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Association between Traditional Mongolian Medicine Body Constitutions and Stroke: A Population based Cross-Sectional Survey in the Tongliao area

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Objectives: This study aims to explore the relationship between body constitution types and risk factors for stroke. **Methods:** The survey collected demographic data and assessed body constitution according to principles of traditional Mongolian medicine. It included results from physical examinations, laboratory tests, and stroke risk assessment. Additionally, expert evaluations of body types were integrated into the analysis. **Results:** The study involved 2,086 participants, examining factors associated with stroke through multivariable method. Age was identified as a significant predictor, with stroke risk increasing in individuals aged 60–69 and 70 above, corresponding to adjusted odds ratios (aORs) of 4.56 (P=0.001) and 5.97 (P<0.001), respectively. Male participants were found to have a significantly higher risk of stroke, with an aOR of 1.54 (P=0.014) compared to females. The prevalence of stroke from single body type was 21.2%, 17.6%, and 14.6% for people of type C, A, and B, respectively. Other significant risk factors for stroke included smoking, family history of stroke, hypertension, dyslipidemia, and related comorbidities, all associated with higher aORs. **Conclusion:** These findings highlight the critical role of demographic, constitutional, and health-related factors in assessing stroke risk in this population. The inclusion of biochemical markers further underscores the need for comprehensive evaluations in stroke prevention strategies.
Keywords: Cross-Sectional Survey; Body constitution; Stroke; Risk factor;

Introduction

Globally, stroke remained the second-leading cause of death (11.6% [10.8-12.2] of total deaths) and the third-leading cause of death and disability combined (5.7% [5.1-6.2] of total DALYs) in 2019. Without urgent implementation of effective primary prevention strategies, the stroke burden will probably continue to grow across the world, particularly in low-income countries.[1-3] The study on the correlation between body constitutions and

