Malaysian Journal of Medical Research, 8(3), 01-06
https://doi.org/10.31674/mjmr.2024.v08i03.001

MJMR
Malaysian Journal of Medical Research

Malaysian Journal of Medical Research

Online ISSN: 2550-1607

www.mjmr.com.my

Original Article

The Effect of Temperature Difference in the Same Quarter on Blood Biochemical Levels in Patients with Cerebral Infarction in Northeast China and Hainan

Wang Yijin[1], Lu Na[2], Zhang Wenxin[3], Farra Aidah Jumuddin[2]*

[1]*Department of Emergency and Trauma Care, Hainan Medical University, 570102 Haikou, China*

[2]*Department of Medicine, Lincoln University College, Wisma Lincoln, 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor, Malaysia*

[3]*Department of Pediatrics, Hainan Medical University, 570102 Haikou, China*

**Corresponding Author's Email: farraaidah@lincoln.edu.my*

ABSTRACT

Introduction: The study examines the impact of temperature differences within the same season on blood biochemical levels in cerebral infarction patients in Northeast China and Hainan. To study the effect of temperature differences in the same season on blood biochemical levels in patients with cerebral infarction in Northeast China and Hainan. **Methods:** A total of 393 patients with cerebral infarction in a certain area of Northeast China and 343 patients with cerebral infarction in a certain area of Hainan were selected from November 2021 to March 2022, and then the general medical history data and blood biochemical test results of patients with cerebral infarction were collected. A binary logistic regression analysis was performed on the data. **Results:** In the same quarter, there was a significant correlation between cerebral infarction in patients in Northeast China and Hainan (OR = 0.034, p = 0.000). Gender, smoking, drinking, hypertension, diabetes, coronary heart disease, and triglycerides are high risk factors for cerebral infarction. **Conclusion:** The incidence of cerebral infarction in patients in Northeast China and Hainan was significantly associated within the same quarter.

Keywords: *Blood Biochemical Levels; Cerebral Infarction; Season*

INTRODUCTION

Ischemic stroke (cerebral infarction) is a vascular disease characterized by focal neuronal loss and necrosis of brain tissue (Chen *et al.,* 2023). The prevalence of cerebral infarction is increasing annually, and the age of onset is becoming younger. Additionally, the prevalence of risk factors is becoming more apparent, leading to a rising burden of cerebral infarction in China (Zhang *et al.,* 2021; Wang *et al.,* 2022). Studies show that the incidence of cerebral infarction peaks in winter and reaches its lowest point in summer, with meteorological factors being significant risk factors for cerebral infarction. The distribution of cerebral infarction in China exhibits clear geographical differences, with higher rates in the north, lower rates in the south, and a notable prevalence in the central region (Tian *et al.,* 2023). The prevalence of cerebral infarction is higher in the Northeast region, with significantly greater incidence of risk classification and lethality compared to other regions. However, there is a lack of epidemiological data related to the investigation of the regional prevalence of cerebral infarction and its risk factors (Dandan *et al.,* 2021). The aim of this study was to investigate the correlation between

Received: 12th June 2024; Revised version received on: 25th June 2024; Accepted: 1st July 2024

temperature changes within the same season and the risk of cerebral infarction in the Northeast and Hainan regions.

METHODOLOGY

From November 2021 to March 2022, 508 people (227 males and 281 females) were selected from a region in Northeast China. Among them, 342 were patients with cerebral infarction (180 males and 162 females). In a region in Hainan, 504 people (275 males and 229 females) were selected, with 393 of them being patients with cerebral infarction (185 males and 208 females).

Inclusion Criteria:

- Meet the diagnostic criteria for ischemic stroke according to the Chinese Guidelines for Diagnosis and Treatment of Acute Ischemic Stroke (2018) (Tian *et al.,* 2023).
- Confirmed by clinical examination, CT scan or (and) MRI.

Exclusion Criteria:

- Patients with cardiac, hepatic, renal or pulmonary dysfunction or serious infection.
- Those with recent history of craniocerebral trauma as well as surgery.
- Transient ischemic attack. The study was approved by the hospital's Ethics Committee, and all subjects signed an informed consent form before participating in the study.

General Information

Basic clinical information, including gender, age, systolic blood pressure, diastolic blood pressure, history of alcohol consumption, history of smoking, history of hypertension, history of hyperlipidemia, history of diabetes mellitus, and other risk factors for cerebral infarction, was collected from all study subjects during the same quarter.

Clinical Information

Clinical data including creatinine (Crea), total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), high-density lipoprotein (HDL), cystatin C (Cys C), urea nitrogen (BUN) and other biochemical test results were collected from all the study participants in the same quarter, and the differences of the above indexes were compared between the Northeast China and Hainan region.

