Original Article

Analysis of the exposure to risk factors for strokes of the high-risk population in Zunyi City, Guizhou Province of China

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Background: To determine the exposure rates of the risk factors and the distribution characteristics of the population at high risk for stroke in Zunyi City, and thereby provide references for health management of the population.

Methods: Cluster sampling was applied to collect the medical histories, laboratory tests, and physical examinations of permanent residents in Zunyi City, Guizhou Province, for the purpose of analyzing the characteristics of risk factors in the population at high risk for stroke.

Results: A total of 1,382 residents were screened as the high-risk population [681 males (49.3%), 701 females (50.7%)] with a detection rate of 11.11%. For the high-risk population, the top 5 risk factors for stroke were hypertension (78.9%), dyslipidemia (64.5%), obesity (54.1%), lack of exercise (48.8%), and smoking (35.1%). The exposure rates of females at high risk of hypertension, diabetes, dyslipidemia, and obesity were significantly higher than those of males, while the smoking rate of the high-risk males was significantly higher than that of the females. Significantly different exposure rates of stroke from hypertension, smoking, dyslipidemia, lack of exercise, overweight or obesity, and family history were shown in high-risk populations of different ages, while the incidence of stroke/transient ischemic attack (TIA) showed an increasing trend with aging.

Conclusions: Hypertension, dyslipidemia, and obesity are the main risk factors for stroke in Zunyi City, with the detection rate of high-risk females being slightly higher than that of the males, and the population with a history of stroke/TIA performed better than the population with more than 3 risk factors.

Keywords: Stroke; high-risk factors; cluster sampling; distribution characteristics; intervention

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Introduction

As a clinical event involving acute cerebral circulatory disorder quickly leading to localized or diffuse brain dysfunction, and a common disease of the nervous system (1), stroke has become the second leading cause of death globally and the main cause of death and disability in China (2). Statistics have shown that the incidence of stroke is increasing rapidly at a rate of 100% in middle-income countries, resulting in a continuous increase in medical expenses related to stroke (3). According to the 2013 Global Burden of Disease Study, more than 90% of the burden of stroke was caused by the potentially intervenable risk factors, and more than 75% of the burden of stroke events could be reduced by controlling the

associated risk factors (4,5), while more than 80% of strokes could be prevented by early intervention (3), indicating that early detection of the population at high-risk of stroke is the key to its prevention and treatment (6).

Included in the 2011 Stroke Guidelines of American Heart Association/American Stroke Association for Primary Prevention were the three categories of risk factors: the immutable, the possibly mutable, and the mutable (7), among which the mutable factors included hypertension, smoking, diabetes, atrial fibrillation, dyslipidemia, carotid artery stenosis, poor diet, obesity, and fat distribution. It has been widely recognized that the effectiveness of initial stroke prevention could be maximized by targeting the major vascular or cardiometabolic risk factors (for example, smoking, hypertension, diabetes) (8,9), demonstrating that, in primary stroke prevention, a comprehensive assessment of risk stratification plays a particularly important role in formulating targeted prevention strategies.

Even though, there are many papers reported the risk factors of stroke based on Chinese population, however, most of them focused on the investigation from nationwide or other regions. The study, published by Dong *et al.* in 2020 (10), confirmed the differences in population attributable (PAP) and the risk factors of stroke in different regions of China. Therefore, the effectiveness of China's primary prevention strategies has been revealed as unsatisfactory by the currently high incidence of stroke, and it is of great value to obtain the local population's exposure rates to the risk factors of stoke for the prevention of stroke. In this study, the screened data of the population at high risk of stroke in the Guizhou Province from 2013 to 2017 were analyzed, with the aim of obtaining the exposure rates of the risk factors for stoke and the population distribution characteristics, which providing reference for the health management of stroke high-risk population in this region. We present the following article in accordance with the STROBE reporting checklist (available at https://dx.doi.org/10.21037/apm-21-2914).

