Relationship Between Sleep Duration and Stroke in Middle-Aged and Elderly in Guiyang: A Cross-Sectional Survey

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Abstract

Background: With over 2 million new cases annually, stroke is associated with the highest disability-adjusted life-years lost of any disease in China. The relationship between sleep time and stroke has not been concluded yet.

To study the relationship between sleep duration and stroke in middle-aged and elderly in Guiyang, China.

Methods: This study was a cross-sectional survey carried out in 40-99-years-old permanent residents in Guiyang. Yunyan, Wudang, and Baiyun districts and Xiuwen County were selected by stratified multilevel sampling for a face-to-face survey. Demographics, stroke, sleep behavior, and health behavior were collected. Multivariable logistic regression models were used to gradually adjust the association between sleep duration and stroke for possible confounding factors.

Results: A total of 5065 participants were included, and 126 (2.5%) had a stroke. Insufficient sleep (<7 h) was observed in 11.0%, sufficient sleep (7-9 h) in 69.4%, and long sleep (>9 h) in 19.6%. Sleep duration and stroke prevalence showed a U-shaped distribution. When taking the sleep duration of 7-9 h as reference, sleep duration >9 h was associated with stroke (all $P < 0.05$) in the univariable model (OR=2.68, 95%CI: 1.83-3.93) and in the multivariable models 1 (OR=2.35, 95%CI: 1.59-3.47), 2 (OR=2.27, 95%CI: 1.53-3.37), 3 (OR=2.25, 95%CI: 1.51-3.33), and 4 (OR=2.11, 95%CI: 1.39-3.19). There were no significant differences between the <7 and 7-9 h groups ($P > 0.05$).

Conclusion: Long sleep duration (>9 h) is independently associated with stroke in middle-aged and elderly people in Guiyang.

Background

Stroke is a cerebrovascular disease that rapidly leads to localized or diffuse brain dysfunction due to acute cerebral circulation disorder[1]. Stroke features a high mortality rate (about 5.5 million each year) and high morbidity rate, as well as long-term disability in up to 50% of survivors[2,3]. The incidence of stroke in China is 298 per 100,000 person-years in rural areas and 204 per 100,000 person-years in urban areas[4], with geographic variations across the country[5] and increasing over time[6]. Stroke is, therefore, a significant public health burden. The risk factors for stroke include a history of transient ischemic attacks, smoking, metabolic syndrome, hypertension, heavy alcohol use, diabetes mellitus type 2, high cholesterol levels, carotid artery stenosis, obesity, and poor physical status, among others[7,8].

Sleep duration and quality can affect not only the quality of life but also physical health. Indeed, sleep duration is associated with hypertension, diabetes, stroke, and other diseases[9]. Frequent snoring during sleep has been associated with the risk of stroke in various populations[10-12]. Furthermore, studies showed that the relationship between sleep duration and the risk of stroke follows a J-shaped curve[13,14]. When considering a normal sleep duration of 7 h as a reference, sleep duration <7 h will

increase the risk of stroke by 7% for every 1 h of shorter sleep, and >7 h will increase the risk of stroke by 17% for every 1 h of sleep duration >7 h[14].

Nevertheless, considering the wide variation in the incidence of stroke among regions in China, it is possible that the relationship between sleep duration and the risk of stroke also varies considerably. Because of the low prevalence of stroke in the community, there is insufficient evidence regarding the relationship between sleep duration and stroke risk in the Chinese population. Only epidemiological studies with sufficiently large population samples can provide reliable evidence to answer the necessary research questions discussed above.

Therefore, the purpose of this study is to investigate the relationship between sleep time and stroke in the middle-aged and elderly people in Guiyang through a survey of more than 10,000 residents in Guiyang. The research results can provide a reference for the prevention and control of stroke.

Methods

Ethics approval and consent to participate

The study was approved by the ethics committee of Drug Clinical Trial of Affiliated Hospital of Guizhou Medical University and all participants signed the study consent form. All patients signed a surgical consent form. Informed consent was obtained from all individual participants included in the study. And all methods were performed in accordance with the relevant guidelines and regulations

Consent for publication

Consent for publication is not applicable since patient records/information was anonymized and de-identified prior to analysis.