Statistical Methods

SPSS 20.0 software was used for data analysis. The count data were expressed as percentages with x^2 test; the measurement data conforming to normal distribution and chi-square were expressed as mean±standard deviation (x±s) with t-test; the non-normally distributed measurement data were expressed as M (Q1, Q3) with non-parametric test, and analysed by binary logistic regression, and the difference of $p < 0.05$ was considered statistically significant.

Ethical Consideration

Ethical approval for the study was obtained from the Hainan Medical College, China with reference number HYLL-2024-021 on 15th January, 2024.

RESULTS

Analysis of Data Relating to the Population in Hainan and the North-Eastern Region:

In the same quarter in Hainan and Northeast China, gender, smoking, alcohol consumption, hypertension, diabetes mellitus, coronary heart disease, systolic blood pressure, diastolic blood pressure, Crea, TG, TC, HDL, LDL, Cys C, and BUN were statistically significant ($p<0.05$), and age was not statistically significant ($p>0.05$) (Table 1).

Table 1: Analyses of Population-Related Data in Hainan and Northeast Regions

Sports Event	Hainan 504	Northeast 508	z/x^2	*p*
Distinguishing between the Sexes	275/229	227/280	10.684	0.005
Age	56 (64, 72)	64 (57, 72.75)	-0.496	0.620
Non-Smoking/Smoking	418/86	304/204	65.999	0.000
Non-Drinking/Drinking	381/123	316/192	21.160	0.000
History of Hypertension	328/176	277/407	1.716	0.001
History of Diabetes	413/91	476/32	32.750	0.000
History of Coronary Heart Disease	473/31	450/58	8.748	0.003
Systolic Blood Pressure	132 (119, 148)	140 (130, 149.75)	-3.363	0.001
Diastolic Blood Pressure	79 (73, 91)	80 (70, 81)	-4.109	0.000
Creatinine	69.8 (56.5, 83.4)	60.4 (48.52, 72.8)	-7.287	0.000
Triglycerides (mmol/L)	0.98 (0.70,1.38)	1.35 (0.94,1.84)	-7.992	0.000
Total Cholesterol (mmol/L)	4.44 (3.74, 5.05)	4.03 (3.25, 4.59)	-7.473	0.000
High-Density Lipoprotein (mmol/L)	1.40 (1.10, 1.60)	1.24 (1.06,1.38)	-7.417	0.000
Low-Density Lipoprotein (mmol/L)	2.91 (2.25, 3.63)	2.26 (1.64, 2.81)	-12.155	0.000
Cystatin C	1.02 (0.87,1.18)	0.84(0.69,1.00)	-10.376	0.000
Urea Nitrogen	4.1 (3.1, 5.2)	5.38 (4.2, 6.74)	-10.647	0.000

Cerebral Infarction Population Analyses in Hainan and Northeastern Regions:

In the population of cerebral infarction in Hainan and Northeast China in the same quarter, alcohol consumption, diabetes, coronary heart disease systolic blood pressure, diastolic blood pressure, Crea, TG, TC, HDL, LDL, Cys C, and BUN were statistically significant ($p<0.05$), and gender, age, and hypertension were not statistically significant ($p>0.05$) (Table 2).

Table 2: Population Analyses of Cerebral Infarction in Hainan Region and Northeast Region

Sports Event	Northeast Cerebral Infarction (*n*=393)	Hainan Cerebral Infarction (*n*=342)	t/x^2	*p*
Distinguishing Between the Sexes	185/208	180/162	2.260	0.133
Age	65 (57, 73)	65 (57,72)	-0.448	0.654
Non-Smoking/Smoking	197/196	284/58	87.595	0.000
Non-Drinking/Drinking	205/188	253/89	37.053	0.000
History of Hypertension	184/209	172/170	0.883	0.347
History of Diabetes	366/27	251/91	52.862	0.000
History of Coronary Heart Disease	339/54	311/31	3.910	0.048
Systolic Blood Pressure	140 (130, 150)	134 (121, 149)	-2.391	0.017
Diastolic Blood Pressure	80 (70, 90)	80 (73, 91)	-4.235	0.000
Creatinine	61.4 (48.6, 72.85)	69.8 (55.8, 84.47)	-5.619	0.000
Triglycerides (mmol/L)	1.49 (1.09, 2.00)	1.09(0.79,1.69)	-6.078	0.000
Total Cholesterol (mmol/L)	3.76 (3.04, 4.52)	4.57 (3.82, 5.44)	-9.782	0.000
High-Density Lipoprotein (mmol/L)	1.26 (1.08, 1.38)	1.4 (1.1, 1.6)	-5.867	0.000
Low-Density Lipoprotein (mmol/L)	2.1 (1.45, 2.71)	3.16 (2.52, 3.94)	-13.826	0.000
Cystatin C	0.82 (0.66, 0.99)	1.05 (0.89, 1.23)	-9.929	0.000
Urea Nitrogen	5.54 (4.21, 6.92)	4.1 (3.0, 5.4)	-9.268	0.000