Methods

Participants

Cluster sampling was adopted to select 19,877 residents who had participated in stroke screening (from 2013 to 2017) in Zunyi City, Guizhou Province, as the research cohort. The inclusion criteria were as follows: age ≥40 years; permanent resident of Zunyi City, Guizhou Province; lucidity and no evidence of speech of communication barriers; and willingness to participate in this study and sign an informed consent. The exclusion criteria were as follows: severe vision, hearing, or communication impairment; psychiatric complications and abnormal cognitive behaviors; severe physical complications; and incomplete clinical data. Finally, we recruited 12,432 aged 20–80 (61.15±11.30) years (4,767 males and 7,665 females). All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Affiliated Hospital of Zunyi Medical University (Date: 17.02.2016, No. 089) and informed consent was taken from all the patients.

Research methods

The cross-sectional survey method was applied to collect and evaluate basic participant information (social demographic characteristics, lifestyles, past medical history, family history), with physical examinations and laboratory examinations carried out on residents assessed as the high-risk population. The competency of all personnel participating in the investigation was verified after the conduction of rigorous training, and all measuring instruments were rigorously calibrated. The neck B-ultrasound, electrocardiogram, and other examinations were performed by experienced technicians from tertiary A hospital, with specific personnel assigned to carry out quality control during the screening process.

Laboratory examinations

A total of 5 mL of cubital venous blood was collected from participants in the morning as fasting for more than 12 h for the determination of the blood glucose (GLU), total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and the level of low-density lipoprotein cholesterol (LDL-C) within 6 h, with the OLYMPUS AU5400 automatic biochemical analyzer (Olympus, Tokyo, Japan) and supporting reagents.

Screening criteria

To assess the risk stratification of the high-risk population, the "8+2" stroke risk elements were applied, therein "8" referred to the following 8 aspects: hypertension [showing systolic blood pressure (SBP) of ≥140 mmHg and/or

diastolic blood pressure (DBP) of ≥90 mmHg in the absence of hypertension drugs, or having been diagnosed as hypertension by a community level hospital or above]; diabetes; atrial fibrillation or valvular heart disease; smoking history (continuous or cumulative smoking for more than 6 months); dyslipidemia (TG ≥2.26 mmol/L, TC ≥6.22 mmol/L, LDL-C ≥4.14 mmol/L, or HDL-C ≤1.04 mmol/L); lack of exercise (exercise frequency of 3 times/week, time of <30 min/time, and duration of <1 year); obvious overweight or obesity [body mass index (BMI) of 24–28 kg/m^2 regarded as overweight, and ≥28 kg/m^2 regarded as obesity]; family history of stroke, while "2" referred to past history of stroke and past history of transient ischemic attack (TIA). High-risk population was defined as those with 3 or more of the "8" stroke risk factors, or a history of TIA or a history of stroke, while the non-high-risk population was defined as having 3 elements or less.

Statistical analysis

Statistical analysis was conducted with the software SPSS 23.0 (IBM Corp., Armonk, NY, USA). Measurement data were expressed as mean ± standard deviation (SD), independent sample *t*-test was used for comparison between two groups, and single-factor variance analysis was used for comparison between multiple groups, and the enumeration data was obtained by a χ^2 test or Fisher's exact probability method. A P value <0.05 was considered to indicate a statistically significant difference.

Results

Comparison between clinical data of the high-risk and non-high-risk population in Zunyi City from 2013 to 2017

After the stroke risk assessment, a total of 1,382 cases were detected from the population at high-risk of stroke (detection rate 11.11%), of which males accounted for 49.3%. Based on the clinical data analysis, the proportion of the male high-risk population (49.3%) was higher than that of men in non-high-risk groups (37.0%) (P<0.05), showing significantly higher levels of BMI, SBP, DBP, GLU, TG, TC, LDL-C, and HDL-C in the high-risk population than those in the non-high-risk population (P<0.05), while in the high-risk population, the exposure rates of the top 5 risk factors were hypertension (78.9%), dyslipidemia (64.5%), obesity (54.1%), lack of exercise (48.8%), and smoking (35.1%) respectively (*Table 1*).

