dietary structure, habit, etc., were recorded. Written informed consents were obtained from all participants before the investigation. This study was approved by the Ethics Committee of Shenzhen Dapeng New district Nan'ao People's Hospital.

Mini Nutritional Assessment (MNA)

It consists of a total of 4 parts with 18 items: 1) human body measurement: 4 items, including body mass index (BMI), upper arm circumference (AC), calf circumference (CC) and body weight in the nearly 3 months; 2) overall assessment: 6 items, including life type, medical condition, condition of disease, medication status, activity ability and neuropsychiatric disease; 3) dietary questionnaire: 6 items, including appetite, number of meals, food types, liquid intake and independent eating; 4) subjective assessment: 2 items, including assessment of self-health status and nutritional status. The total score was 30 points. The scoring criteria are as follows: MNA value ≥ 24 points: normal nutritional status; 17 points $\leq$ MNA value ≤ 23.5 points: potential malnutrition; MNA value < 17 points: malnutrition. In the relevant analysis, patients with MNA < 24 points were included into the nutritional risk group, while those with MNA ≥ 24 points were included into the normal nutrition group.

MNA-short Form (MNA-SF)

MNA-SF is the simplified MNA, and 18 items in MNA and MNA results received the correlation analysis to obtain 6 closely-related items: (1) BMI; (2) recent loss of weight; (3) acute disease or stress; (4) bedridden or not; (5) with or without dementia or depression; (6) with or without loss of appetite or difficulty in eating. The scoring criteria are as follows: MNA-SF value ≥ 12 points: good nutritional status; MNA-SF value = 8-11 points: potential malnutrition; MNA-SF value ≤ 7 points: malnutrition.

Mini-mental State Examination (MMSE)

MMSE is the preferred scale for dementia screening. It consists of the following seven aspects: time orientation, location orientation, immediate memory, attention and calculation ability, delayed memory, language and visual space. There are a total of 30 questions: 1 point for each correct answer, and 0 point for each wrong answer or no idea. The total score of the scale is 0-30 points. The test performance is closely related to the educational level, and the classification criteria of normal boundary value are as follows: > 17 points: illiteracy; > 20 points: primary school; > 24 points: junior high school and above.

Statistical Analysis

All statistics were performed using Statistical Product and Service Solutions (SPSS) 20.0 software. The independent-samples *t*-test was used for the intergroup comparison; Pearson correla-

Table I. Nutritional assessment in high-risk stroke groups via MNA and MNA-SF.

	Malnutrition (%)	Nutritional Risk (%)	Normal Nutrition (%)	r	Kappa
MNA	13 (1.27)	263 (25.71)	747 (73.03)	0.771 ($p=0.000$)	0.578 ($p=0.000$)
MNA-SF	5 (0.49)	124 (12.12)	894 (87.39)		

Abbreviation: MNA, mini nutritional assessment; MNA-SF, MNA-short form.

tion test was used for the correlation analysis between groups, and Kappa test was used for the consistency between the two assessment methods. In the comparison between MNA and MNA-SF, the sensitivity, specificity, accuracy, negative predictive value and positive predictive value were calculated. Enumeration data were presented as a percentage, and the prevalence rate of nutritional risk under basal conditions was compared using the fourfold table χ^2 test; the statistically significant factors were screened for multivariate logistic regression analysis. $p<0.05$ suggested that the difference was statistically significant.

Results

Nutritional Assessment in High-Risk Stroke Groups via MNA and MNA-SF

1023 out of 1196 patients screened had the complete data. According to MNA, there were 13 cases of malnutrition (1.27%), 263 cases of nutritional risk (25.71%) and 747 cases of normal nutrition (73.03%) (Table I). The prevalence rate of malnutrition was significantly lower than that of nutritional risk, and the difference was statistically significant ($p<0.05$). According to MNA-SF, there were 5 cases of malnutrition (0.49%), 124 cases of nutritional risk (12.12%) and 894 cases of normal nutrition (87.39%) (Table I). The prevalence rate of malnutrition was lower than that of nutritional risk, and the difference was statistically significant ($p<0.05$). The correlation coefficient between MNA and MNA-SF was $r=0.771$, $p=0.000$; Kappa consistence =0.578, $p=0.000$. The sensitivity of MNA-SF was 50.1%, the specificity was 97.8%, the accuracy was 85.9%, the positive predictive value was 97.6% and the negative predictive value was 86.4%.