stroke aims to provide evidence-based classification and intervention schemes for primary stroke prevention according to body constitutions. In traditional Eastern medicine, numerous studies were demonstrated the relationship between body constitutions and disease. A study was the first to apply Chinese body constitution concepts and measurable variables to assess the risk of having CAD (coronary artery disease) in patients with chest pain before receiving cardiac catheterization. The higher scores of Yang-Xu and blood stasis body type were found to be risk factors for CAD. The results revealed that body constitution quality has the potential to be a first-line diagnostic tool for patients with chest pain to facilitate early recognition and diagnosis of CAD.[4] The correlation studies were between traditional Chinese medicine body constitution and ischemic stroke (IS) that 41 studies involving 11,211 participants. Among the nine constitution types, qi-deficiency constitution, phlegm-dampness constitution, and blood stasis constitution were the common types, accounting for 25% [0.22, 0.29], 23% [0.20, 0.29], and 17% [0.13, 0.22], respectively, in IS patients.[5] Three case-control and 26 cross-sectional studies conducted by Luo. et al, also demonstrated that phlegm-dampness, qi-deficiency, and damp-heat were the main constitution types in patients with metabolic syndrome, accounting for 29% (22%–39%), 18% (13%–24%), and 12% (9%–17%) of the population, respectively; the risk of metabolic syndrome in people with phlegm-dampness and qi-deficiency constitution was 1.74 [1.27, 2.38] and 1.29 [1.01, 1.65] times higher than that in those with other constitutions.[6] Dyslipidemia plays a significant role in the risk factors for stroke, and some studies revealed that dyslipidemia is associated with genetic factors in humans. A cross-sectional, longitudinal study found that higher estimated D6D activity has been associated with higher serum TAG, higher LDL-cholesterol, lower HDL-cholesterol, higher CRP, higher blood pressure, higher BMI and obesity, and higher HOMA insulin resistance, whereas higher estimated D5D activity has been associated with lower serum TAG, lower LDL-cholesterol, higher HDL-cholesterol, lower CRP, lower blood pressure, lower BMI and lower HOMA insulin resistance. Higher D5D activity was favourably associated and higher D6D activity unfavourably associated with several stroke risk factors.[7] The study conducted by Huang. et al, revealed the linkage between Yu-Zhi (YZ, indicating stasis and stagnation) constitution and peripheral arterial disease (PAD) in patients with type 2 diabetes. Multivariate logistic regression revealed significant correlations between PAD and, respectively, YZ score, age, diabetes duration, current smoking, and hs-CRP.[8] Traditional Korean Sasang constitutional (SC) medicine categorizes individuals into four constitutional types [Taeeum (TE), So-eum (SE), Tae-yang (TY), or So-yang (SY)] based on biological and physiological characteristics. The study conducted by Kim. et al, demonstrated SC type-specific differences in mitochondrial function and gene mutations were detected in a small group of healthy, young Korean males. Collected blood samples were subjected to blood composition analysis, mitochondrial function analysis, and whole-exome sequencing. The SY type showed significantly lower total cholesterol and high-density lipoprotein cholesterol levels than the SE type. Cellular and mitochondrial adenosine triphosphate (ATP) levels were similar across types. All types showed similar basal mitochondrial oxygen consumption rates, whereas the TE type showed a significantly lower ATP-linked oxygen consumption rate than the other types. Whole-exome sequencing identified several gene variants that were exclusively detected in particular SC types, including 19 for SE, seven for SY, 11 for TE, and six for TY.[9] In Korean sasang constitutional medicine, a cross-sectional study conducted by Younghwa B. et al, revealed that the Taeeumin type might be a risk factor for pre-diabetes mellitus (pre-DM) in the normal BMI group, and the Soyang in type with general obesity could be a risk factor for pre-DM compared with the Soyang in type with normal BMI. Accordingly, SC and BMI should be considered when managing pre-DM.[10] In one more study, sasang constitutional medicine, gas chromatography–mass spectrometry, and 1H nuclear magnetic resonance (NMR)–based metabolic analyses were conducted to find maker metabolites in serum and urine according to different SC types. The results suggested that metabolomics analysis could be used to determine SC type. The results revealed that levels of lactate, glutamate, triglyceride, and fatty acids in serum and glycolic acid in the urine of the Tae-Eum type were higher than those of the So-Eum and So-Yang types. However, the Tae-Eum type showed higher lactate levels in serum than the So-Yang type for both normal weight and overweight groups, suggesting that the contents of serum lactate might be dependent on the SC type regardless of body weight. Fatty acids, triglyceride, and lactate levels were found to be metabolites related to body mass index, indicating that marker metabolites for the diagnosis of SC type could be associated with obese.[11] Researchers determined the differential effect of sleep deprivation in individuals with different body compositions (fluid) according to Soyang type (SY)

and Taeeum type (TE). A study indicated the differential effect of sleep deprivation in individuals with different body compositions (fluid) according to Soyang type (SY) and Taeeum type (TE). SY individuals were more sensitive to sleep deprivation and were slower to recover from the effects of sleep deprivation than TE individuals.[12] Revealed close interrelations between rheological and microcirculation parameters testified the important role of hemorheological factors in maintenance of microvascular blood flow and oxygen delivery to tissue. Researchers such as Zang Yung. et al, selected 223 cases of stroke patients from the clinic, determined stroke using traditional Mongolian medicine, measured blood flow changes and blood flow in four bands, and said that the ratio of stroke combined with "badgan-mkhris combined body type" and "mkhris" body type is quite high.[13] Erdun Chaolun. et al, selected 300 sample patients who were admitted to the neurology department of the traditional Mongolian medicine (TMM) and diagnosed with a stroke, and evaluated their physical characteristics using the "Body Constitutions Evaluation Table" and revealed that cerebral stroke are related to each other. It has been proved that the body constitution types of patients with cerebral stroke are more common with "badgan-mkhris" and "mkhris" body constitutions.[14] The above-mentioned several studies suggested that the risk factors leading to disease are related to the body's constitutions. The study aims to investigate the relationship between residents' body constitutions in Tongliao and risk factors for stroke. The study was examined multiple factors that determined stroke risk assesment at the same time and relates them to the body constitution types of traditional medicine. Further study including epigenetic factors, energy metabolism, and whole-exome sequensing-based analysis are needed to clarify the risk of stroke and body constitutions in traditional Mongolian medicine.