Logistic regression analysis of the risk factors affecting the population at high-risk of stroke

The stepwise method was adopted to perform multi-factor logistic regression analysis, with a probability of entering the model of 0.01, and a probability of excluding the model of 0.05. Using stroke as the dependent variable and the included 19 influencing factors as independent variables (*Table 2*), it was revealed that hypertension, dyslipidemia, diabetes, atrial fibrillation, smoking, lack of exercise, overweight or obesity, and family history of stroke were all risk factors for the population at high risk of stroke (P<0.05).

Comparison of the exposure rates of risk factors among high-risk populations of different genders

The detection rate of women at high risk (50.7%) was slightly higher than that of men (49.3%). The rates of females at high risk exposed to risk factors such as hypertension, diabetes, dyslipidemia, and overweight or obesity was significantly higher than those of males (P<0.05), while the smoking rate of men at high risk was significantly higher than that of women (P<0.05; *Table 3*). In addition, compared with the male high-risk population, the levels of BMI, GLU, TG, TC, LDL-C, and HDL-C in female high-risk groups were shown to have significantly increased (P<0.05; *Table 4*).

Comparison of exposure rates of risk factors among high-risk populations of different ages

The exposure rates of hypertension, smoking, dyslipidemia, lack of exercise, overweight or obesity, and family history were significantly different among high-risk populations of different ages (P<0.05; *Table 5*): for the high-risk population <40 years old, dyslipidemia, obesity, and smoking were the risk factors for the higher exposure rate; for the high-risk population 40–59 years old, hypertension, dyslipidemia, and obesity were the risk factors for higher exposure rates; for the high-risk population 60–79 years old, hypertension, dyslipidemia, and lack of exercise were the risk factors for the higher exposure rate; and for high-risk population ≥80 years, hypertension, lack of exercise, and dyslipidemia were the risk factors for the higher exposure rate. In addition, the incidence of stroke/TIA showed an increasing trend with age (P<0.05), with significantly different levels of BMI, SBP, DBP, and TG among populations of different ages (P<0.05; *Table 6*), therein the BMI showed a decreasing

Table 1 Comparison of clinical data between high-risk and non-high-risk groups in Zunyi City from 2013 to 2017

Features	Non-high (n=11,050)	High (n=1,382)	P value
Gender, n (%)			<0.001
Male	4,086 (37.0)	681 (49.3)	
Female	6,964 (63.0)	701 (50.7)	
Age (years), n (%)			0.306
<40	64 (0.6)	7 (0.5)	
40–59	4,681 (42.4)	566 (41.0)	
60–79	5,776 (52.3)	754 (54.6)	
≥80	529 (4.8)	55 (4.0)	
BMI (kg/m^2), mean ± SD	23.71±3.68	26.74±4.06	<0.001
SBP, mean ± SD	133.13±22.18	144.00±22.36	<0.001
DBP, mean ± SD	82.11±12.71	88.95±13.23	<0.001
GLU, mean ± SD	4.96±1.46	5.60±2.28	<0.001
TG, mean ± SD	1.76±1.31	2.57±1.93	<0.001
TC, mean ± SD	4.68±0.99	4.91±1.08	<0.001
LDL-C, mean ± SD	2.13±0.81	2.26±0.82	<0.001
HDL-C, mean ± SD	1.46±0.59	1.31±0.59	<0.001
Risk factors, n (%)			
Hypertension	3,224 (29.2)	1,091 (78.9)	<0.001
Diabetes	281 (2.5)	302 (21.9)	<0.001
Atrial fibrillation	27 (0.2)	19 (1.4)	<0.001
Smoking history	1,598 (14.5)	485 (35.1)	<0.001
Dyslipidemia	2,601 (23.5)	892 (64.5)	<0.001
Lack of exercise	1,922 (17.4)	674 (48.8)	<0.001
Overweight or obese	1,853 (16.8)	748 (54.1)	<0.001
Family history of stroke	192 (1.7)	152 (11.0)	<0.001
Previous stroke history or TIA	–	200 (14.5)	<0.001

BMI, body mass index; SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure; GLU, blood glucose; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; TIA, transient ischemic attack.

trend with aging while SBP showed an increasing trend (P<0.05).