Study design and participants

The survey adopted a stratified and multilevel sampling method. From July 2017 to August 2017, according to the geographical location, Guiyang city is divided into three types of regions. In each type of regions, districts or counties are randomly selected according to the random number table method, and then 1 township (town or community) is randomly selected from each district or county. In the final selected area, the survey was conducted with the family as the unit, and the residents of middle-aged and elderly members were included in this study as the subjects of the survey. The inclusion criteria were 1) voluntary participation; 2) >40 years of age, and 3) have lived for >6 months in Guiyang in the past 12 months or have left Guiyang for <12 months. The exclusion criterion was unable to contact the potential participant after three attempts. The study was approved by the ethics committee of Drug Clinical Trial of Affiliated Hospital of Guizhou Medical University and all participants signed the study consent form.

Survey method

The questionnaire of the 2017 Guiyang Residents Disease Spectrum Survey was adopted, with the household as a unit, and a face-to-face questionnaire survey was conducted on all residents who met the eligibility criteria in the household. In principle, the questionnaire had to be answered face to face. For those who could not answer the questionnaire due to physical, mental, intellectual, and age factors, their families could answer the questionnaire on their behalf. Guiyang's resident population who have been working/studying abroad for a long time and who have been out or hospitalized during the survey could be interviewed by telephone. The survey contents included general situation (sex, age, nationality, education, marital status, and annual family income), whether suffering from stroke, sleep behavior (including sleep duration and sleep quality), and lifestyle behaviors (smoking, drinking, and exercise frequency).

Definition of relevant indicators and grouping

Stroke was defined as a confirmed diagnosis of stroke by a hospital. Sleep duration was obtained by "sleep duration and getting up time in the past month", and the participants were divided into <7, 7-9, and >9 h. Referring to the sleep duration standard[15], <7 h was deemed insufficient sleep duration, 7-9 h was normal sleep duration, and >9 h was long sleep duration. Sleep quality was obtained through "self-evaluation of night sleep quality in the past month". In this study, sleep quality was divided into "good" (including "very good" and "better"), average, and poor (including "very poor" and "poor"). Hypertension, diabetes, and coronary heart disease were reported by the participants according to a diagnosis made at a hospital. Overweight and obesity were evaluated based on the body mass index (BMI, kg/m²). In this study, the Chinese Adult Weight Determination Standard was adopted to classify overweight and obesity [16]: BMI <18.5 was lean, 18.5≤BMI<24.0 was normal, 24.0 ≤BMI<28.0 was overweight, and BMI ≥28.0 was obesity. Health status was obtained through self-assessment. This study divided self-perceived health status into "good" (including "very good" and "better"), general, and poor (including "very poor" and "poor"). Exercise frequency was divided into 0-3, 4-5, and 6-7 days/week.

Statistical method

EpiData 3.1 (Centers for Disease Control, Atlanta, GA, USA) was used to establish the database. All data were double-entered and verified by comparison of the independent two entries. SPSS 25.0 (IBM Corp, Armonk, NY, USA) was used for statistical analysis. The data are described as means ± standard deviations and n (%). The distribution of sleep duration and the prevalence of stroke according to different characteristics were tested using the chi-square test. The relationship between sleep duration and stroke was analyzed by a two-classification logistic regression model. First, univariable logistic regression analysis was carried out with sleep duration as the independent variable and stroke prevalence as the dependent variable. Then, the possible confounding factors were gradually added using a multivariable logistic regression analysis (Supplementary Table S1): Model 1: adjusted for sex and age; Model 2: On the basis of Model 1, adjusted for education, occupation, marital status, migrant workers, and years of education; Model 3: on the basis of Model 2, adjusted for smoking, drinking, and sitting or leaning time every day; and Model 4: on the basis of Model 3, further adjusted for health status, sleep quality,

hypertension, diabetes, and coronary heart disease. GraphPad Prism 8.4.2 (GraphPad Software Inc., San Diego, CA, USA) was used to draw the forest map of the results of the multivariate analysis. Two-sided P-values <0.05 were considered statistically significant.

Results

Characteristics of the participants

A total of 5065 participants were included in the analysis. They were between 40 and 99 years of age, with an Median age of 57.5 (48.8, 67.9) years. Among them, 2327 (45.9%) were men, and 2738 (54.1%) were women. They were mainly farmers (26.7%) and unemployed/out of work (24.5%), 53.5% of them had a primary school education or below, 81.7% were married, 46.9% (n=2373) felt that their health status was "good" and 17.8% (902) felt that their health status was "poor", and 2816 (55.6%) suffered from chronic diseases (Table 1).