Materials and Methods

Study design

This cross-sectional study was conducted in the Tongliao region of Inner Mongolia and involved a randomly selected sample of 2,127 residents aged 40 years and older. Data were collected through one-on-one, on-site interviews, utilizing screening tools to identify individuals at high risk of stroke, along with the Mongolian Medicine Human Characteristics determination table.

Classification of Body Constitutions: According to the principles of Mongolian medicine, human traits are categorized into seven distinct constitutions: A, B, C, AB, BC, AC, and ABC.

Physical Examination: Participants' blood pressure in the upper limbs, recorded height, weight, and waist circumference were measured, and their body mass index (BMI)were calculated.

Laboratory Tests: Laboratory tests were conducted to assess blood lipid and blood glucose levels.

Stroke Risk Assessment: The assessment of stroke risk factors was carried out according to the following criteria: 1) Hypertension: Defined as high blood pressure ≥140/90 mmHg, and normal high blood pressure is considered as 129-139/80-89 mmHg. 2) Lipid: Triglyceride level (TG) were identified as TG ≥2.26 mg/dl; total cholesterol level (TC) ≥6.22 mg/dl; low-density lipoprotein cholesterol level (LDL-C) ≥4.14 mg/dl; and high-density lipoprotein cholesterol level (HDL-C) <1.04 mg/dl were considered abnormal levels, respectively. 3) Diabetes: Presence of diabetes symptoms and a plasma glucose level ≥11.1 mmol/L at any time. Fasting plasma glucose (FPG) ≥7.0 mmol/L. Blood glucose ≥11.1 mmol/L within 2 hours during an oral glucose tolerance test (OGTT). 4) Smoking history was defined as a history of smoking at least one cigarette per day for more than one year. 5) Atrial Fibrillation: Diagnosed there were clear indications of atrial fibrillation or noticeable pulse irregularities, as confirmed by district or county-level hospitals. 6) Overweight or obesity was defined as BMI of ≥26 kg/m^2. Overweight is defined as BMI ≥24 kg/m^2, and obesity as BMI ≥26 kg/m^2, as per the "Guidelines for the Prevention and Control of Overweight and Obesity in Chinese Adults (Trial) (2003)." 7) Family history of stroke was evaluated by inquiring about the presence of stroke, coronary heart disease, hypertension, hyperlipidemia, or diabetes in the family.

Statistical Methods

The statistical analysis to determine factors associated with stroke occurrence involved multiple steps. Initially, descriptive statistics were calculated to understand the distribution of key variables among participants with and without a history of stroke. Fisher's exact test was employed to assess the association between categorical variables and stroke status. A P-value less than 0.05 was considered statistically significant. The prevalence of stroke was calculated as a percentage with its 95% confidence intervals. For multivariate analysis, multiple logistic regression models were used to identify independent predictors of stroke. The results are presented as odds ratios (OR) with correspond-

ing 95% confidence intervals (CI). All statistical analyses were performed using RStudio version 2023.03.0 Build 386 software.

Ethical Consideration

The survey protocol received ethical approval from the Ethics Committee of the Mongolian National University of Medical Sciences on November 19, 2021 (Protocol No. 2021/3-11). The study adhered to international and local ethical regulations and was granted approval to commence.