Comparison between the general data of ≥3 risk factors in the high-risk population and those with previous TIA/stroke history

Among the populations at high risk for stroke detected in this study, 200 had a history of stroke or TIA, and 1,182 presented with ≥3 items of the 8 stroke risk factors, therein the top 3 exposure rates of risk factors were respectively listed as hypertension (81.0%), dyslipidemia (70.3%), and overweight or obesity (59.1%) (*Table 7*). At the same time, compared with the population with a history of stroke/TIA, age, BMI, GLU, and TG levels of the high-risk population with risk factors ≥3 were significantly higher (P<0.05), while

Table 2 Logistic regression analysis

Factor	β	Standard error	Wald	P value	OR	95% CI (lower)	95% CI (upper)
TC	–0.125	0.050	6.226	0.013	0.882	0.800	0.974
Hypertension	4.566	0.145	990.131	0.000	96.132	72.337	127.755
Dyslipidemia	4.371	0.143	936.067	0.000	79.147	59.816	104.725
Diabetes	4.304	0.196	481.247	0.000	74.022	50.390	108.737
Atrial fibrillation	4.175	0.619	45.419	0.000	65.017	19.309	218.926
Smoking history	4.003	0.144	768.931	0.000	54.763	41.267	72.671
Lack of exercise	4.124	0.136	914.748	0.000	61.803	47.309	80.737
Overweight or obese	4.174	0.135	961.423	0.000	64.955	49.893	84.565
Family history of stroke	4.272	0.242	310.626	0.000	71.632	44.546	115.187
Constant	–21.993	0.876	630.935	0.000	0.000	–	–

TC, total cholesterol; OR, odds ratio; CI, confidence interval.

Table 3 Exposure rates of risk factors among stroke high-risk populations with different gender in Zhunyi City

Items	Male (n=681)	Female (n=701)	P value
Hypertension, n (%)	518 (76.1)	573 (81.7)	0.010
Diabetes, n (%)	108 (15.9)	194 (27.7)	<0.001
Atrial fibrillation, n (%)	10 (1.5)	9 (1.3)	0.768
Smoking history, n (%)	450 (66.1)	35 (5.0)	<0.001
Dyslipidemia, n (%)	402 (59.0)	490 (69.9)	<0.001
Lack of exercise, n (%)	316 (46.4)	358 (51.1)	0.083
Overweight or obese, n (%)	339 (49.8)	409 (58.3)	0.001
Family history of stroke, n (%)	70 (10.3)	82 (11.7)	0.399
Previous stroke history or TIA, n (%)	86 (12.6)	114 (16.3)	0.055

TIA, transient ischemic attack.

Table 4 Comparison of clinical data of high-risk stroke populations of different genders

Items	Male (n=681)	Female (n=701)	P value
Age (years), n (%)			0.076
<40	6 (0.9)	1 (0.1)	
40–59	284 (41.7)	282 (40.2)	
60–79	359 (52.7)	395 (56.3)	
≥80	32 (4.7)	23 (3.3)	
BMI (kg/m^2), mean ± SD	26.22±4.10	27.24±3.95	<0.001
SBP, mean ± SD	143.27±22.18	144.71±22.53	0.230
DBP, mean ± SD	88.94±12.68	88.96±13.75	0.977
GLU, mean ± SD	5.38±2.04	5.80±2.47	0.001
TG, mean ± SD	2.42±1.87	2.72±1.98	0.003
TC, mean ± SD	4.70±1.03	5.12±1.09	<0.001
LDL-C, mean ± SD	2.19±0.77	2.33±0.86	0.001
HDL-C, mean ± SD	1.26±0.56	1.35±0.61	0.002

BMI, body mass index; SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure; GLU, blood glucose; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol.