Distribution of sleep duration with different characteristics

Among the 5065 subjects, 555 (11.0%) had slept <7 h, 3516 (69.4%) slept 7-9 h, and 994 (19.6%) slept >9 h. People of different ages, education, occupation, marital status, health status, sleep quality, regular three meals, dietary pattern, smoking, and drinking had different sleep durations (all $P < 0.05$) (Table 1). With increasing age, the proportion of people who slept for 7-9 h gradually decreased ($P_{\text{trend}} < 0.001$) (Table 1).

Prevalence of stroke

A total of 126 middle-aged and elderly people suffered from a stroke in this survey, with a prevalence of 2.5%, including 55 men (prevalence of 2.4%) and 71 women (prevalence of 2.6%). The prevalence of stroke was the lowest (1.8%) among the subjects with 7-9 h of sleep duration, while the prevalence of stroke among the subjects with <7 and >9 h of sleep duration increased continuously and showed a U shape distribution. The prevalence of stroke among the subjects with long sleep duration (>9 h) was higher than that of the subjects with insufficient sleep duration (<7 h). With increasing age, the prevalence of stroke gradually increased ($P_{\text{trend}} < 0.001$). The prevalence of stroke among middle-aged and elderly people with different occupations, education, marital status, health status, chronic disease, sleep quality, smoking, and drinking status was significantly different (all $P < 0.05$) (Table 2).

Relationship between sleep duration and stroke

The results of the univariable and multivariable logistic regression analysis showed that when taking the sleep duration of 7-9 h as reference, sleep duration >9 h was associated with stroke (all $P < 0.05$) in the univariable model (OR=2.68, 95%CI: 1.83-3.93) and in the multivariable model 1 (OR=2.35, 95%CI: 1.59-3.47), model 2 (OR=2.27, 95%CI: 1.53-3.37), model 3 (OR=2.25, 95%CI: 1.51-3.33), and model 4 (OR=2.11, 95%CI: 1.39-3.19). There were no significant differences between the <7 and 7-9 h groups ($P > 0.05$) (Table 3 and Figures 1-5).

Discussion

Sleep duration is associated with the risk of stroke[13,14], but the incidence of stroke varies considerably among countries and often within a given country[2-5]. Therefore, the relationship between sleep duration and stroke could also vary. The relationship between sleep time and stroke has not been concluded yet in China. This study aimed to study the relationship between sleep duration and stroke in middle-aged and elderly in Guiyang, China. The results strongly suggest that a long sleep duration (>9 h) is independently associated with stroke in middle-aged and elderly people in Guiyang.

In this study, the prevalence of stroke was 2.5% among middle-aged and elderly people aged ≥ 40 years old in Guiyang, which is similar to that of other regions of China [5,17-19]. The prevalence of stroke in Guiyang was 2.4% for men and 2.6% for women, without significant difference. The prevalence of stroke gradually increased with age, as previously observed, and since age is one of the main risk factors for stroke [5,7,8,17-19]. In addition, the prevalence of stroke in individuals with hypertension, diabetes, and coronary heart disease was 8.1%, 7.5%, and 10.1%, respectively, which was significantly higher than in individuals without these diseases, also supported by previous studies [5,7,8,17-19].

Of the 5065 middle-aged and elderly participants in Guiyang, most (69.4%) had normal sleep duration (7-9 h), 11% had insufficient sleep duration (<7 h), while 19.6% had long sleep duration (>9 h). Age, education, occupation, marital status, health status, sleep quality, smoking status, and drinking status were associated with sleep duration. Moreover, the worse the sleep quality, the greater the proportion of people who have insufficient sleep duration, as observed by previous studies[20]. Sleep duration is a protective factor for sleep quality[21].

This study showed that the prevalence of stroke in middle-aged and elderly people with different sleep duration was different. The prevalence of stroke in people with normal sleep duration (7-9 h) was the lowest, at 1.8%, while that in people with long sleep duration (>9 h) was 4.7%, which is still higher than that in people with insufficient sleep duration (<7 h) (2.7%). There is a "U" distribution between sleep duration and stroke. This relationship was still observed after adjusting for the other risk factors of stroke. These results are supported by previous studies[11,13,14,20,22,23].