Logistic Analysis of District Covariates:

Acute cerebral infarction was used as the dependent variable, while the region was set as the subvariable, and gender, smoking, alcohol consumption, hypertension, diabetes, coronary heart disease, TG, and BUN were included in the regression model analysis using stepwise method as the independent variables. The results showed a significant association between the occurrence of cerebral infarction in patients from the Northeast and Hainan regions within the same quarter (OR=0.034; $p=0.000$). Gender, smoking, alcohol consumption, hypertension, diabetes mellitus, coronary heart disease, and TG were all high-risk factors for developing cerebral infarction (Table 3).

Table 3: Logistic Regression Analysis

Variables in the Equation									
Characteristics		B	Standard Error	Vardø	Degrees of Freedom	Significance	EXP (B)	95% Confidence Interval for EXP(B)	
								Lower Limit	Limit
Step 8[h]	Distinguishing between the Sexes	0.444	0.190	5.457	1	0.019	1.559	1.074	2.263
	Smoking	0.668	0.249	7.189	1	0.007	1.950	1.197	3.176
	Drink (Alcohol)	1.401	0.245	32.763	1	0.000	4.058	2.512	6.556
	Hypertensive	1.982	0.235	70.916	1	0.000	7.260	4.577	11.517
	Diabetes	2.219	0.501	19.610	1	0.000	9.201	3.446	24.573
	Coronary Heart Disease	1.995	0.560	12.701	1	0.000	7.352	2.454	22.023
	Triglyceride	1.975	0.213	85.751	1	0.000	7.209	4.746	10.951
	Urea Nitrogen	.032	0.024	1.775	1	0.183	1.032	0.985	1.082
	Constant	-3.379	0.424	63.583	1	0.000	0.034		

DISCUSSION

The incidence of acute cerebral infarction (ACI) is negatively correlated with mean daily temperature, especially in cold temperatures, which are more likely to cause ACI. Low temperature is one of the risk factors for the development of acute cerebral infarction, while high temperature may play a protective role (Yanan *et al.,* 2018; Okubo *et al.,* 2024). Patients with ischemic cerebral infarction are admitted to hospital more frequently in winter than in other seasons (Lei, 2024; Elbqry *et al.,* 2019). Due to the decrease in plasma volume and increase in plasma viscosity in winter, platelet, cholesterol and fibrinogen concentrations increase, while the increase in protein-free C leads to an increase in atherothrombotic risk factors (Chu *et al.,* 2018). Studies have shown that the risk of cerebral infarction in patients rises by 3% for each additional cold day in the week prior to the onset of infarction. For each additional cold day in the summer, the patient's probability of having a cerebral infarction also increased by 8%. This association was positively related to cold weather and ischaemic stroke, but not to haemorrhagic stroke (Vaičiulis *et al.,* 2023). The study found that nighttime blood pressure was lower than morning in all months, with the lowest blood pressure in August. Outdoor temperatures were also highest in August (Izumi & Suzuki, 2021). In cold climates, both normotensive and hypertensive individuals showed varying degrees of elevated systolic blood pressure, with hypertensive individuals showing more pronounced blood pressure fluctuations. Blood pressure fluctuations are negatively correlated with temperature changes (Weiwei *et al.,* 2011). Studies have shown that the association between cold and stroke is stronger in the male population (Luo *et al.,* 2018).

The incidence and mortality rates of stroke were highest in the north-eastern region (365 and 159 per 100,000 person-years), followed by the central region (326 and 154 per 100,000 person-years); the prevalence of stroke was highest in the central region (15.5 per 100,000 person-years), followed by the north-eastern region (14.5 per 100,000 person-years), and lower in the southern region (625 per 100,000 person-years). The geographical difference in the incidence of cerebral infarction is consistent with its geographical distribution, which is "high in the north, low in the south, and prominent in the centre" (de Havenon *et al.,* 2021, Purnama *et al.,* 2024). A new study shows that the rate of hypertension is the highest in North China, reaching 39.09%, and the lowest in South China, 29.41%; the rate of dyslipidaemia is the highest in Northwest China, 38.81%, and the lowest in East China, 31.94%; and the rate of diabetes mellitus is close to the same rate in different regions and there is no significant difference (Wang *et al.,* 2022). It can be seen that the risk factors of cerebral infarction also have regional differences.