Univariate Analysis of Relevant Factors to Nutritional Risk in High-Risk Stroke Groups

The basal condition, dietary structure habits, nutrition-related factors and prevalence rate

of nutritional risk in high-risk stroke groups are shown in Table II. There was no statistically significant difference in the prevalence rate of nutritional risk between different genders of high-risk stroke groups ($p>0.05$, Table II); smoking, drinking, heart disease history, hypertension, hyperlipidemia, recurrent stroke and stroke type had effects on the prevalence rate of nutritional risk, but the low educational level, hyper-homocysteinemia, high-salt, high-oil and less-fruit diet had no significant effects on it ($p>0.05$, Table II). However, the diabetes mellitus, a history of stroke, less-vegetable diet, less physical exercise or light physical labor, daily use of three or more kinds of prescription medicine, low MMSE score and increase of age could increase the prevalence rate of nutritional risk ($p<0.05$, Table III).

Multivariate Logistic Regression Analysis of Relevant Factors to Nutritional Risk in High-Risk Stroke Groups

After univariate analysis, factors with $p<0.05$ were selected for multivariate Logistic regression analysis. The results showed that the prevalence rate of nutritional risk in patients taking more than three kinds of prescription medicine every day was 1.782 times that in those taking less than three kinds of prescription medicine every day; the prevalence rate of nutritional risk in diabetic patients was 1.659 times that in non-diabetic patients; the prevalence rate of nutritional risk in patients with less physical exercise or light physical labor was 1.677 times that in patients with more physical exercise or moderate-heavy physical labor. The prevalence rate of nutritional risk was increased by 1.113 times for every 1-year increase in age. After the influences of other factors were corrected, the prevalence rate of nutritional risk in normal patients did not have a statistically significant difference compared with that in patients with a previous history of stroke, less-vegetable diet and lower MMSE score (Table IV).

Table II. Univariate analysis of relevant factors to nutritional risk in high-risk stroke groups.

Relevant Factor	Group	n	Nutritional Risk (n)	Rate (%)	χ^2	p
Gender	Male	474	123	25.95	0.160	0.876
	Female	549	140	25.50		
Smoking	Yes	359	88	24.51	0.114	0.854
	No	664	173	26.05		
Drinking	Yes	320	84	26.25	0.201	0.739
	No	703	179	25.46		
Heart disease	Yes	446	129	28.92	3.267	0.078
	No	577	128	22.18		
Diabetes mellitus	Yes	319	113	35.42	9.308	0.000*
	No	704	144	20.45		
Hypertension	Yes	598	160	26.76	0.556	0.618
	No	425	103	24.24		
Hyperlipidemia	Yes	387	102	26.36	0.642	0.639
	No	636	155	24.37		
Stroke history	Yes	183	62	33.88	4.517	0.039*
	No	840	200	23.81		
Recurrent stroke	1	123	44	35.77	0.547	0.622
	≥ 2	60	18	30.00		
Stroke type	Ischemia	170	57	33.53	0.461	0.115
	Bleeding	13	6	46.15		
Physical exercise or labor	Light	569	171	30.05	7.626	0.015*
	Heavy	454	92	20.26		
High-salt	Yes	392	105	26.79	0.731	0.548
	No	631	158	25.04		
High-oil	Yes	289	64	22.15	0.859	0.413
	No	734	195	26.57		
Vegetable intake	Much	909	217	23.87	8.714	0.004*
	Little	114	48	42.11		
Fruit intake	Much	607	144	23.72	2.813	0.316
	Little	416	118	28.37		
Educational level	High school below	755	203	26.89	2.133	0.729
	College or higher	268	62	23.13		
Daily use of medicine	≥ 3	369	137	37.13	7.635	0.000*
	< 3	654	109	16.67		
Hyperhomocysteinemia	Yes	962	246	25.57	0.804	0.517
	No	61	17	27.87		

Note: *, $p < 0.05$ suggested statistically significant difference.

Table III. Univariate analysis of relevant factors to nutritional risk in high-risk stroke groups.

		MMSE	Age (y)
Active chronic gastritis MNA		50.76 $\pm$ 8.23	39.1 $\pm$ 8.09
	Nutritional Risk	27.19 $\pm$ 2.47*	62.58 $\pm$ 8.21*
	Normal Nutrition	27.90 $\pm$ 1.89	65.91 $\pm$ 3.22

Note: *, $p < 0.05$ in comparison with normal nutrition group.

Cognitive Function and Relevant Influencing Factors of High-Risk Stroke Groups

In high-risk stroke groups, MMSE score had no statistically significant difference between different genders, ages above and below 65 years old, educational level above and below senior high

school, and daily drinking of more than and less than 3 cups of water ($p > 0.05$, Table V); smoking, drinking, diabetes mellitus, hypertension, hyperlipidemia, less physical exercise or heavy physical labor, less-vegetable and less-fruit diet had no significant effects on MMSE score ($p > 0.05$, Table V). Compared with that in patients with no histo-

Table IV. Multivariate Logistic regression analysis of relevant factors to nutritional risk in high-risk stroke groups.