Results

General characteristics of participants

General characteristics of the study participants were as follows. Initially, 2,127 residents were considered for the study, but after applying inclusion criteria, 2,086 individuals were included in the final analysis. The average age of the study participants was 60 years, with the interquartile range was spanned from 53 to 66 years. The gender distribution was predominantly composed of females, accounting for 64% of the participants, while males represented 36%. The study population was representative of both Han (61%) and Mongolian (39%) ethnic backgrounds. Educational attainment varied among participants, with 60% having completed secondary education, 31% primary education, and 9% high education. A small fraction of the participants (1.7%) reported living alone, whereas the vast majority (98%) lived with others (Table 1).

Table 1. General characteristics of the survey participants by stroke status

Characteristic	Overall, N = 2,086	Stroke history		P-value
		Non stroke, N = 1,721	Stroke, N = 365	
Age groups				<0.001
40-59	999 (47.9%)	888 (51.6%)	111 (30.4%)	
≥ 60	1,087 (52.1%)	833 (48.4%)	254 (69.6%)	
Gender				<0.001
Female	1,344 (64%)	1,146 (67%)	198 (54%)	
Male	742 (36%)	575 (33%)	167 (46%)	
Nation				0.015
Han	1,282 (61%)	1,037 (60%)	245 (67%)	
Mongolian	804 (39%)	684 (40%)	120 (33%)	
Education				0.004
Primary	644 (31%)	508 (30%)	136 (37%)	
Secondary or high	1,436 (69.0%)	1,208 (70.4%)	228 (62.6%)	
Living alone				0.041
Alone	35 (1.7%)	24 (1.4%)	11 (3.0%)	
Not alone	2,046 (98%)	1,693 (99%)	353 (97%)	

1 n (%)
2 Fisher's exact test

Body constitution 'B' appears to be the most prevalent, accounting for 40.8% of the total responses, while body constitutions 'A' and 'C' follow closely behind with 14.4% and 17.9%, respectively. Among combined body constitution types, people with 'AB' body type accounted for 7.4% of participants, while 'CA' combined body type accounted for 4.2% of participants. Additionally, 'BC' body constitution type made up 11.8% of the total, and the rarest body constitution among the participants was 'ABC' at 3.4% (Figure 1).

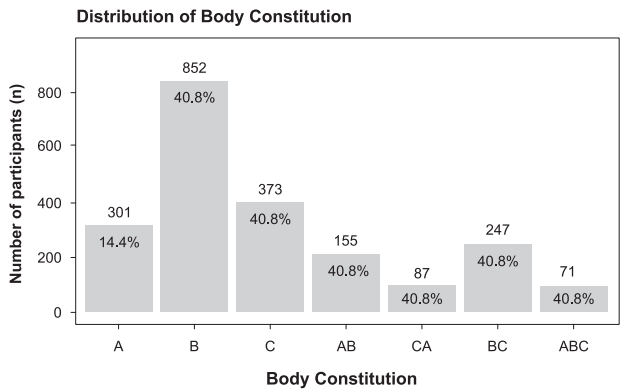

Figure 1. Distribution of Body Constitutions Among Participants.

A-"rlung" body constitution, B-"mkris" body constitution, C-"badgan" body constitution, AB, CA, BC-combined body constitutions, ABC-mixed body constitution

Prevalence of stroke risk factors and health conditions of the participants

A total of 365 stroke cases were observed among the study participants, reflecting a clear age-related trend (P<0.001). Notably, the incidence of stroke varied significantly across age groups, with a mere 4.5% prevalence in the 40-49 age bracket, soaring to 26% among individuals aged 70 and older (P < 0.001). Gender disparities also emerged, with 15% of women and 22.5% of men experiencing stroke (P < 0.001). Ethnicity, education also display varying degrees of association with stroke history. The prevalence of stroke from single body type was 21.2%, 17.6%, and 14.6% for people of type C, A, and B, respectively. Among the combined body types, the ABC triad body type had the highest prevalence of stroke, 23.9%, CA, BC, and AB body types had prevalence of 23%, 18.2%, and 17.4%, respectively (Figure 2).