Various reasons might explain the relationship between long sleep and stroke. Long sleep is associated with elevated inflammatory markers[24,25], and inflammation is involved in the pathogenesis of stroke[7,8,26]. Long sleep is also associated with high blood lipid levels[27,28], which directly contribute to atherogenesis. Indeed, the elevated prevalence of metabolic syndrome[29], carotid artery stenosis[30], and white matter hyperintensities[31,32] is observed in people with long sleep duration. Furthermore, indirect associations could be that long sleep is associated with a more sedentary life[33,34], which is a risk factor for stroke[7,8]. Long sleep is also associated with depression, sleep apnea, and lower socioeconomic status[12,35,36], which are all risk factors for stroke [7,8]. Future studies should focus on sleep duration, stroke pathogenesis, and molecular epidemiology.

This study has limitations. This study was a cross-sectional survey, preventing any determination of a cause-to-effect relationship. Sleep duration, stroke, and other indicators were reported by the participants, resulting in inevitable subjectivity and biases. No blood parameters were observed in this study. Due to the lack of prospective observation, the causal relationship between sleep duration and stroke disease cannot be obtained, and further epidemiological verification is needed.

In conclusion, a long sleep duration (>9 h) is independently associated with stroke in middle-aged and elderly people in Guiyang. Insufficient sleep was not associated with stroke in this population.

Declarations

Ethics approval and consent to participate

The study was approved by the ethics committee of Drug Clinical Trial of Affiliated Hospital of Guizhou Medical University and all participants signed the study consent form. All patients signed a surgical consent form. Informed consent was obtained from all individual participants included in the study.

Consent for publication

Consent for publication is not applicable since patient records/information was anonymized and de-identified prior to analysis.

Availability of data and materials

The data set supporting the results of this article are included within the article.

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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Authors' contributions

LL conceived the study, designed, analyzed and wrote the paper. JY, JW and ZW revised the paper, HG and JH carried out the data collection, MN carried out the data analysis, FH was responsible for the project and ensuring that the descriptions were accurate. All authors reviewed the results and approved the final version of the manuscript.

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References

1. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2013;44:2064-2089.
2. Lunardi Baccetto S, Lehmann C. Microcirculatory Changes in Experimental Models of Stroke and CNS-Injury Induced Immunodepression. *Int J Mol Sci*. 2019;20.
3. Donkor ES. Stroke in the 21(st) Century: A Snapshot of the Burden, Epidemiology, and Quality of Life. *Stroke Res Treat*. 2018;2018:3238165.
4. Wu S, Wu B, Liu M, Chen Z, Wang W, Anderson CS, et al. Stroke in China: advances and challenges in epidemiology, prevention, and management. *Lancet Neurol*. 2019;18:394-405.
5. Jiang B, Wang WZ, Chen H, Hong Z, Yang QD, Wu SP, et al. Incidence and trends of stroke and its subtypes in China: results from three large cities. *Stroke*. 2006;37:63-68.
6. Hu S, Cui B, Mlynash M, Zhang X, Mehta KM, Lansberg MG. Stroke epidemiology and stroke policies in China from 1980 to 2017: A systematic review and meta-analysis. *Int J Stroke*. 2020;15:18-28.
7. Meschia JF, Bushnell C, Boden-Albala B, Braun LT, Bravata DM, Chaturvedi S, et al. Guidelines for the primary prevention of stroke: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2014;45:3754-3832.
8. Allen CL, Bayraktutan U. Risk factors for ischaemic stroke. *Int J Stroke*. 2008;3:105-116.
9. Cabeza de Baca T, Chayama KL, Redline S, Slopen N, Matsushita F, Prather AA, et al. Sleep debt: the impact of weekday sleep deprivation on cardiovascular health in older women. *Sleep*. 2019;42.
10. Hermann DM, Bassetti CL. Role of sleep-disordered breathing and sleep-wake disturbances for stroke and stroke recovery. *Neurology*. 2016;87:1407-1416.
11. Li J, McEvoy RD, Zheng D, Loffler KA, Wang X, Redline S, et al. Self-reported Snoring Patterns Predict Stroke Events in High-Risk Patients With OSA: Post Hoc Analyses of the SAVE Study. *Chest*. 2020;158:2146-2154.
12. Yaggi HK, Concato J, Kernan WN, Lichtman JH, Brass LM, Mohsenin V. Obstructive sleep apnea as a risk factor for stroke and death. *N Engl J Med*. 2005;353:2034-2041.

13. Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *Eur Heart J*. 2011;32:1484-1492.
14. Li W, Wang D, Cao S, Yin X, Gong Y, Gan Y, et al. Sleep duration and risk of stroke events and stroke mortality: A systematic review and meta-analysis of prospective cohort studies. *Int J Cardiol*. 2016;223:870-876.
15. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, et al. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health*. 2015;1:40-43.
16. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363:157-163.
17. Yi X, Luo H, Zhou J, Yu M, Chen X, Tan L, et al. Prevalence of stroke and stroke related risk factors: a population based cross sectional survey in southwestern China. *BMC Neurol*. 2020;20:5.
18. Wang W, Jiang B, Sun H, Ru X, Sun D, Wang L, et al. Prevalence, Incidence, and Mortality of Stroke in China: Results from a Nationwide Population-Based Survey of 480 687 Adults. *Circulation*. 2017;135:759-771.
19. Li Q, Wu H, Yue W, Dai Q, Liang H, Bian H, et al. Prevalence of Stroke and Vascular Risk Factors in China: a Nationwide Community-based Study. *Sci Rep*. 2017;7:6402.
20. Ji A, Lou H, Lou P, Xu C, Zhang P, Qiao C, et al. Interactive effect of sleep duration and sleep quality on risk of stroke: An 8-year follow-up study in China. *Sci Rep*. 2020;10:8690.
21. Bin YS. Is Sleep Quality More Important Than Sleep Duration for Public Health? *Sleep*. 2016;39:1629-1630.
22. Patyar S, Patyar RR. Correlation between Sleep Duration and Risk of Stroke. *J Stroke Cerebrovasc Dis*. 2015;24:905-911.
23. Zhou L, Yu K, Yang L, Wang H, Xiao Y, Qiu G, et al. Sleep duration, midday napping, and sleep quality and incident stroke: The Dongfeng-Tongji cohort. *Neurology*. 2020;94:e345-e356.
24. Patel SR, Zhu X, Storfer-Isser A, Mehra R, Jenny NS, Tracy R, et al. Sleep duration and biomarkers of inflammation. *Sleep*. 2009;32:200-204.
25. Dowd JB, Goldman N, Weinstein M. Sleep duration, sleep quality, and biomarkers of inflammation in a Taiwanese population. *Ann Epidemiol*. 2011;21:799-806.
26. Su H. Inflammation and genetic factors in stroke pathogenesis. *Neuroimmunol Neuroinflamm*. 2017;4:260-262.
27. Yang L, Yang H, He M, Pan A, Li X, Min X, et al. Longer Sleep Duration and Midday Napping Are Associated with a Higher Risk of CHD Incidence in Middle-Aged and Older Chinese: the Dongfeng-Tongji Cohort Study. *Sleep*. 2016;39:645-652.
28. Zhan Y, Chen R, Yu J. Sleep duration and abnormal serum lipids: the China Health and Nutrition Survey. *Sleep Med*. 2014;15:833-839.

29. Yang L, Xu Z, He M, Yang H, Li X, Min X, et al. Sleep Duration and Midday Napping with 5-Year Incidence and Reversion of Metabolic Syndrome in Middle-Aged and Older Chinese. *Sleep*. 2016;39:1911-1918.
30. Abe T, Aoki T, Yata S, Okada M. Sleep duration is significantly associated with carotid artery atherosclerosis incidence in a Japanese population. *Atherosclerosis*. 2011;217:509-513.
31. Ramos AR, Dong C, Rundek T, Elkind MS, Boden-Albala B, Sacco RL, et al. Sleep duration is associated with white matter hyperintensity volume in older adults: the Northern Manhattan Study. *J Sleep Res*. 2014;23:524-530.
32. DeBette S, Beiser A, DeCarli C, Au R, Himali JJ, Kelly-Hayes M, et al. Association of MRI markers of vascular brain injury with incident stroke, mild cognitive impairment, dementia, and mortality: the Framingham Offspring Study. *Stroke*. 2010;41:600-606.
33. Lakerveld J, Mackenbach JD, Horvath E, Rutters F, Compernelle S, Bárdos H, et al. The relation between sleep duration and sedentary behaviours in European adults. *Obes Rev*. 2016;17 Suppl 1:62-67.
34. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: a review of prospective studies. *Int J Epidemiol*. 2012;41:1338-1353.
35. Patel SR, Malhotra A, Gottlieb DJ, White DP, Hu FB. Correlates of long sleep duration. *Sleep*. 2006;29:881-889.
36. Pan A, Sun Q, Okereke OI, Rexrode KM, Hu FB. Depression and risk of stroke morbidity and mortality: a meta-analysis and systematic review. *Jama*. 2011;306:1241-1249.

