ORIGINAL RESEARCH

Comparative Analysis of Risk Factors and Dietary Status of High-risk Groups of Stroke in Urban and Rural Areas of Xiangtan City

Zheng Liu, MM; Zili Han, BS; Jianwen Chen, BS; Bingbing Tang, BS; Lin Ding, BS; Hongmei Zhao, BS; Zhouyang Wei, MM

ABSTRACT

Objective • This study aimed to explore the risk factors and dietary status of middle-aged and elderly people at high risk of stroke in urban and rural areas of Xiangtan City, with a view to providing a basis for formulating stroke prevention and control strategies in urban and rural areas of Xiangtan City.

Methods • Using the cluster sampling method, a total of 8,453 permanent residents aged ≥40 years old were selected from Yuetang Street, Yuetang District, and Jiangshe Town, Yuhu District, Xiangtan City in 2020 and 2021 for face-to-face questionnaire surveys to collect their demographic information, daily life Method, family history, height, weight, waist circumference, blood pressure, blood sugar, blood lipids, glycosylated hemoglobin, homocysteine and other indicators, and analyze them.

Results • A total of 8453 permanent residents were screened in this study, and a total of 1,804 stroke high-risk patients (including stroke and TIA, 21.34%) were screened out, including 973 urban residents (23.53%), and 831 rural residents (19.25%), and the distinction had statistical significance ($P < .05$); 263 stroke sufferers were screened out, and the prevalence ratio was 3.11%. The exposure rates of risk factors for high-risk groups in urban and rural areas of Xiangtan City from high to low are hypertension, dyslipidemia, smoking, family history of stroke, diabetes, obesity, lack of exercise and atrial fibrillation or heart valve disease. The high-risk groups for urban strokes The proportions of lack of exercise (23.54%) and obesity (38.44%) were significantly higher than the proportions of lack of exercise (17.09%) and obesity (22.64%) in rural areas. The high-risk groups in rural areas had hypertension (87.73%) and a history of TIA (2.89%). The proportion of patients with hypertension (82.43%) and TIA history (1.34%) was significantly higher than those in urban areas, and the differences were statistically significant ($P < .05$). The proportion of rural residents who eat a salty diet (17.93%) and eat fruits ≤2 days/week (93.98%) is significantly higher than that of urban residents who eat a salty diet (14.49%) and eat fruits ≤2 days/week (59.61%). There are differences. Statistically significant ($P < .05$), the proportion of urban residents who consume vegetables ≤2 days/week (11.91%) is significantly lower than the proportion of urban residents who consume vegetables ≤2 days/week (28.98%) ($P < .01$).

Conclusion • The high-risk factors for stroke in Xiangtan City are mainly hypertension, dyslipidemia, smoking history, family history of stroke, and diabetes. Tailored public health measures should be taken by residents to address the different risk status and dietary habits of urban and rural populations. Especially dietary intervention for rural residents. (*Altern Ther Health Med.* [E-pub ahead of print.])

Zheng Liu, MM; **Zili Han**, BS; **Jianwen Chen**, BS; **Bingbing Tang**, BS; **Lin Ding**, BS; **Hongmei Zhao**, BS; **Zhouyang Wei**, MM, Department of General Medicine; Xiangtan Central Hospital; Xiangtan; Hunan; China.

Corresponding author: Zhouyang Wei, MM
E-mail: xtch1662@163.com

INTRODUCTION

Stroke is a common sudden cerebrovascular illness with 5 features, namely, high morbidity, great disability, high death ratio, great recurrence ratio, and great economic burden, which has become the leading cause of death for adults in China.[1,2] The National Health Commission (NHC for short) Stroke Prevention Engineering Committee (Break Prevention Committee for short) has achieved initial results in screening and intervention projects for highly highly-risky groups in China. The frequency of stroke in China has reduced from 222/100 000 to 201/100 000 in 2019, but the prevalence rate is still on the rise. By the end of 2019, the population-standardized prevalence ratio of stroke among people aged forty and over in China rose from 1.89% in 2012 to 2.58% in 2019, and the number of current and former stroke patients is about 17.04 million.[3] Therefore, the situation of stroke