The incidence of acute cerebral infarction (ACI) is significantly influenced by temperature, with colder weather increasing the risk, especially in winter when blood viscosity and related risk factors are higher. Geographically, the incidence and mortality rates of stroke vary, being highest in the north-eastern and central regions of China. These regional differences correlate with varying rates of hypertension,

dyslipidaemia, and other risk factors, underscoring the importance of regional and seasonal considerations in managing and preventing ACI (Cho, 2024).

Limitations

This study has some limitations. Firstly, this study is a retrospective study, and the selected clinical information comes from hospital case data, which may have some information bias and selection bias. Second, only a few districts were selected for analysis in this study, which could have increased the selection of districts. In conclusion, the association between region and the occurrence of cerebral infarction in patients was significant in the same quarter.

CONCLUSION

This study highlights the significant impact of seasonal temperature differences on blood biochemical levels and the incidence of cerebral infarction in Northeast China and Hainan. Cold temperatures are associated with increased risk factors such as elevated triglycerides, cholesterol, and blood pressure, leading to a higher incidence of cerebral infarction. The findings reveal substantial regional differences, with the colder Northeast region showing higher stroke rates compared to the warmer Hainan region. These results underscore the need for region-specific preventive measures that account for both seasonal and geographic variations. Future research should further explore these relationships to develop effective, targeted strategies for stroke prevention.

Conflict of Interest

The authors declare that they have no competing interests.

ACKNOWLEDGEMENT

Authors are thankful to the faculty of medical science and management of Lincoln University College, Malaysia for providing all the necessary support and facilities to complete the present study.

REFERENCES

Cho, E. J. (2024). Sex/Gender Differences in Hypertension and Dyslipidemia. In *Sex/Gender-Specific Medicine in Clinical Areas* (pp. 249-259). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-0130-8_11

Chu, S. Y., Cox, M., Fonarow, G. C., Smith, E. E., Schwamm, L., Bhatt, D. L., ... & Sheth, K. N. (2018). Temperature and precipitation associate with ischemic stroke outcomes in the United States. *Journal of the American Heart Association*, *7*(22), e010020. https://doi.org/10.1161/jaha.118.010020

de Havenon, A., Sheth, K., Johnston, K. C., Delic, A., Stulberg, E., Majersik, J., ... & Ney, J. (2021). Acute ischemic stroke interventions in the United States and racial, socioeconomic, and geographic disparities. *Neurology*, *97*(23), e2292-e2303. https://doi.org/10.1212/WNL.0000000000012943

Elbqry, M. G., Sherif, W. I., Mahdy, N. E., Gaballah, S. H., & Altantawy, A. M. (2019). Implementing of an Educational Program on Patients' Knowledge and Self-Efficacy Regarding Recurrent Cerebrovascular Stroke. *The Malaysian Journal of Nursing (MJN)*, *11*(2), 40-48. https://doi.org/10.31674/mjn.2019.v11i02.005

Izumi, M., & Suzuki, K. (2021). Differentiation between stroke subtypes and the causes of monthly variations: the Akita stroke registry. *Internal Medicine*, *60*(18), 2933-2938. https://doi.org/10.2169/internalmedicine.6146-20

Lei, J. (2024). Risk factors for acute myocardial infarction in patients with acute cerebral infarction: a case-control study. *Signa Vitae*, *20*(6), 18-24. https://doi.org/10.22514/sv.2024.067

Luo, Y., Li, H., Huang, F., Van Halm-Lutterodt, N., Qin Xu, Wang, A., Guo, J., Tao, L., Li, X., Liu, M., Zheng, D., Chen, S., Zhang, F., Yang, X., Tan, P., Wang, W., Xie, X., & Guo, X. (2018). The cold effect of ambient temperature on ischemic and hemorrhagic stroke hospital admissions: A large database study in Beijing, China between years 2013 and 2014-Utilizing a distributed lag non-linear analysis. *Environmental Pollution (Barking, Essex: 1987)*, *232*, 90–96. https://doi.org/10.1016/j.envpol.2017.09.021

Okubo, S., Tamagawa, T., Yamada, M., Bannai, T., Seki, T., Usuki, K., & Shiio, Y. (2024). Asymptomatic Acute Cerebral Infarction in a Patient with Hemoglobin Köln. *Internal Medicine*, 2775-23. https://doi.org/10.2169/internalmedicine.2775-23