Table 5 Clinical data among stroke high-risk populations with different age in Zhunyi City

Items	<40 (n=7)	40–59 (n=566)	60–79 (n=754)	≥80 (n=55)	P value
Hypertension, n (%)	3 (42.9)	413 (73.0)	629 (83.4)	43 (83.6)	<0.001
Diabetes, n (%)	1 (14.3)	116 (20.5)	177 (23.5)	8 (14.5)	0.292
Atrial fibrillation, n (%)	–	8 (1.4)	11 (1.5)	–	0.623
Smoking history, n (%)	5 (71.4)	224 (39.6)	233 (30.9)	23 (41.8)	0.001
Dyslipidemia, n (%)	6 (85.7)	398 (70.3)	460 (61.0)	28 (50.9)	<0.001
Lack of exercise, n (%)	3 (42.9)	258 (45.6)	380 (50.4)	33 (60.0)	0.112
Overweight or obese, n (%)	5 (71.4)	356 (62.9)	363 (48.1)	24 (43.6)	<0.001
Family history of stroke, n (%)	1 (14.3)	84 (14.8)	63 (8.4)	4 (7.3)	0.002
Previous stroke history or TIA, n (%)	1 (14.3)	60 (10.6)	126 (16.7)	13 (23.6)	0.003

TIA, transient ischemic attack.

Table 6 Exposure rates of risk factors among stroke high-risk populations with different age in Zhunyi City

Items	<40 (n=7)	40–59 (n=566)	60–79 (n=754)	≥80 (n=55)	P value
Gender, n (%)					0.076
Male	6 (85.7)	284 (50.2)	359 (47.6)	32 (58.2)	
Female	1 (14.3)	282 (49.8)	395 (52.4)	23 (41.8)	
BMI (kg/m^2), mean ± SD	27.67±3.38	27.64±3.43	26.18±4.35	24.85±4.14	<0.001
SBP, mean ± SD	131.43±19.00	137.92±21.91	148.03±21.51	153.07±23.56	<0.001
DBP, mean ± SD	89.86±15.48	89.46±14.03	88.92±12.70	83.87±10.51	0.029
GLU, mean ± SD	5.15±2.37	5.43±1.98	5.74±2.52	5.29±1.34	0.066
TG, mean ± SD	2.71±0.85	2.83±2.26	2.42±1.68	1.95±0.84	<0.001
TC, mean ± SD	4.79±0.93	4.94±1.14	4.91±1.04	4.67±0.99	0.372
LDL-C, mean ± SD	2.00±0.80	2.23±0.80	2.28±0.82	2.33±0.98	0.509
HDL-C, mean ± SD	1.07±0.19	1.30±0.62	1.32±0.58	1.24±0.32	0.568

BMI, body mass index; SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure; GLU, blood glucose; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol.

Table 7 Exposure rates of risk factors between high-risk residents with at least 3 risk factors and those with previous TIA/stroke history

Items	Risk factors ≥3 (n=1,182)	Previous TIA/stroke (n=200)	P value
Hypertension, n (%)	958 (81.0)	133 (66.5)	<0.001
Diabetes, n (%)	283 (23.9)	19 (9.5)	<0.001
Atrial fibrillation, n (%)	17 (1.4)	2 (1.0)	0.870
Smoking history, n (%)	439 (37.1)	46 (23.0)	<0.001
Dyslipidemia, n (%)	831 (70.3)	61 (30.5)	<0.001
Lack of exercise, n (%)	616 (52.1)	58 (29.0)	<0.001
Overweight or obese, n (%)	699 (59.1)	49 (24.5)	<0.001
Family history of stroke, n (%)	113 (9.6)	39 (19.5)	<0.001

TIA, transient ischemic attack.

Table 8 Clinical data between high-risk residents with at least 3 risk factors and those with previous TIA/stroke

Items	Risk factors ≥3 (n=1,182)	Previous TIA/stroke (n=200)	P value
Male, n (%)	595 (50.3)	86 (43.0)	0.055
Age (years), n (%)			0.003
<40	6 (0.5)	1 (0.5)	
40–59	506 (42.8)	60 (30.0)	
60–79	628 (53.1)	126 (63.0)	
≥80	42 (3.6)	13 (6.5)	
BMI (kg/m^2), mean ± SD	27.10±3.98	24.58±3.88	<0.001
SBP, mean ± SD	143.92±22.12	144.51±23.77	0.731
DBP, mean ± SD	89.19±13.19	87.48±13.41	0.090
GLU, mean ± SD	5.66±2.28	5.20±2.23	0.007
TG, mean ± SD	2.66±2.06	2.06±1.16	<0.001
TC, mean ± SD	4.93±1.09	4.78±1.02	0.062
LDL-C, mean ± SD	2.27±0.83	2.20±0.76	0.216
HDL-C, mean ± SD	1.28±0.57	1.44±0.66	<0.001

TIA, transient ischemic attack; SD, standard deviation; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; GLU, blood glucose; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol.

the HDL-C level was significantly reduced (P<0.05; *Table 8*).