prevention and treatment is still very serious. Due to my country's vast territory, stroke has different geographical and urban-rural distribution characteristics. Long-term data have found that the geographical distribution is "high in the north and low in the south". Due to the vast territory in China, stroke has different geographical and urban-rural distribution characteristics. Long-term data have found that there is a phenomenon of "great in the north and low in the south" in the geographical distribution, and the prevalence and mortality in rural areas are greater than in urban areas,[4] so the prevention and therapy for stroke are more complex. At present, it is known that smoking, alcoholism, and other unhealthy lifestyles can cause stroke, but in the daily diet structure, if you eat too much salt and too little vegetables and fruits, it will have adverse effects on cardiovascular and cerebrovascular diseases, which may indirectly lead to stroke. However, at present, there are few research reports on the risk factors and dietary status of high-risk groups of stroke in Xiangtan city, so carrying out risk factor screening and intervention for stroke highly-risky groups according to local conditions and strengthening the construction of regional stroke prevention and control system will help to improve the awareness of stroke and prevention compliance in the region, and reduce the incidence, recurrence, mortality and disability of stroke.[3,5] Xiangtan Central Hospital is the advanced stroke center of the Brain Prevention Committee of the National Health Commission. Since 2013, it has undertaken the screening and intervention projects for stroke highly-risky groups in China. It has passed the screening and intervention data of highly-risky groups in Xiangtan City from 2020 to 2021. The general stroke characteristics, risk factors, and dietary status of urban and rural high-risk populations in Xiangtan area were compared to understand the exposure conditions of risk factors and urban-rural differences of stroke high-risk populations to provide a basis for formulating targeted regional prevention and control measures for stroke.

OBJECTIVES AND METHODS

Research objects

The permanent residents who were more than forty years old (who lived more than six months) were selected from May 2020 to November 2021 using cluster sampling for investigation. After the patients participated in the study, the relevant requirements and contents were informed in detail to every patient who participated in the study, and the ethical issues involved were recorded and approved by the hospital ethics committee. This study is in line with the Helsinki Declaration.

Methods

The "Cardiovascular and Cerebrovascular Disease Risk Factors Community, Township Population Comprehensive Intervention Questionnaire" formulated by the project was used to conduct the survey, and the trained grassroots doctors conducted interviews and data collection on the survey subjects, including basic information, physical examination, and laboratory examination, in which the basic information included half of the demographic information, lifestyle, family history, physical examination including height, weight, waist circumference and blood pressure, etc., and laboratory tests included blood sugar, blood lipids, glycosylated hemoglobin, homocysteine, etc. The venous blood of all the individuals were collected. After registering and coding all the respondents' information, the information was filled in on the National Stroke Screening and Intervention Project Platform. Cronbach'sα coefficients of the questionnaire are all greater than 0.7, indicating that the overall reliability of the questionnaire is high.

Diagnostic criteria

(1) Stroke risk assessment. 1) High blood pressure. It refers to a history of hypertension, or the screening shows elevated blood pressure (systolic blood pressure ≥ 140mmHg or diastolic blood pressure ≥ 90mmHg); 2) Atrial fibrillation or valvular heart disease. It refers to a previous history of atrial fibrillation or the screening shows atrial fibrillation. 3) Smoking. It refers to continuous or accumulated smoking for 6 months or more. 4) Dyslipidemia. It refers to the past history of dyslipidemia or one or more followings, namely, total cholesterol ≥ 6.22 mmol/L (240 mg/dl), triglyceride ≥ 2.3 mmol/L (200 mg/dl), high-density lipoprotein < 1.04 mmol/L (40 mg/dl)), and low-density lipoprotein ≥ 4.1mmol/L (160 mg/dl) can be judged as dyslipidemia; 5) Diabetes. It refers to a previous history of diabetes (diagnosed by a hospital above grade II) or this measurement shows random blood sugar ≥ 11.0 mmol/L or fasting blood sugar ≥ 7.0 mmol/L; 6) Lack of exercise. Those who exercise ≥ three times each week, exercise ≥ thirty minutes at moderate intensity or above every time, or engage in moderate or heavy physical labor are considered to have regular physical exercise. On the contrary, it is a lack of exercise. 7) Obesity. BMI≥ twenty-eight is considered obese [(BMI=weight (kg)/height ^{2} (m^2)]; 8) Family history of stroke. It refers to a history of previous stroke or transient ischemic attack (TIA). (2) Determination of stroke classification. The high-risk group refers to those who have 3 or more of the above 8 stroke risk factors, or have TIA, or have had a stroke in the past; the medium-risk group refers to those who have 3 or fewer risk factors but suffer from hypertension, diabetes, atrial fibrillation or one of the three chronic diseases of valvular heart disease; low-risk group refers to patients with less than three risky factors and no chronic illnesses for example hypertension, diabetes, atrial fibrillation or valvular heart illness. (3) Diet status. 1) The taste is divided into salty, light, and moderate; 2) The meat and vegetables are divided into balanced meat and vegetables, more meat and mainly vegetarian; 3) Vegetable frequency is divided into ≥5 days/week, 3-4 days/week, and ≤ 2 days/week; fruit frequency is divided into ≥5 days/week, 3-4 days/week, and ≤2 days/week.