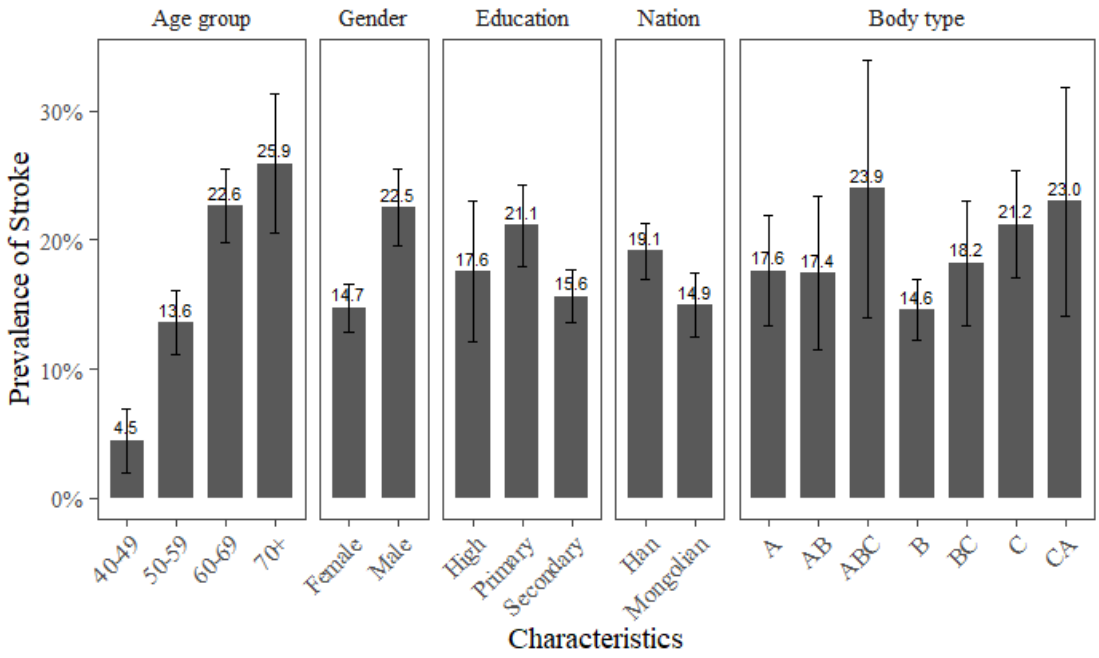

Figure 1. Distribution of Body Constitutions Among Participants.

Notably, half of the participants (50%) reported having hypertension, while a slightly smaller percentage (14%) had diabetes mellitus. Furthermore, a relatively small proportion of the population had experienced transient ischemic attacks (TIA) (4.1%) but there had a family history of stroke (36%). A substantial portion of the cohort reported dyslipidemia (37%), while a minority had atrial fibrillation (4.0%). In terms of weight, the study population was fairly evenly split, with 54% categorized as overweight and 46% as non-overweight (Table 2).

Table 2. Prevalence of key risk factors and health conditions among the participants by stroke status

Morbidities	Stroke history			P-value[2]
	Non-stroke, N = 1,721[1]	Stroke, N = 365[1]	Total, N = 2,086[1]	
Hypertension			0.176	<0.001
Hypertension	976 (57%)	1,053 (50%)	288 (79%)	
Non hypertension			77 (21%)	
Diabetes mellitus	211 (12%)	294 (14%)		<0.001
Diabetes	1,510 (88%)	1,792 (86%)	83 (23%)	
Non diabetes			282 (77%)	
TIA	33 (1.9%)	85 (4.1%)		<0.001
Ischemia	1,688 (98%)	2,001 (96%)	52 (14%)	
Non ischemia			313 (86%)	
Family history of stroke	573 (33%)	761 (36%)		<0.001
Had history	1,148 (67%)	1,325 (64%)	188 (52%)	
Had not history			177 (48%)	
Dyslipidemia	390 (30%)	565 (37%)		<0.001
Dyslipidemia	892 (70%)	953 (63%)	175 (74%)	
Non dyslipidemia			61 (26%)	
Atrial fibrillation	51 (3.0%)	84 (4.0%)		<0.001
Atrial fibrillation	1,669 (97%)	2,000 (96%)	33 (9.1%)	
Non atrial fibrillation			331 (91%)	
Overweight	810 (47%)	959 (46%)		0.032
Non overweight	911 (53%)	1,127 (54%)	149 (41%)	
Overweight			216 (59%)	