Tables

Table 1. Characteristics of 5065 middle-aged and elderly people in Guiyang City in 2017 according to sleep duration

Item	Grouping	n	%	Sleep duration			χ^2	P
				<7 h	7-9 h	>9 h		
Gender	Male	2327	45.9	277 (11.9)	1600 (68.8)	450 (19.3)	3.967	0.138
	Female	2738	54.1	278 (10.2)	1916 (70.0)	544 (19.3)		
Age	40~	1453	28.7	155 (10.7)	1037 (71.4)	261 (18.0)	70.380	<0.001
	50~	1382	27.3	179 (13.0)	975 (70.5)	228 (16.5)		
	60~	1154	22.8	137 (11.9)	796 (69.0)	221 (19.2)		
	70~	768	15.2	68 (8.9)	521 (67.8)	179 (23.3)		
	≥80	308	6.1	16 (5.2)	187 (60.7)	105 (34.1)		
Migrant workers	Yes	328	6.5	42 (12.8)	233 (71.0)	53 (16.2)	3.372	0.185
	No	4737	93.5	513 (10.8)	3283 (69.3)	941 (19.9)		
Major occupation	Unemployed/out of work	1243	24.5	103 (8.3)	840 (67.6)	300 (24.1)	83.341	<0.001
	Farmers	1351	26.7	123 (9.1)	922 (68.2)	306 (22.6)		
	Teachers/civil servants/institutions	114	2.3	24 (21.1)	77 (67.5)	13 (11.4)		
	Private business owner/self-employed person	462	9.1	67 (14.5)	323 (69.9)	72 (15.6)		
	Retirees	1094	21.6	139 (12.7)	765 (69.9)	190 (17.4)		
	Workers	261	5.2	32 (12.3)	180 (69.0)	49 (18.8)		
	Other occupations	540	10.7	67 (12.4)	409 (75.7)	64 (11.9)		
Educational Background	Illiterate/semi-illiterate	1707	33.7	152 (8.9)	1141 (66.8)	414 (24.3)	62.774	<0.001
	Primary school	1002	19.8	111 (11.1)	672 (67.1)	219 (21.9)		

	Junior high school	1345	26.6	165 (12.3)	974 (72.4)	206 (15.3)		
	High school/technical secondary school	645	12.7	77 (11.9)	459 (71.2)	109 (16.9)		
	College or above	366	7.2	50 (13.7)	270 (73.8)	46 (12.6)		
Marital Status	Married	4140	81.7	450 (10.9)	2918 (70.5)	772 (18.6)	14.906	0.001
	Others	925	18.3	105 (11.4)	598 (64.6)	222 (24.0)		
Health status	Good	2373	46.9	268 (11.3)	1671 (70.4)	434 (18.3)	10.234	0.037
	General	1790	35.3	190 (10.6)	1249 (69.8)	351 (19.6)		
	Poor	902	17.8	97 (10.8)	596 (66.1)	209 (23.2)		
Body mass index	Lean	2716	53.6	29 (10.8)	176 (65.4)	64 (23.8)	6.449	0.375
	Normal	269	5.3	286 (10.5)	1883 (69.3)	547 (20.1)		
	Overweight	1538	30.4	174 (11.3)	1080 (70.2)	284 (18.5)		
	Obese	542	10.7	66 (12.2)	377 (69.9)	99 (18.3)		
Chronic diseases	Yes	2816	55.6	324 (11.5)	1930 (68.5)	562 (20.0)	2.805	0.246
	No	2249	44.4	231 (10.3)	1586 (70.5)	432 (19.2)		
Hypertension	Yes	1092	21.6	110 (10.1)	742 (67.9)	240 (22.0)	5.354	0.069
	No	3973	78.4	445 (11.2)	2774 (69.8)	754 (19.0)		
Diabetes	Yes	268	5.3	29 (10.8)	179 (66.8)	60 (22.4)	1.387	0.500
	No	4797	94.7	526 (11.0)	3337 (69.6)	934 (19.5)		
CHD	Yes	119	2.3	13 (10.9)	79 (66.4)	27 (22.7)	0.744	0.689
	No	4946	97.7	542	3437	967		