Statistical analysis

The 2020-2021 stroke screening and intervention data were derived from the National Stroke Screening and Intervention Project Platform, and SPSS 22.0 software was

Table 1. General conditions of stroke screening among urban and rural residents in Xiangtan City

Area	Total	Age	Gender (%)		Hazard classification (%)			Stroke (%)	
			Male	Female	High risk	Medium risk	Low risk	Yes	No
City	4167	55 (48, 64)	1865 (45.09)	2283 (54.91)	973 (23.53)	1083 (26.18)	2080 (50.29)	129 (3.12)	4007 (96.88)
The countryside	4329	57 (50, 67)	1825 (42.27)	2492 (57.63)	831 (19.25)	1373 (31.80)	2125 (48.95)	134 (3.10)	4183 (96.90)
Total	8496	56 (49, 66)	3690 (43.65)	4763 (56.35)	1804 (21.34)	2456 (29.05)	4236 (49.60)	263 (3.11)	8190 (96.89)
Z/ χ^2		-8.715	6.815		41.823			0.002	
P value		.000	.009		.000			.968	

Table 2. General situation of high-risk groups of stroke in urban and rural areas of Xiangtan City

AREa	Total	Age	Gender(%)		Education (%)				Household income per capita (%)			
			Male	Female	Primary and secondary schools and below	Junior high school	High school or technical secondary school	College and above	Less than 5000 yuan	5000-10000	10000-20000	More than 20000 yuan
City	973	59 (52.5, 67)	609 (62.59)	364 (37.41)	106 (10.89)	301 (30.94)	341 (35.05)	255 (23.12)	36 (3.70)	9 (0.92)	2 6 (2.67)	902 (92.70)
The countryside	831	62 (55, 70)	424 (51.02)	407 (48.98)	498 (59.93)	250 (30.08)	75 (9.03)	8 (0.96)	527 (63.41)	100 (12.03)	67 (8.06)	137 (16.49)
total	1804	61 (51, 69)	1033 (27.99)	771 (16.19)	604 (33.48)	551 (30.54)	416 (23.06)	233 (12.92)	563 (31.21)	109 (6.14)	93 (5.16)	1039 (57.59)
Z/ χ^2		4.269	24.504		424.005				1081.034			
P value		.000	.000		.000				.000			

used for statistical analysis. Measurement data subject to normal distribution were represented as mean ± standard deviation ($\bar{x} \pm s$), and conducted with *t* test for comparison. The measurement data with non-normal distribution were represented by median (quartile), conducted with Wilcoxon rank sum test for comparison; constituent ratios or ratios expressed count data, the comparison of the constituent ratios or ratios of dichotomous variables uses the four-table χ^2 test, and χ^2-test or *Fisher's* exact test was used for the comparison of the constituent ratios or ratios of multi-categorical variables *(R × C)*. $P < .05$ meant the difference had statistical significance. For the research object with serious data missing, it will not be considered for the time being. For individual missing data, linear interpolation method is used to fill in.