Relevant Factor	Regression coefficients	Wald	OR	95% CI	p
Age (y)	0.041	5.137	1.113	1.1051.147	0.028*
Daily use of medicine (≥ 3)	0.714	6.484	1.782	1.208-3.015	0.016*
Diabetes mellitus	0.582	4.546	1.659	1.003-2.626	0.034*
Less physical exercise/light physical labor	0.565	5.016	1.677	1.004-2.716	0.019*
Less-vegetable diet	0.647	4.136	2.014	0.873-3.599	0.084
MMSE	-0.095	2.875	0.921	0.824-1.103	0.075
Stroke history	0.056	0.045	0.973	0.569-1.452	0.361

Note: *, $p < 0.05$ suggested statistically significant difference.

Table V. Cognitive function and relevant influencing factors of high-risk stroke groups.

Relevant Factor	Group	MMSE	t	p
Age	<65	27.94 $\pm$ 2.13	2.164	0.412
	≥ 65	27.66 $\pm$ 2.25		
Gender	Male	27.72 $\pm$ 2.01	-3.417	0.835
	Female	27.75 $\pm$ 1.80		
Smoking	Yes	27.51 $\pm$ 2.39	2.014	0.364
	No	27.84 $\pm$ 2.01		
Drinking	Yes	27.49 $\pm$ 2.29	0.639	0.263
	No	27.74 $\pm$ 1.96		
Diabetes mellitus	Yes	27.55 $\pm$ 2.20	2.649	0.149
	No	27.83 $\pm$ 2.11		
Hypertension	Yes	27.70 $\pm$ 2.04	0.487	0.613
	No	27.75 $\pm$ 2.16		
Hyperlipidemia	Yes	27.68 $\pm$ 2.13	0.966	0.531
	No	27.78 $\pm$ 2.04		
Stroke history	Yes	25.97 $\pm$ 2.62	2.857	0.006*
	No	27.86 $\pm$ 1.96		
Physical exercise or labor	Light	27.68 $\pm$ 2.16	0.346	0.608
	Heavy	27.74 $\pm$ 2.02		
Drinking water (cup)	≥ 3	27.69 $\pm$ 2.06	0.419	0.719
	<3	27.71 $\pm$ 2.08		
MNA	≥ 24	27.89 $\pm$ 1.96	1.925	0.005*
	<24	27.17 $\pm$ 2.36		
Vegetable intake	Much	27.48 $\pm$ 2.05	3.114	0.416
	Little	27.64 $\pm$ 2.24		
Fruit intake	Much	27.88 $\pm$ 2.06	-0.898	0.234
	Little	27.69 $\pm$ 2.17		
Educational level	High school below	27.71 $\pm$ 2.09	-2.938	0.765
	College or higher	27.78 $\pm$ 2.13		
Daily use of medicine	≥ 3	27.38 $\pm$ 2.24	3.614	0.014*
	<3	27.89 $\pm$ 2.06		
Hyperhomocysteinemia	Yes	26.49 $\pm$ 2.05	3.126	0.038*
	No	28.27 $\pm$ 1.28		

Abbreviation: MNA, mini nutritional assessment. Note: *, $p < 0.05$ suggested statistically significant difference.

ry of stroke, daily use of less than three kinds of prescription medicine, normal HCY and normal nutrition evaluated by MNA, the MMSE score was lower in patients with a history of stroke, daily use of three or more kinds of prescription medicine, hyperhomocysteinemia and nutritional risk evaluated by MNA ($p < 0.05$, Table V).

Discussion

There is no unified golden standard and assessment method of determining malnutrition yet in China, mainly because the clinical manifestations of malnutrition lack specificity. Nutritional assessment scale can simply reflect the nutritional status

of patients, providing the basis and guidance for further rational nutritional support^{6,7}. A study was performed for 251 patients with stroke in recovery phase admitted into the community hospital using the traditional measurement indexes, and the results showed that the prevalence rate of malnutrition was 41.3%. An investigation was conducted for 9450 elderly people aged over 60 years old in Beijing community using MNA, and the results revealed that the prevalence rate of malnutrition was 0.2% and that of nutritional risk was 32.3%, people with normal nutrition accounted for 67.5%⁸. In this work, the proportion of patients with malnutrition and nutritional risk was lower than that reported in the literature, maybe because some individuals younger than 60 years old were included in this study (26.46%). Patients with a history of stroke accounted for only 17.89%.