				(11.0)	(69.5)	(19.6)		
Stroke	Yes	126	2.5	15 (11.9)	64 (50.8)	47 (37.3)	27.136	<0.001
	No	4939	97.5	540 (10.9)	3452 (69.9)	947 (19.2)		
Smoking	Never	2996	59.2	292 (9.7)	2114 (70.6)	590 (19.7)	14.412	0.006
	Current	1702	33.6	226 (13.3)	1147 (67.4)	329 (19.3)		
	Previous	367	7.2	37 (10.1)	255 (69.5)	75 (20.4)		
Drinking alcohol	Never	2996	59.2	301 (10.0)	2080 (69.4)	615 (20.5)	16.091	0.003
	Current	1608	31.7	201 (12.5)	1133 (70.5)	274 (17.0)		
	Previous	461	9.1	53 (11.5)	303 (65.7)	105 (22.8)		
Regular three meals	Yes	3753	74.1	387 (10.3)	2675 (71.3)	691 (18.4)	23.587	<0.001
	No	1312	25.9	168 (12.8)	841 (64.1)	303 (23.1)		
Dietary structure	Mainly vegetarian diet	1198	23.7	129 (10.8)	792 (66.1)	277 (23.1)	22.294	<0.001
	Mainly meat	217	4.3	37 (17.1)	136 (62.7)	44 (20.3)		
	Meat and vegetable	3650	72.1	389 (10.7)	2588 (70.9)	673 (18.4)		
Sleep quality	Good	3038	60.0	286 (9.4)	2154 (70.9)	598 (19.7)	43.090	<0.001
	General	1030	20.3	103 (10.0)	728 (70.7)	199 (19.3)		
	Poor	997	19.7	166 (16.6)	634 (63.6)	197 (19.8)		
Exercise frequency (day/week)	0-3	3704	73.1	410 (11.1)	2509 (67.7)	785 (21.2)	23.059	<0.001
	4-5	229	4.5	25 (10.9)	169 (73.8)	35 (15.3)		
	6-7	1132	22.3	120 (10.6)	838 (74.0)	174 (15.4)		

CHD☐coronary heart disease.

Table 2. Prevalence of stroke in 5065 middle-aged and elderly people in Guiyang City in 2017					
Item	Grouping	With stroke	Without stroke	χ^2	P
Gender	Male	55 (2.4)	2272 (97.6)	0.273	0.601
	Female	71 (2.6)	2667 (97.4)		
Age	40~	6 (0.4)	1447 (99.6)	74.885	<0.001
	50~	22 (1.6)	1360 (98.4)		
	60~	41 (3.6)	1113 (96.4)		
	70~	36 (4.7)	732 (95.3)		
	≥80	21 (6.8)	287 (93.2)		
Migrant workers	Yes	1 (0.3)	327 (99.7)	6.888	0.009
	No	125 (2.6)	4612 (97.4)		
Major occupation	Unemployed/out of work	56 (4.5)	1187 (95.5)	51.705	<0.001
	Farmers	24 (1.8)	1327 (98.2)		
	Teachers/civil servants/institutions	0 (0.0)	114 (100.0)		
	Private business owner/self-employed person	3 (0.6)	459 (99.4)		
	Retirees	39 (3.6)	1055 (96.4)		
	Workers	0 (0.0)	261 (100.0)		
	Other occupations	4 (0.7)	536 (99.3)		
Educational Background	Illiterate/semi-illiterate	53 (3.1)	1654 (96.9)	11.857	0.018
	Primary school	31 (3.1)	971 (96.9)		
	Junior high school	26 (1.9)	1319 (98.1)		
	High school/technical secondary school	14 (2.2)	631 (97.8)		