Discussion

In 2013, China's cause of death monitoring system showed that circulatory system diseases had become the major cause of death for Chinese residents, with stroke ranking the first among all such diseases (11). A recent study showed that stroke was still the number one cause of death in China in 2015 (12). Fortunately, stroke is a preventable disease (13), and an economical means of effectively reducing stroke incidence is to manage the intervenable risk factors. The British National Health Service (NHS) assesses the major risk factors for cardiovascular and cerebrovascular diseases in people between 40 and 74 years old, and plays an important role in the primary prevention of cardiovascular and cerebrovascular diseases (3). It was shown in a case-control study that 10 risk factors had a correlation with 90% of the stroke risks, and the burden of stroke could be profoundly reduced by targeted interventions, such as lowering blood pressure, quitting smoking, doing physical exercises, and adopting a healthy diet (14). Consequently, gathering evidence of the exposure rates of risk factors for stroke of local populations at high risk is of important reference value in formulating targeted prevention strategies.

In this study, a total of 1,382 (11.11%) people at high risk of stroke in Guizhou were screened, which is higher than the standardized prevalence rate (2.19%) of stroke for people ≥40 years old in China in 2016. Common risk factors for stroke include hypertension, diabetes, coronary heart disease, dyslipidemia, smoking, alcohol consumption, and so on (15), among which the risk factors that had a close correlation with the occurrence of stroke in China were hypertension, smoking, and dyslipidemia (12,16). In this study, hypertension, dyslipidemia, and obesity were found to be the major risk factors for stroke among the high-risk population in Zunyi City. In both developing and developed countries, hypertension is one of the main risk factors for stroke (17), since it is closely related to ischemic strokes and hemorrhagic strokes, and it, independent of other risk factors, functions as a continuous variable for strokes (18). Hypertension was shown to present the highest exposure rate of strokes in the high-risk population in Guizhou (78.9%), which was in conformity with the relevant results that hypertension is the most deadly risk factor for stroke

(14,19). A large proportion of the stroke population were shown by Kawle *et al.* to have hypertension, including 45% of the young stroke population and 80% of the elderly stroke population, which correlated with inferior prognosis and a higher disability rate (20). Lowering blood pressure has been identified as an effective approach to preventing stroke in individuals with hypertension (21,22). Early anti-hypertensive interventions were shown in a randomized clinical trial from China to reduce recurrent strokes of hypertensive ischemic stroke by 56% and decrease vascular events by 34% (23). The administration of statins is associated with the reduced absolute risk of ischemic strokes and cardiovascular events. Despite the encouraging improvement in patients' awareness of the risks resulting from hypertension and its treatment and control, the proportion of people whose hypertension is under control is still less than 20% in China (24). As a result, optimizing the control of blood pressure is of vital importance in preventing and treating of the population at high risk of stroke in Zunyi City.

Dyslipidemia is one of the main risk factors for cerebrovascular diseases. Lipid metabolism is a key factor in the formation of unstable carotid plaques, and about 20–25% of strokes are caused by carotid atherosclerotic plaques (25). In this study, the detection rate of dyslipidemia in the high-risk population, lower only than that of hypertension, was 64.5%, indicating the key role of dyslipidemia in increasing the risk of stroke. Studies showed that patients with dyslipidemia were at an increased risk of hemorrhagic stroke (26), and the administration of statins was an independent protective factor against macrovascular events (27). Diabetes is an independent risk factor for stroke, and the stroke exposure rate of people with diabetes is 1.5–3.0 times that of non-diabetic people (28). In this study, the diabetes exposure rate of the high-risk population was relatively low, which was speculated to have a correlation with the local diet.