1 n (%)
2 Fisher's exact test

In the multivariate logistic regression analysis, the age groups continued to show a strong association with stroke risk. Individuals aged 50-59 had 2.65 times higher adjusted odds of stroke compared to those aged 40-49, and this risk increased markedly for older age groups, with adjusted odds ratios of 4.56 for those aged 60-69 and 5.97 for those aged 70 and above (P<0.001 for all). Gender remained a significant predictor, with males having 1.54 times higher adjusted odds of stroke compared to females (P=0.014).

Table 2. Prevalence of key risk factors and health conditions among the participants by stroke status

Characteristic	Multivariate		
	aOR1	95% CI1	P-value
Age groups			
40-49	1.0		
50-59	2.65	1.16, 7.19	0.033
60-69	4.56	2.04, 12.2	<0.001
≥ 70	5.97	2.51, 16.7	<0.001
Gender			
Female	1.0		
Male	1.54	1.09, 2.19	0.014
B type	0.76	0.55, 1.06	0.11
Smoke	1.56	1.09, 2.23	0.015
Family history of stroke	2.39	1.73, 3.30	<0.001
Hypertension	3.37	2.34, 4.92	<0.001
Dyslipidaemia	5.01	3.59, 7.08	<0.001

1-Addjusted Odds Ratio, Confidence interval

Other significant predictors in the final model included smoking (aOR 1.56, P=0.015), family history of stroke (aOR 2.39, P<0.001), hypertension (aOR 3.37, P<0.001), and dyslipidemia (aOR 5.01, P< 0.001). These findings highlight the substantial impact of age, gender, lifestyle factors like smoking, and underlying health conditions such as family history of stroke, hypertension, and dyslipidemia on stroke risk. Interestingly, the protective effect of body constitution "B" observed in the univariate analysis did not remain significant in the multivariate model (P= 0.11) (Table 3).

Discussion

According to traditional Mongolian medicine (TMM) theory, humans are classified into seven constitutions, single symbolic codes are "Rlung" (A), "Mkris" (B), "Badgan" (C); combined symbolic codes are AB, BC, and AC; triad symbolic code is ABC. The "Rlung" symbolic code people are lean, bent, with bluish, dry, and cool skin; they get easily tired and very talkative; and they are very reactive by psychological characteristics. The "Mkris" symbolic code individuals have middle body mass, the skin is warm and the color is yellowish; they usually feel thirsty and hungry; and they are very intelligent, but become easily angered. The "Badgan" symbolic code people have fatty and large bodies; their skin is cold; and they are very patient and slow in physical, physiological, and psychological characteristics.[15-18] The researchers compared the classification of constitution types in TMM with the classification of constitution types in ancient Indian Ayurveda, Tibetan, Korean, and Chinese medicine. Theory of five elements is the fundamental theory of Ayurveda, traditional Tibetan and Mongolian medicine. In Ayurvedic medicine, body constitution types are called vatta, pitta, and kappa. In TMM, constitution types are called rlung, mkris, and badgan.

However, traditional Chinese medicine (TCM) and Sasang constitutional medicine (SCM) of traditional Korean medicine have the theory of yin yang. The taieum (yin energy dominant) constitution type in the SCM, similar with badgan constitution type in TMM, taiyang (yang energy dominant) constitution type

with mkris constitution type in TMM, soyang (with little yang energy) constitution type is similar to the rlung-badgan combined constitution type in TMM respectively, soeum (with little yin energy) with rlung-mkris combined constitution type is equivalent to TMM.[19] The following relationship was be found[20] that body constitutions of TMM were compared to the body constitutions of TCM, and SCM.