RESULTS

General conditions of the screening population

8453 permanent residents were screened in this study, including 4,136 urban residents and 4,317 rural residents. There were 1865 and 1825 male residents in urban and rural areas and 2,271 and 2492 female residents, respectively. The median ages of urban and rural residents were 55 and 57 years old, respectively. A total of 1,804 stroke high-risk patients (including stroke and TIA, 21.34%) were screened out, including 973 urban residents (23.53%), and 831 rural residents (19.25%), and the difference between urban and rural areas had statistical significance (χ^2=41.823, $P < .01$); 263 stroke patients were screened out, with a crude prevalence ratio of 3.10%, including 129 urban patients, with a crude prevalence ratio of 3.12%, and 134 rural residents, with a crude prevalence ratio of 3.10%. It had no obvious distinction in the crude prevalence ratio between urban and rural areas (χ^2=0.002, $P > .05$), as shown in Table 1.

Basic situation of stroke high-risk groups in urban and rural areas

The median age of the urban highly-risky group was 59 years old, and that of the rural high-risk group was 62 years old, and the distinction had statistical significance ($P < .01$). It had 609 and 424 males in the urban and rural highly-risky groups of stroke, separately, and the detection ratios were 32.32% and 23.17%, respectively. There were 364 and 407 high-risk female groups of stroke in urban and rural areas, and the detection rates were 13.79% and 14.01%, separately. It clearly distinguished the detection ratios between urban and rural females (χ^2=0.078, $P > .05$). 106 (10.89%) urban stroke high-risk groups had primary and secondary school education or below, 301 (30.94%) had junior high school education, 341 (35.05%) had high school or technical secondary education, 225 (23.12%) had junior college or above, and 225 (23.12%) had junior high school education. High-risk groups accounted for 498 (59.93%), 250 (30.08%), 75 (9.03%), and 8 (0.96%), separately. It had a statistically obvious distinction in educational background between urban and rural stroke high-risk groups (χ^2=424.005, $P < .01$). The family income per capita of the stroke high-risk groups in urban areas was mainly above 20,000 yuan (92.70%), and that in rural areas was mainly below 5,000 yuan (63.41%), and the difference was statistically significance (χ^2=1081.034, $P < .01$). See Table 2.

Comparison of the risky factors in highly risky groups of stroke in urban and rural areas

The top 5 risky factors for stroke highly-risky groups in the Xiangtan area were hypertension (84.87%), dyslipidemia (73.39%), smoking history (43.18%), family history of stroke (40.96%) and diabetes (39.91%). The exposure ratio of risky factors in urban stroke highly-risky groups from great to low was hypertension (82.43%), dyslipidemia (72.46%), smoking (43.68%), family history of stroke (41.42%), diabetes (39.77%), obesity (38.44%), lack of exercise (23.54%), and atrial fibrillation or heart valve disease (2.06%); in rural areas, it was hypertension (87.73%), dyslipidemia (74.49%), smoking (42.60%), family history of stroke (40.43%), diabetes (40.07%), obesity (22.26%), lack of exercise (17.09%) and atrial fibrillation or heart valve disease (1.81%). The proportions of lack of exercise (23.54%) and obesity (38.44%) among high-risk groups in urban areas are significantly higher than those in rural areas. The proportions of hypertension (87.73%) and TIA among high-risk groups in rural areas are significantly higher than those in rural areas. The proportion of patients with a history of hypertension (2.89%) was significantly higher than that of urban hypertension (82.43%) and TIA (1.34%), and the differences were statistically significant ($P < .05$), as shown in Table 3.

Table 3. The risk factors compared between urban and rural highly risky groups of stroke in Xiangtan City

Area	Total	High blood pressure	Dyslipidemia	Smoking history	Family history of stroke	Diabetes	Atrial fibrillation or valvular heart disease	Lack of exercise	Obesity	Previous stroke	TIA
City	973	802 (82.43)	705 (72.46)	425 (43.68)	403 (41.42)	387 (39.77)	20 (2.06)	229 (23.54)	374 (38.44)	129 (13.26)	13 (1.34)
The countryside	831	619 (87.73)	424 (74.49)	354 (42.60)	336 (40.43)	333 (40.07)	15 (1.81)	142 (17.09)	185 (22.64)	134 (16.13)	24 (2.89)
Total	1804	1531 (84.87)	1324 (73.39)	779 (43.18)	739 (40.96)	720 (39.91)	35 (1.94)	371 (20.57)	559 (30.99)	263 (14.59)	37 (2.05)
χ^2		9.804	0.948	0.213	0.180	0.017	0.148	11.406	54.838	2.959	5.374
P value		.002	.330	.644	.672	.897	.701	.001	.000	.085	.020