Statistics show that stroke is more common in men, with the incidence of 30–45% higher than that of women (29). Wang *et al.* showed that men were susceptible to higher risks for strokes, which was speculated to be the result of men's more unhealthy lifestyles (30). However, on the basis of the gender distinction results in this study, the detection rate of women at high risk is slightly higher than that of men. A study in Brazil showed that the exposure rate of the risk factors for stroke in overweight people is 40% higher than that of people with normal BMI (31). Although the exposure rate of smoking in the male population at high risk of stroke was found in this study to be much higher than that of women, the exposure rates of hypertension, diabetes, dyslipidemia, and obvious overweight or obesity risk factors in the high-risk female population were demonstrated significantly higher than those of men, which was speculated to be the cause of the higher detection rate in the female population in Zunyi, suggesting that more attention should be paid to general health education for female residents.

Aging is a non-interventional risk factor for ischemic stroke. The incidence of stroke in the young population was demonstrated by a 10-year demographic study to be on the rise (32). The 60–79 years old population was revealed as the prevalent age group (54.6%) among the population at high risk of stroke, which was speculated to correlate with degenerative changes in the relative organ systems with the superimposed exposure to risk factors. Meanwhile, the detection rate of the ≥80 years' population at high risk of strokes was lower than that of the 40–79 years old population, which might be related to the fact that the elderly population was somewhat underrepresented in the study. Despite a trend of younger stroke incidence not having been shown in this study, it is still impossible to determine the changes in the incidence of stroke among young people in this region. In addition, different from the condition of the high-risk population of ≥60 years of age, overweight or obesity and smoking are the risk factors for the high exposure rate of high-risk populations of <40 years of age, suggesting that the local young population should be offered dietary and lifestyle guidance.

High-risk populations with risk factors ≥3 presented with significantly higher exposure rates of dyslipidemia, overweight or obesity, diabetes, lack of exercise, smoking, and hypertension compared to the population with previous stroke/TIA (33). It was proposed by Rutten-Jacobs *et al.* that unhealthy lifestyle is an independent risk factors for stroke (33). The risk of stroke can be reduced by adopting a healthy lifestyle (34). Kubota *et al.* proposed that engaging in moderate physical activity is the best strategy for stroke prevention (35). A follow-up study in Japan showed that better functional recoveries had a significant correlation with stroke populations' better adherence to the programs for physical activities and work-outs (36). By the results of a questionnaire survey on stroke knowledge, 87.7% of the population were aware that hypertension was a risk factor for stroke, but only 44.2–64.4% of the population were aware of other risk factors for stroke (37), indicating the necessity of strengthening the publicity and education on blood pressure, blood lipids, and exercise management, thus

managing the populations at high risks in Zunyi through intervening the mutable risk factors.

However, there were still many defects in this study: first of all, this study is obviously characterized by regional limitation; secondly, this study only analyzed the populations with complete clinical data, which may have led to biased results; thirdly, this study was based on the analysis of physical examination data only, without incorporating statistics on the intervention strategies and drug use of the populations at high risk of stroke.

Conclusions

The detection rate of the population at high risk of strokes in Zunyi City was 11.11%, with hypertension, dyslipidemia, and obesity included as the main stroke risk factors of local residents. In addition, the detection rate of the local females at high risk of stroke was shown to be higher than that of the males, and residents with a history of stroke/TIA were doing better in controlling blood pressure, blood lipids, and weight than those with ≥3 risk factors. In view of the current exposure to stroke risk factors, it is recommended that health education and intervention strategies should be actively adjusted and formulated in Zunyi City, Guizhou Province, to meet the needs of residents in the region, thus improving local populations' awareness of stroke prevention, eliminating unhealthy lifestyles, actively seeking medical care, and reducing the overall risk of stroke.

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Footnote

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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. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Affiliated Hospital of Zunyi Medical University (Date: 17.02.2016, No. 089) and informed consent was taken from all the patients.

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