Researchers found high distributions for each biased constitution type in different patient populations as follows: Qi-deficiency, phlegm-dampness, and blood-stasis constitution in stroke.[21] Others have shown that people with a phlegm-damp constitution, yin depletion body type, blood clotting constitution, and yin-yang essence depletion constitution are more likely to have a ischemic stroke.[21] Some researcher found that body constitutions in "badgan-mkris", and mkhris depletion constitution are more likely to have a hemorrhagic stroke.[13]

The study revealed that a significant factor, with an increasing rate of stroke as age advanced, particularly in individuals aged 60-69 and those 70 and above. TMM describes three contrasting constituions of humans, Rlung, Mkris, Badgan – each of which has been distinguished by varying degree of metabolic and adaptation capacities and predisposition to different diseases. It is believed that in the development of a human body, the badgan symbolic metabolism is dominant in childhood, the mkris symbolic metabolism is dominant in middle age, and the rlung symbolic metabolism is dominant in the age of 70 and over. As you get older, both yin and yang are deficient in energy metabolism. Some researchers hypothesized that the healthy subject with rlung symbolic code have a low protective capacity of using NADPH, formed to oxidative damage of membrane structures, and slow resistant activity to detergent-pro oxidant action of H2O2 low serum oxidation capacity in relation to these donators, because of deficiency of oxygen – H+, e- acceptors, very high negative gradient between body weight and body height, very low value of body mass index, very low contents of subcutaneous fat, presenting visceral fat.[23] Liu Y. et al, revealed that iron deposition at lenticular nucleus may increase in cases of more severe ischemia in aged patients with transient ischemic attack, and it may be an imaging marker for cerebral microbleeds of ischemic origin.[24] The patients up to 60 years old had more cases of body type with phlegm-damp, patients 60-70 years old had more cases of yin-yang depletion body type and yin deficiency body type, and patients over 70 had more cases of yin-yang depletion body type, while overweight patients had more cases of body type with phlegm-damp.[25] In our study, B-mkris type person had 40,8% highest number of participants but body type "B-mkris" was 14,6% minimium prevalance of stroke. Healthy subject with "mkris" symbolic code, in the membrane-redoxy potentials line is high concentration of H+, e- donators and high diffusion concentration of H+, e- acceptors–oxygen in the background of alpha state of membrane state-with more unsaturated fatty acids and high value of oxy potentials high in the serum compartment, very moderate gradient between body weight and body height, relatively moderate value of body mass index, moderate contents of visceral fat, relatively high serum and urine oxidation activity in the second compartment. On the contrary, C-body type single inheritance and combined CA, BC, and ABC body types all show that the presence of C body type has a higher prevalence of stroke. Some researchers have proven that healthy subject with "C-badgan" symbolic code, in the membrane -redoxy potentials line is high concentration of H+, e- donators and low diffusion concentration of H+, e- acceptors–oxygens, very high positive gradient between weight and body height, very high value of body mass index, very high contents of visceral fat.[26]

Conclusion

Considering that the incidence of stroke is getting younger and the complications of stroke have a serious negative impact on a person's with stroke quality of life, traditional complementary and integrative medicine may be an alternative treatment option.

Futhermore in TMM have richness experience of concerning with "Rlung, mrkis, and badgan"-three elements unbalanced disease early diagnosis and remedy them effectively. According to the theory of Mongolian traditional medicine, by determining body type, it is possible to diagnose diseases that may occur in people with that body type. Individualized treatments and lifestyle recommended should be provided to patients with different body constitutions to prevent non-infectious diseases, especially obesity, hypertension, diabetes, high blood fat levels, heart arrhythmias, which are risk factors for stroke.

Conflict of Interest

The authors declared no conflicts of interest.

Acknowledgements

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