Purnama, A., Nursanti, I., Irawati, D., Nugraha Agung, R., Pradana Putri, A., Koto, Y., Susaldi, S., & Irawan AM, A. (2024). Effectiveness of Acupoint Therapy on Swallowing Ability among Patients with Post-Stroke Dysphagia. *The Malaysian Journal of Nursing (MJN)*, *15*(4), 61-69. https://doi.org/10.31674/mjn.2024.v15i04.008

Tian, D. S., Liu, C. C., Wang, C. L., Qin, C., Wang, M. H., Liu, W. H., ... & Wang, W. (2023). Prevalence and risk factors of stroke in China: a national serial cross-sectional study from 2003 to 2018. *Stroke and Vascular Neurology*, *8*(3). https://doi.org/10.1136/svn-2022-001598

Vaičiulis, V., Jaakkola, J. J., Radišauskas, R., Tamošiūnas, A., Lukšienė, D., & Ryti, N. R. (2023). Risk of ischemic and hemorrhagic stroke in relation to cold spells in four seasons. *BMC Public Health*, *23*(1), 554. https://doi.org/10.1186/s12889-023-15459-4

Wang, L. D., Peng, B., Zhang, H. Q., Wang, Y. L., Liu, M., & Shan, C. L. (2022). Summary of the china stroke prevention and control report 2020. *Chinese Journal of Cerebrovascular Diseases*, *19*(2), 136-44.

Weixuan, B. I., Yu, Z. H. A. N. G., Zhongyan, W. A. N. G., Qi, D. O. N. G., Hongyan, C. U. I., Lin, W. A. N. G., & Xin, L. I. (2022). Influence of seasonal meteorological factors on blood pressure fluctuation in elderly patients with essential hypertension. *Tianjin Medical Journal*, *50*(11), 1196.

Zhang, W., Lou, B., Li, J., Shi, W. Y., Liu, X. J., & Tang, J. (2021). Clinical practice guidelines of Chinese medicine rehabilitation for ischemic stroke (cerebral infarction). *Rehabilitation Medicine*, *31*(6), 437-447. https://doi.org/10.3724/SP.J.1329.2021.06001

唐晨、蓝睿、傅雪琴、王薇薇、邹旭焕、王曼曼……&刘爽。（2023）。环状 RNA 在缺血性脑卒中领域的研究进展中国比较医学杂志, 33(10), 100-105. [Chen, T., Rui, R., Xueqin, F., Weiwei, W., Xuhuan, Z., Manman, W., ... & Shuang, L. (2023). Research progress of circular RNA in the field of ischemic stroke. *Chinese Journal of Comparative Medicine, 33*(10), 100-105.] https://www.doi.org/10.3969/j.issn.1671-7856.2023.10.013

孙丹丹, 韩柳, 巴馨悦, 李玲玲, & 李改. (2021). 吉林地区居民缺血性脑卒中患病现状及危险因素分析. 临床军医杂志, 49(12), 1316-1318. [Dandan, S., Liu, H., Xinyue, B., Lingling, L & Gai, L. (2021). Analysis of the prevalence and risk factors of ischemic stroke among residents in Jilin area. *Journal of Clinical Military Medicine, 49*(12), 1316-1318.] https://lib.cqvip.com/Qikan/Article/Detail?id=HS724622023004028&from=Qikan_Article_Detail. Accessed on 10th February, 2020.

林亚楠, 郭岩, 杨西, 陶梦醒, 林永忠, 马强, & 孙晓培. (2018). 大连市气象因素与急性脑梗死发病的相关性分析. 中国脑血管病杂志, 15(3), 113-118. [Yanan, L., Yan, G., Xi, Y., Mengxing, Yongzhong, L., Qiang, M. & Xiaopei, S. (2018). Analysis of the correlation between meteorological factors and the incidence of acute cerebral infarction in Dalian. *Chinese Journal of Cerebrovascular Diseases, 15*(3), 113- 118.] https://qikan.cqvip.com/Qikan/Article/Detail?id=006380EAEA8C160F3A8CE13645609C9CD85A9. Accessed on 10th July, 2017.

苏微微, 易兴阳, 池丽芬, 池万章, & 娄刚. (2011). 复发性脑梗死患者血小板聚集及其影响因素. 中国老年学杂志, 31(4), 681-682. [Weiwei, S., Xingyang, Y., Lifen, C., Wanzhang, C., & Gang, L. (2011). Platelet aggregation in patients with recurrent cerebral infarction and its influencing factors. *Chinese Journal of Gerontology, 31*(4), 681-682.] http://dx.chinadoi.cn/10.3969/j.issn.1005-9202.2011.04.061. Accessed on 8th May, 2010.