Table 4. To compare dietary habits of urban and rural high-risk groups of stroke in Xiangtan City

Area	Total	Salty diet	Carnivore	Vegetables ≤ 2 days/week	Fruit ≤ 2 days/week
City	973	141 (14.49)	70 (7.19)	282 (28.98)	580 (59.61)
The countryside	831	149 (17.93)	43 (5.17)	99 (11.91)	781 (93.98)
Total	1804	290 (16.08)	113 (6.26)	381 (21.12)	1360 (75.44)
χ^2		3.929	3.114	78.378	285.852
P value		.047	.078	.000	.000

Eating habits of urban and rural stroke high-risk groups

The proportion of rural residents who eat a salty diet (17.93%) and have fruits ≤2 days/week (93.98%) is significantly higher than the proportion of urban residents who eat a salty diet (14.49%) and have fruits ≤2 days/week (59.61%). The difference is All were statistically significant ($P < .05$), and the proportion of urban residents who consumed vegetables ≤2 days/week (11.91%) was significantly lower than the proportion of urban residents who consumed vegetables ≤2 days/week (28.98%) ($P < .01$), as shown in Table 4.

DISCUSSION

In recent years, with the constant change in people's lifestyles and diet structure, the incidence of stroke is increasing year by year. As one of the major diseases that seriously threaten human health in the clinic, stroke has the characteristics of high incidence, high recurrence rate, high disability rate, and high mortality rate. Up to now, the specific pathogenesis of stroke is not completely clear, but with the deepening of related research in recent years, many researchers believe that stroke is mainly a disease caused by environmental, genetic, and other factors. With the rapid development of China's economy and society, the aging population is becoming more and more serious, and the prevalence of chronic illnesses for example, hypertension, diabetes, and dyslipidemia, is increasing. For example, the obesity rate has risen from 7.1% to 16.8% in 2004-2018. The prevalence of hypertension has risen from 18.6% to 27.5%,[6-10] which poses a great challenge to the prevention and therapy of stroke. According to the 2020 Stroke Prevention and Control Report, the population-standardized prevalence ratio of stroke in the population aged forty and over in China is increasing at a rate of 8.1% per year. In terms of geographical characteristics, the standardized prevalence ratio of stroke in 2017 was the highest in the central region (1549.5 per 100 000), the Northeast Region ranked second (14.503/100 000), and the lowest was South China (624.5/100 000). Xiangtan City belongs to the central region, with a crude prevalence rate of 3.1%, and a standardized prevalence rate of 2.90%, slightly higher than the standardized prevalence ratio of stroke in China in 2019, which was 2.58%.[3] The report showed that the standardized prevalence ratio of stroke in urban areas was 2.65% in 2019, slightly greater than in rural areas, with a standardized prevalence ratio in rural areas of 2.55%. It is consistent with the results in Yantai City.[12-15]

At present, the detection ratio of high-risk groups of stroke in China is 12.94%~28.86%. The detection ratio of highly risky groups is lower in coastal areas and higher in inland areas, such as 28.86% in Xinzheng City, Henan Province, 28.41% in Hefei City, 25.9% in Lanzhou City, and 25.9% in Ningde City, Fujian Province. 13.52%, 12.94% in Qinhuangdao City, 18.13% in Baoshan District, Shanghai, and the detection ratio of highly risky groups in Xiangtan City is at an intermediate level (21.34%), which is lower than the standardized detection ratio of highly-risky groups in China in 2019 (26.02%).[16-25] The detection rate of stroke high-risk groups in urban areas in Xiangtan City was significantly higher than that in rural areas, but it had no obvious distinction in the crude prevalence ratio of stroke between urban and rural areas, which may be related to the fact that the intervention effects of urban stroke are better, thereby fewer high-risk groups developing strokes than rural areas. The study showed that the detection ratio of men at high risk of stroke was significantly higher than that of women, which is consistent with the epidemiological characteristics of stroke in China. This phenomenon may be related to the fact that men have more risk factors for example, smoking and drinking, than women.[26-28]