The results of a research for 144 hospitalized patients showed that the correlation coefficient between MNA and MNA-SF was $r=0.933$, $p<0.05$. Compared with MNA, the sensitivity of MNA-SF was 85.7%, the specificity was 96.0%, the accuracy was 87.5%, the positive predictive value was 99.0% and the negative predictive value was 58.5%⁹. MNA and MNA-SF for 276 patients with senile dementia revealed that MNA and MNA-SF had a high correlation ($r=0.924$, $p<0.01$), compared with MNA, the sensitivity of MNA-SF was 50.6% and the specificity was 92.4%. This study showed that the correlation coefficient between MNA and MNA-SF was $r=0.771$, $p=0.000$. Compared with MNA, the sensitivity of MNA-SF was 50.1%, the specificity was 97.8%, the accuracy was 85.9%, the positive predictive value was 97.6% and the negative predictive value was 86.4%. Compared with those in literature, the sensitivity was lower, the specificity was higher, the true negative rate was higher, and the false positive rate was low, suggesting that the possibility that the malnutrition or nutritional risk assessed by MNA-SF is evaluated as normal nutrition by MNA is very low, so it is applicable to people with a high prevalence rate of malnutrition. This study showed that there was no statistically significant difference in the prevalence rate of nutritional risk between different genders of high-risk stroke groups ($p>0.05$); smoking, drinking, heart disease history, hypertension, hyperlipidemia, recurrent stroke and stroke type had effects on the prevalence rate of nutritional risk, but the low educational level, hyperhomocysteinemia, high-salt, high-oil and less-fruit diet had no significant effects on it ($p>0.05$). However,

the diabetes mellitus, a history of stroke, less-vegetable diet, less physical exercise or light physical labor, daily use of three or more kinds of prescription medicine, low MMSE score and increase of age, had effects on the prevalence of nutritional risk ($p<0.05$). After the influences of other factors were corrected, the daily use of more than three kinds of prescription medicine, diabetes mellitus, high age, less physical exercise or light physical labor were still the risk factors of nutritional risk, and its prevalence rate was also increased with the increase of age^{10,11}. Previous studies revealed that the age was the risk factor of malnutrition and nutritional risk. In this work, the prevalence rate of nutritional risk was increased by 1.113 times for every 1-year increase in age^{12,13}. It was also shown that the prevalence rate of nutritional risk in patients taking more than three kinds of prescription medicine every day was 1.782 times that in those taking less than three kinds of prescription medicine every day. An investigation including 9338 individuals also showed that the activity of daily living is an influencing factor of malnutrition and nutritional risk⁹⁻¹¹. In this report, compared with that in patients with no history of stroke, daily use of less than three kinds of prescription medicine, normal HCY and normal nutrition evaluated by MNA, the MMSE score was lower in patients with a history of stroke, daily use of three or more kinds of prescription medicine, hyperhomocysteinemia and nutritional risk evaluated by MNA ($p<0.05$). Ballard et al¹⁴ studied and found that more than 30% stroke patients suffer from cognitive dysfunction within 3-15 months, 9% of which will develop into dementia. This research also showed that the MMSE score in patients with a history of stroke was significantly lower than that in individuals without a history of stroke. Besides, the MMSE score in patients taking three or more kinds of prescription medicine every day was lower than that in patients taking less than three kinds of prescription medicine every day, maybe because the individuals taking more than three kinds of prescription medicine are often accompanied with hypertension, hyperlipidemia, diabetes mellitus, coronary heart disease and other cerebrovascular risk factors¹⁵. The long-term existence of these risk factors will cause recurrent microembolization, arteriolar spasm, sclerosis and cerebral microvascular lesion; combined with changes in hemodynamics, ischemia-hypoxia will occur in brain tissues, leading to cognitive decline and even dementia. In this study, according to MNA, the MMSE score

in nutritional risk group was higher than that in normal nutrition group, maybe because there is a correlation between nutrient intake and cognitive function, which is often the result of interaction between malnutrition caused by various nutrient deficiencies and other factors. Studies^{16,17} have shown that Hcy is neurotoxic and is an independent risk factor for dementia. We revealed that the MMSE score in hyperhomocysteinemia patients was lower than that in patients with normal HCY ($p<0.05$), suggesting that the mechanism may be related to that fact that HCY is involved in the process of vascular atherosclerosis, leading to the cortical and subcortical chronic ischemia, causing neuronal defects, decreased excitatory transmitter and memory loop damage.

Conclusions

According to MNA and MNA-SF, high-risk stroke groups in community suffer from a high risk of malnutrition. MNA-SF can be used for the nutritional screening of high-risk stroke groups in community. High-risk stroke groups in community with a higher nutritional risk are more prone to cognitive impairment. High-risk stroke groups in community complicated with hyperhomocysteinemia, daily use of three or more kinds of prescription drugs, and a previous history of stroke, were accompanied by cognitive impairment easily.

Conflict of interest

The authors declare no conflicts of interest.

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