	College or above	2 (0.5)	364 (99.5)		
Marital Status	Married	94 (2.3)	4046 (97.7)	4.406	0.036
	Others	32 (3.5)	893 (96.5)		
Health status	Good	24 (1.0)	2349 (99.0)	154.659	<0.001
	General	27 (1.5)	1763 (98.5)		
	Poor	75 (8.3)	827 (91.7)		
Chronic diseases	Yes	112 (4.0)	2704 (96.0)	58.012	<0.001
	No	14 (0.6)	2235 (99.4)		
Sleep duration	<7 h	15 (2.7)	540 (97.6)	27.136	<0.001
	7-9 h	64 (1.8)	3452 (98.2)		
	>9 h	47 (4.7)	947 (95.3)		
Sleep quality	Good	50 (1.6)	2988 (98.4)	26.901	<0.001
	General	31 (3.0)	999 (97.0)		
	Poor	45 (4.5)	952 (95.5)		
Smoking	Never	78 (2.6)	2918 (97.4)	6.149	0.046
	Current	33 (1.9)	1669 (98.1)		
	Previous	15 (4.1)	352 (95.9)		
Drinking alcohol	Never	88 (2.9)	2908 (97.1)	18.877	<0.001
	Current	19 (1.2)	1589 (98.8)		
	Previous	19 (4.1)	442 (95.9)		
Exercise frequency (day/week)	0-3	86 (2.3)	3618 (97.7)	1.678	0.432
	4-5	6 (2.6)	223 (97.4)		
	6-7	34 (3.0)	1098 (96.0)		

Regular three meals	Yes	99 (2.6)	3654 (97.4)	1.348	0.246
	No	27 (2.1)	1285 (97.9)		
Dietary structure	Mainly vegetarian diet	33 (2.8)	1165 (97.2)	1.099	0.577
	Mainly meat	7 (3.2)	210 (96.8)		
	Meat and vegetable	86 (2.4)	3564 (97.6)		
BMI	Lean	64 (2.4)	2652 (97.6)	2.348	0.503
	Normal	7 (2.6)	262 (97.6)		
	Overweight	45 (2.9)	1493 (97.1)		
	Obese	10 (1.8)	532 (98.2)		
Hypertension	Yes	88 (8.1)	1004 (91.9)	178.111	<0.001
	No	38 (1.0)	3935 (99.0)		
Diabetes	Yes	20 (7.5)	248 (92.5)	28.873	<0.001
	No	106 (2.2)	4691 (97.8)		
CHD	Yes	12 (10.1)	107 (89.9)	28.989	<0.001
	No	114 (2.3)	4832 (97.7)		
Total	-	126 (2.5)	4939 (97.5)	-	-

BMI—body mass index (kg/m²). **CHD**—coronary heart disease.

Table 3. Correlation between sleep duration and stroke in middle-aged and elderly people in Guiyang City, OR (95% CI)				
Item		Sleep duration		
		<7 h	7-9 h	>9 h
Univariable model	-	1.498 (0.848-2.648)	1	2.677* (1.825-3.927)
Multivariable model	1	1.600 (0.900-2.843)	1	2.346* (1.589-3.465)
	2	1.718 (0.963-3.066)	1	2.272* (1.533-3.367)
	3	1.700 (0.952-3.036)	1	2.245* (1.514-3.331)
	4	1.673 (0.911-3.071)	1	2.107* (1.391-3.190)

The univariable factor model includes sleep duration only. Model 1: sleep duration, gender, and age. Model 2: Model 1, educational level, occupation, marital status, migrant workers, and years of education. Model 3: Model 2, smoking, drinking, and sitting or leaning time every day. Model 4: Model 3, health status, sleep quality, hypertension, diabetes, and coronary heart disease.

*P<0.05)

Figures

Figure 1

Univariable model for the association between sleep duration and the risk of stroke.Single Factor Model

Figure 2

Multivariate model 1 for the association between sleep duration and the risk of stroke.

Figure 3

Multivariate model 2 for the association between sleep duration and the risk of stroke.

Figure 4

Multivariate model 3 for the association between sleep duration and the risk of stroke.

Figure 5

Multivariate model 4 for the association between sleep duration and the risk of stroke.

Supplementary Files

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- [SupplementaryTableS1.docx](#)