The risk factors of stroke in the study are hypertension (84.87%), dyslipidemia (73.39%), smoking history (43.18%), family history of stroke (40.96%) , and diabetes (39.91%). The rankings of these high-risk factors overall and in other regions are slightly different. In 2019, the top 3 risk factors for the highly risky population of stroke in China were hypertension, dyslipidemia, and lack of exercising and the standardized detection rates were 75.25%, 71.45%, and 48.62%, respectively,[3] while the top five exposure rates of the risk factors for highly-risky stroke in Jiangxi Province were hypertension (81.14%), dyslipidemia (70.07%), lack of exercise (43.89%), smoking (33.40%) and stroke family history (31.89%),[13] and the top five exposure rates of risk factors for stroke highly-risky groups in Lanzhou area were: high blood pressure (70.7%), obvious overweight or obesity (61.1%), lack of physical activity (60.5%), high Lipemia (55.9%) and smoking (40.0%).[12,8] Hypertension is one of the most common risk factors for cerebrovascular diseases, and it is also the most significant risk factor for premature death worldwide.[29] In this study, the number of hypertensive patients in the rural stroke high-risk population has reached 87.73%, which is much greater than the national average level and also higher than the hypertensive patients

(81.14%) among the highly-risky groups of stroke in Jiangxi Province.[15,3] The proportion of dyslipidemia is comparable to that of the national stroke highly-risky population, basically consistent with the dyslipidemia (70.07%) of the stroke highly-risky population in Jiangxi Province and greater than in Lanzhou. From the results of the study, it could be known that lack of exercise among the risk factors in stroke highly-risky population was only 20.57%, which was significantly lower than the national average level, indicating that residents of Xiangtan City have a relatively high amount of physical activity. The study showed that the proportions of lack of exercise and obesity in urban high-risk groups were obviously greater than those in rural areas, which may be relevant to urban residents' lack of physical activity and high dietary fat intake.[30] The research results showed that the proportions of high-risk populations in rural areas with a history of hypertension and TIA were obviously greater than those in urban areas, which may be relevant to the development of the rural economy and the improvement of life recently. The research results showed that rural residents had a salty diet, and the proportion of fruits ≤ 2 days/week was significantly higher than that of urban residents, and the proportion of vegetables ≤ 2 days/week was significantly lower than urban residents. Compared with the urban residents, rural residents are more likely to obtain vegetables, but due to the traditional rural eating habits and less health education, poor dietary conditions such as salty diet and lack of fruits in rural areas have occurred, so it is suggested to strengthen health education on stroke risk factors for rural residents and persuade rural residents to eat a balanced diet to control the progress of chronic diseases, thereby reducing the incidence of stroke in rural areas. This study found that whether in rural or urban areas, the main risk factors for high-risk groups of stroke are hypertension, dyslipidemia, and smoking history. Among them, hypertension is still the primary risk factor for stroke. Good management of hypertension has Stroke prevention is very important. At present, it is still necessary to actively advocate changing bad lifestyles, adjusting dietary structure, low-salt and low-fat, quitting smoking and limiting alcohol, strengthening physical exercise, and reasonably controlling blood pressure, blood sugar, and blood lipids; at the same time, for urban people, efforts to control smoking in public spaces should be further increased , reduce the proportion of passive smoking, in order to reduce the incidence of stroke, slow down its development, and prevent the occurrence of cardiovascular diseases.

In summary, the high-risk factors for stroke in Xiangtan City are mainly hypertension, dyslipidemia, smoking history, family history of stroke, and diabetes. Tailored public health measures should be taken by residents to address the different risk status and dietary habits of urban and rural populations. Especially dietary intervention for rural residents.

This paper only screened and intervened in the highly risky population of stroke in one city and one rural community in Xiangtan City. Selection bias may lead to under-representation. In addition, face-to-face questionnaire surveys may lead to recall bias in the prevalence of stroke, which needs to be improved with further research.

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REFERENCES

1. Global Burden of Disease Collaborative Network. Global burden of disease study 2019 (GBD 2019) *results*. (2020-10-17)[2021-05-07].
2. Zhao SF, Wang AM, Yu XJ, Wang LL, Xu XN, Shi GJ. Association between gallstone and cardio-cerebrovascular disease: systematic review and meta-analysis. *Exp Ther Med*. 2019;17(4):3092-3100. doi:10.3892/etm.2019.7291
3. Wang L, Bin P, Zhang H. Brief report on stroke prevention and treatment in China,2020 [J]. *Chinese Journal of Cerebrovascular Diseases*. 2022;19(02):136-144.
4. Yanan WANG, Simiao WU, Min LIU. Temporal trends and characteristics of stroke in China in the past 15 years [J]. *West China Medical Journal*. 2021;36(06):803-807.
5. Wang L, Ji X, Kang D, et al. Brief report on stroke center in China,2020 [J]. *Chinese Journal of Cerebrovascular Diseases*. 2021;18(11):737-743.
6. Wu S, Wu B, Liu M, et al; China Stroke Study Collaboration. Stroke in China: advances and challenges in epidemiology, prevention, and management. *Lancet Neurol*. 2019;18(4):394-405. doi:10.1016/S1474-4422(18)30500-3
7. Li H, Han Y. sheng f, kong f, do, dong j. Influence and significance of bilateral upper-excreniteremity training on recovery motor function for hemiplegi. C Patients with Mild-Modrate Cerebral Apoplexy: A Randomised Controlled Study. *Afr Health Sci*. 2022;22(3):375-382. doi:10.4314/ahs.v22i3.40
8. do Kleyton Palmeira Ó, da Silva Freire AK, de Nóbrega DN, et al. Polymorphisms and gene expression of metalloproteinases and their inhibitors associated with cerebral ischemic stroke in young patients with sickle cell anemia. *Mol Biol Rep*. 2023;50(4):3341-3353. doi:10.1007/s11033-023-08262-2
9. Polonikov AV, Vialykh EK, Churnosov MI, et al. The C718T polymorphism in the 3'-untranslated region of glutathione peroxidase-4 gene is a predictor of cerebral stroke in patients with essential hypertension. *Hypertens Res*. 2012;35(5):507-512. doi:10.1038/hr.2011.213
10. Maners J, Gill D, Pankratz N, et al; CHARGE Inflammation Working Group; INVENT Consortium; MEGASTROKE consortium of the International Stroke Genetics Consortium (ISGC). A Mendelian randomization of γ and total fibrinogen levels in relation to venous thromboembolism and ischemic stroke. *Blood*. 2020;136(26):3062-3069. doi:10.1182/blood.2019004781
11. Juan C, Liu C. The comparative analysis of stroke risk factor exposure levels in urban and rural areas of Yantai city [J]. *Stroke and Nervous Diseases*. 2019;26(02):189-192.
12. Peng X, Bao S, Wang H, Fan Z, Ge C. Analysis of high-risk population of stroke in Lanzhou stroke prevention and control database [J]. *Zhongguo Manxingbing Yufang Yu Kongzhi*. 2018;26(11):826-829.
13. Majidi S, Fifi JT, Ladner TR, et al. Emergent Large Vessel Occlusion Stroke During New York City's COVID-19 Outbreak: Clinical Characteristics and Paraclinical Findings. *Stroke*. 2020;51(9):2656-2663. doi:10.1161/STROKEAHA.120.030397
14. Wei Y, Wang M, Gui Y, et al. Carotid artery stiffness in rural adult Chinese: a cross-sectional analysis of the community-based China stroke cohort study. *BMJ Open*. 2020;10(10):e036398. doi:10.1136/bmjopen-2019-036398
15. Wang W, Jiang B, Sun H, et al; NESS-China Investigators. Prevalence, Incidence, and Mortality of Stroke in China: Results from a Nationwide Population-Based Survey of 480 687 Adults. *Circulation*. 2017;135(8):759-771. doi:10.1161/CIRCULATIONAHA.116.025250
16. WU Cui;CHEN Qiu-yan;WAN Jin-bao.Screening results of high-risk stroke population in Banshan district,Shanghai,2018[J].*Practical Preventive Medicine*,2020,27(10):1207-1209+1281.
17. YAO Xiao-li;YANG Gai-qing;JIANG Jiao-jiao;LI Cai-xia.Analysis on screening results of high-risk population of stroke among urban and rural residents, Xinzheng city,2020[J].*Preventive Medicine Tribune*,2022,28(03):166-168+171.
18. Mei-fen CHEN, Su-ying WANG, Xiao-hong FENG, Xu-fang HUANG, Li-ping JIANG. Risk factors for stroke in high-risk populations of different ages and genders [J]. *Pract Prev Med*. 2020;27(04):451-454.
19. Lian-lian XIONG, Guang-hui WU, Lan-yong FU. Screening on individuals at high-risk of stroke among middle-aged and elderly community residents in Ningde city,Fujian province [J]. *Chin J Publ Health*. 2020;36(12):1822-1824.
20. Wei Y, Li Z, Chen Y, et al. Prevalence and risk factors of stroke high-risk population among residents aged over 40 years in Jiangxi Province [J]. *Mod Prev Med*. 2021;48(12):2130-2134.
21. Chun Y, Zhao X, Chen X, Hao X, Yang P, Liu J. Screening of high risk population of stroke among permanent residents aged≥40 years in Huangpu District,Guangzhou [J]. *S China J Prev Med*. 2021;47(04):445-448.
22. Dai C, Qiang W, Ji H. Analysis on the screening results among high-risk stroke residents in a community of Hefei [J]. *Acta Universitatis Medicinalis Anhui*. 2021;56(01):148-152.
23. WANG Xiao-tang;ZOU Zhe-hua;LI Yan-li. Analysis of screening results of high-risk population of stroke in Qinhuangdao City[J].*South China Journal of Preventive Medicine*,2022,48(03):376-378 +382.
24. Wang YJ, Li ZX, Gu HQ, et al; China Stroke Statistics Writing Committee. China Stroke Statistics: an update on the 2019 report from the National Center for Healthcare Quality Management in Neurological Diseases, China National Clinical Research Center for Neurological Diseases, the Chinese Stroke Association, National Center for Chronic and Non-communicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention and Institute for Global Neuroscience and Stroke Collaborations. *Stroke Vasc Neurol*. 2022;7(5):415-450. doi:10.1136/svn-2021-001374
25. Xu J, Zhang X, Jin A, et al. Trends and Risk Factors Associated With Stroke Recurrence in China, 2007-2018. *JAMA Netw Open*. 2022;5(6):e2216341. doi:10.1001/jamanetworkopen.2022.16341
26. Poggesi A, Insalata G, Papi G, et al. Gender differences in post-stroke functional outcome at discharge from an intensive rehabilitation hospital. *Eur J Neurol*. 2021;28(5):1601-1608. doi:10.1111/ene.14769
27. Boehme AK, Siegler JE, Mullen MT, et al. Racial and gender differences in stroke severity, outcomes, and treatment in patients with acute ischemic stroke. *J Stroke Cerebrovasc Dis*. 2014;23(4):e255-e261. doi:10.1016/j.jstrokecerebrovasdis.2013.11.003
28. Ospel JM, Schaafsma JD, Leslie-Mazwi TM, Amin-Hanjani S, Asdaghi N, Gordon-Perue GL, Couillard P, Hadidi NN, Bushnell C, McCullough LD, Goyal M; American Heart Association Stroke Council; Council on Cardiovascular Radiology and Intervention; and Council on Epidemiology and Prevention. Toward a Better Understanding of Sex- and Gender-Related Differences in Endovascular Stroke Treatment: A Scientific Statement From the American Heart Association/American Stroke Association. Stroke. 2022 Aug;53(8):e39 6 -e406.
29. Brief report on stroke prevention and treatment in China, 2019 [J]. *Chinese Journal of Cerebrovascular Diseases*. 2020;17(05):272-281.
30. Report on the Nutrition and Chronic Diseases Status of Chinese Residents 2020 [J]. *Ying Yang Xue Bao*. 2020;42(06):521.